Real Options and Land Value

Land value is the most fundamental topic in real estate development. the pivotal link between asset and space markets in the development process. This presentation explores option valuation theory (OVT) and real options as tools to understand land value and development timing decisions.

Understanding Options

Definition

An option is a right without obligation to obtain something of value upon payment of something else of value.

Key Components

Options have an underlying asset, exercise price, and can be American (exercise anytime) or European (exercise only at expiration).

Real Options

These are options whose underlying assets are real assets (physical capital) rather than financial

The Call Option Model of Land Value

Land as an Option

Land obtains its value through the option it gives its owner to develop a structure on the land.

The landowner can obtain a valuable rent-paying asset upon paying the construction cost necessary to build.

Irreversibility

The exercise of the option is essentially irreversible; the option is given up through its exercise.

Most applicable to vacant land or land in transition zones where highest and best use is changing.

Simple Numerical Example

$100M	$88.24M	$11.76M
Building Value Today	Construction Cost	Immediate Profit
Current value of potential building	Cost to build today	If developed today

But what if we wait? Future uncertainty creates an option premium that may make waiting more valuable than immediate development.

Future Uncertainty Creates Value

Wait One Year

Development option doesn't expire today

Market Changes

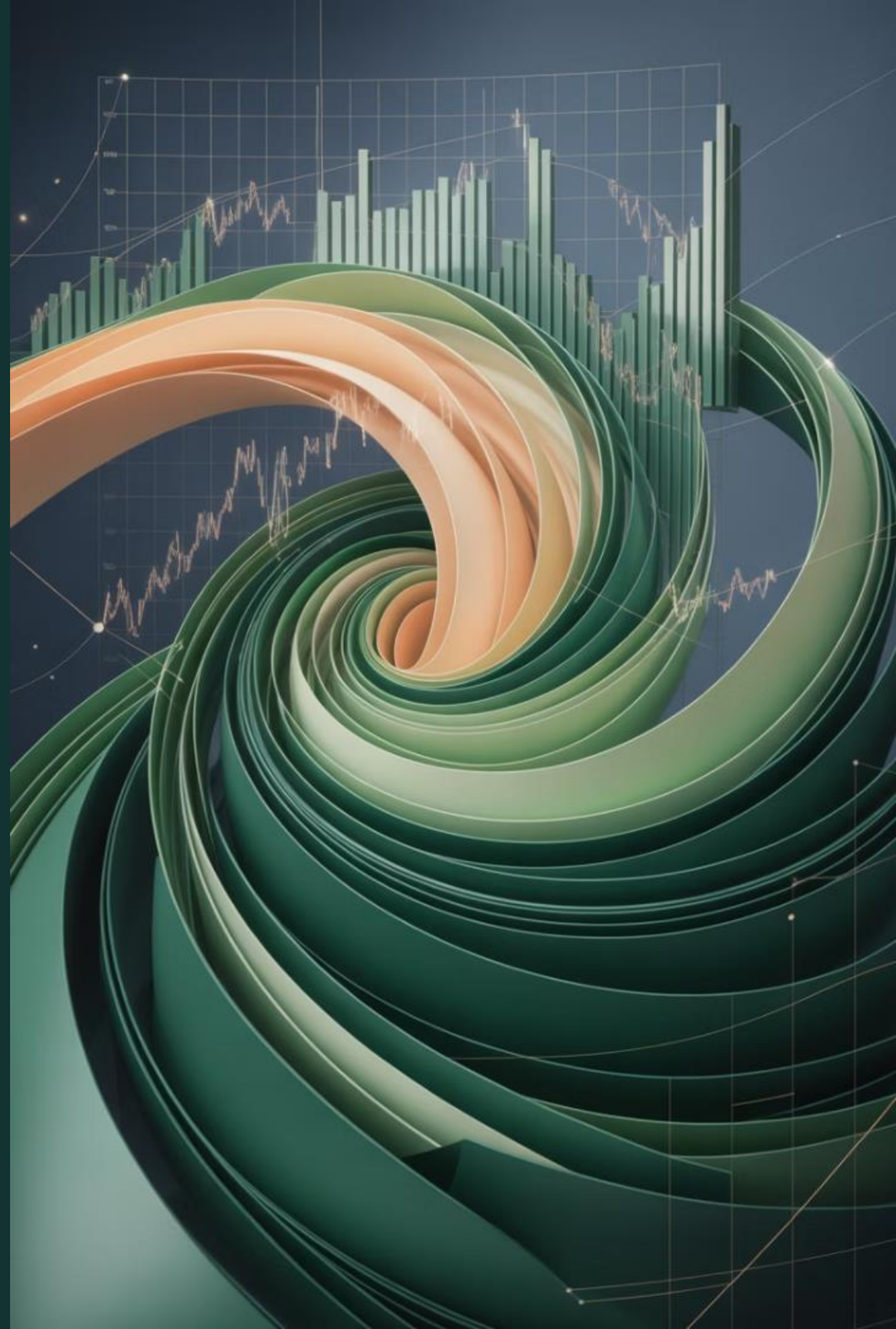
70% chance value rises to $113.21M; 30% chance falls to $78.62M

Construction Costs Rise

Costs increase by 2% to $90M next year

Flexibility Advantage

Only develop if market improves; avoid downside risk



Calculating Option Value

Expected Value Next Year

If market improves (70%): $113.21M - $90M = $23.21M profit

If market declines (30%): Don't build = $0

Expected value = (0.7)($23.21M) + (0.3)($0) = $16.25M

Present Value Challenge

Must account for time and risk differences between immediate development ($11.76M) and waiting ($16.25M next year).

Need appropriate discount rate - the opportunity cost of capital (OCC).

Traditional Approach

Using 20% discount rate: $16.25M/1.20 = $13.54M

Option premium = $13.54M - $11.76M = $1.78M

The NPV Rule and Option Value

Traditional NPV Rule

Invest to maximize NPV among mutually exclusive alternatives.

Land Market

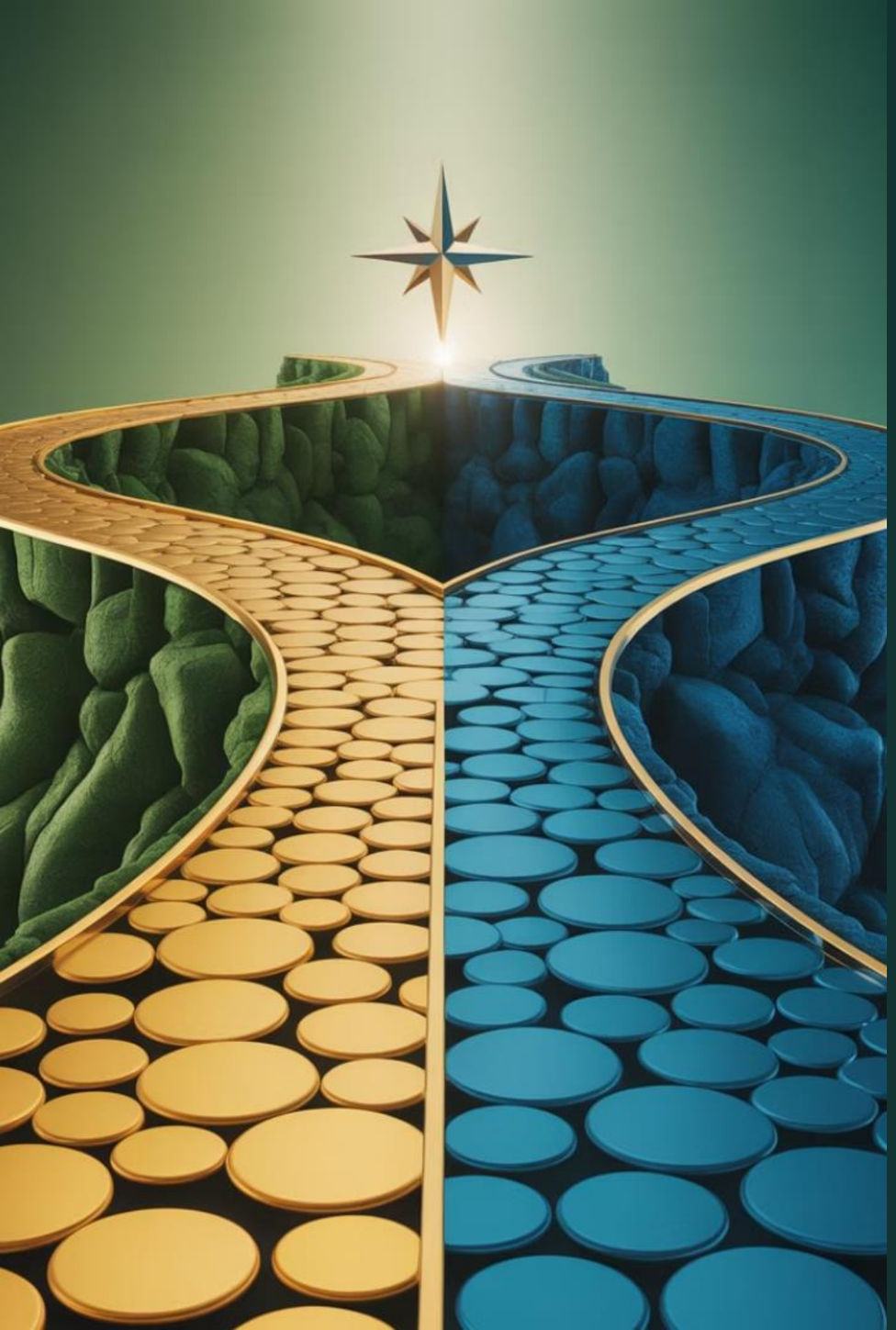
In well-functioning land markets, development option premium should be included in current market value of land.

Timing Matters

Building today versus building next year are mutually exclusive alternatives.

Option Premium

Include current value of option premium as part of cost incurred by exercising development option.



A Rigorous Model of Option Value

The Challenge

We need to know the opportunity cost of capital (OCC) of the option to wait.

Two Approaches

The arbitrage argument and the certainty-equivalence valuation procedure.

Key Insight

These approaches are equivalent and solve the problem of determining the true OCC.

The Arbitrage Perspective

Complete Markets Assumption

Investors can buy or sell without trading costs in three markets: land, built properties, and bonds.

Create a Replicating Portfolio

Construct a portfolio that will have exactly the same value as the option next year, no matter what scenario unfolds.

Calculate Present Value

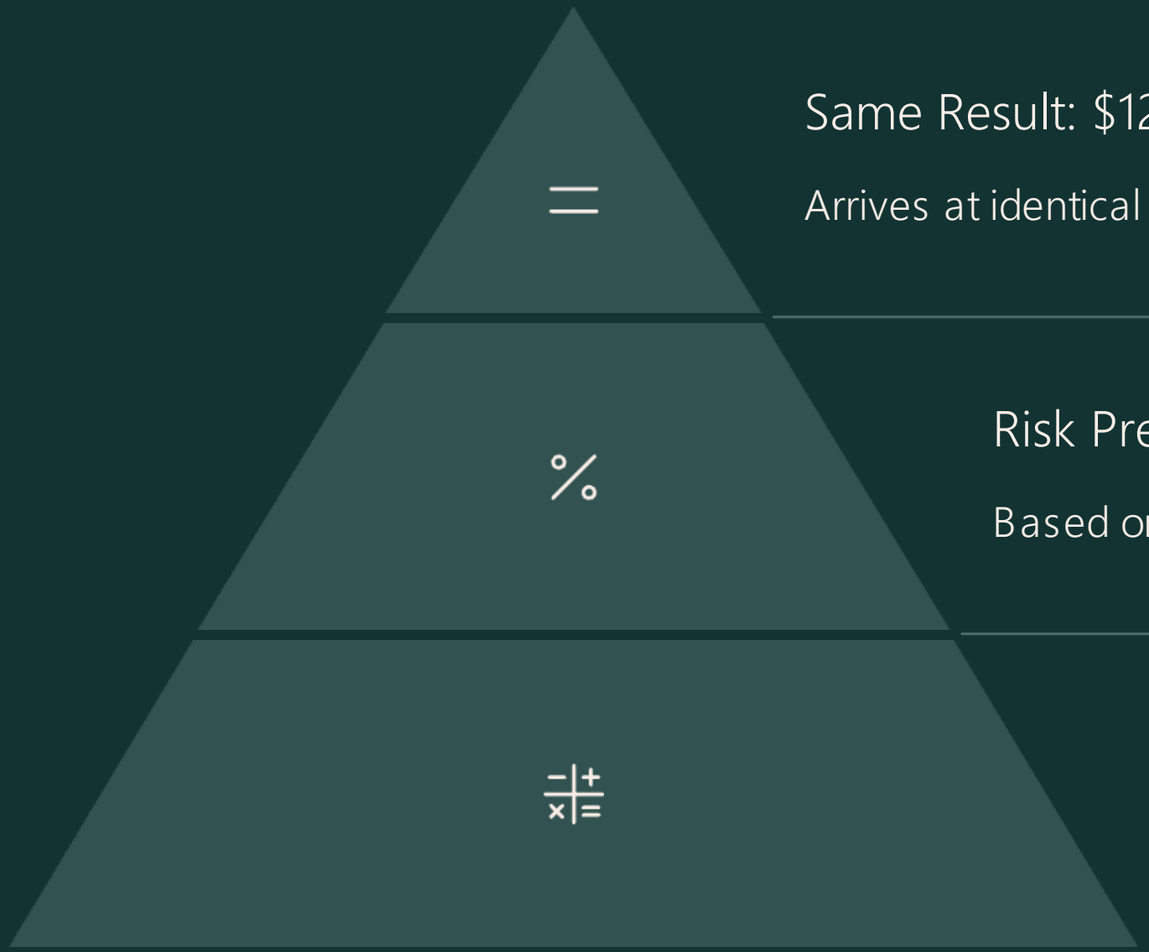
The option to wait and develop must be worth exactly the same as the replicating portfolio today: $12.09M.

Replicating Portfolio Construction

Portfolio Component	Today	Next Year (Up)	Next Year (Down)
67% share in future building	$63.29M	$75.95M	$52.74M
Borrowed at 3% interest	-$51.21M	-$52.74M	-$52.74M
Net Portfolio Value	$12.09M	$23.21M	$0
Development Option Value	?	$23.21M	$0

Since the portfolio exactly replicates the option's future values, the option must be worth $12.09M today.

Certainty-Equivalence Approach



Same Result: $12.09M

Arrives at identical valuation as arbitrage approach

Risk Premium Proportionality

Based on the principle that risk premium is proportional to risk

Certainty Equivalent Value

Expected value minus risk discount, then discounted at risk-free rate

True Option Return Rate

34.42%	9%	3%	5.24x
Option OCC	Built Property OCC	Risk-Free Rate	Risk Premium Ratio
True opportunity cost of capital for the development option	Opportunity cost for completed buildings	Return on riskless bonds	Option risk premium vs. built property risk premium

How the Option Valuation Model Works

Market Equilibrium

Same expected return risk premium per unit of risk across investments

Normative Tool

Model tells what land "should" be worth for fair returns

Cross-Market Balance

Equilibrium across markets for built property and land

Risk Measurement

Risk measured by spread in possible investment return outcomes

The Binomial Model of Option Value

Building Block Approach

The one-period binomial world is a simplification that can be extended to create more realistic models.

Think of an individual binomial scenario as a financial economic "molecule" containing one unit of time and risk.

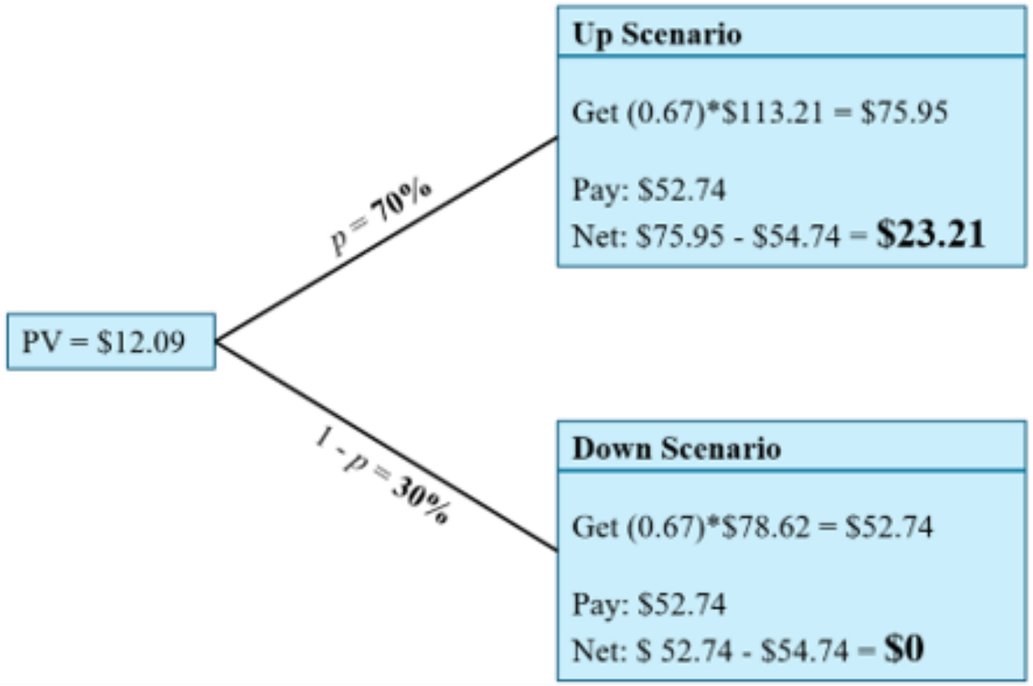
Extending to Reality

By stitching individual binomial outcomes together sequentially, we can span longer timeframes.

Making each period shorter approaches continuous time and continuous pricing realistically.

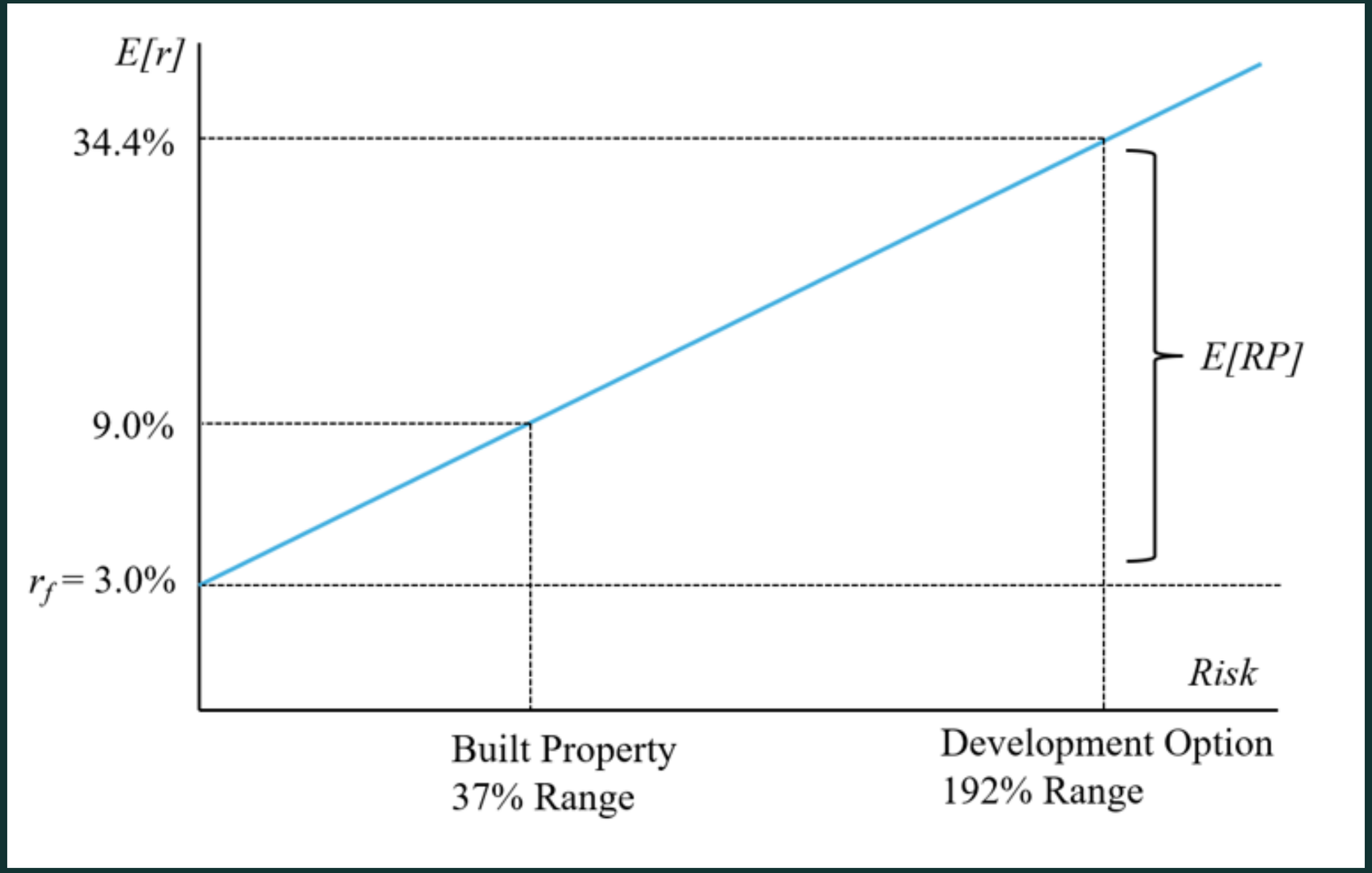
Binomial Value Tree

EXHIBIT 16-2 Binomial Outcome Possibilities for the One-Period Development Option Arbitrage or "Hedge Portfolio" (values in millions)



The binomial model can create a realistic probability distribution of future property values, making it useful for practical land valuation and development timing decisions.

Development Option and Risk Premium Illustrated



The Perpetual Model in Continuous Time

Perpetual Rights

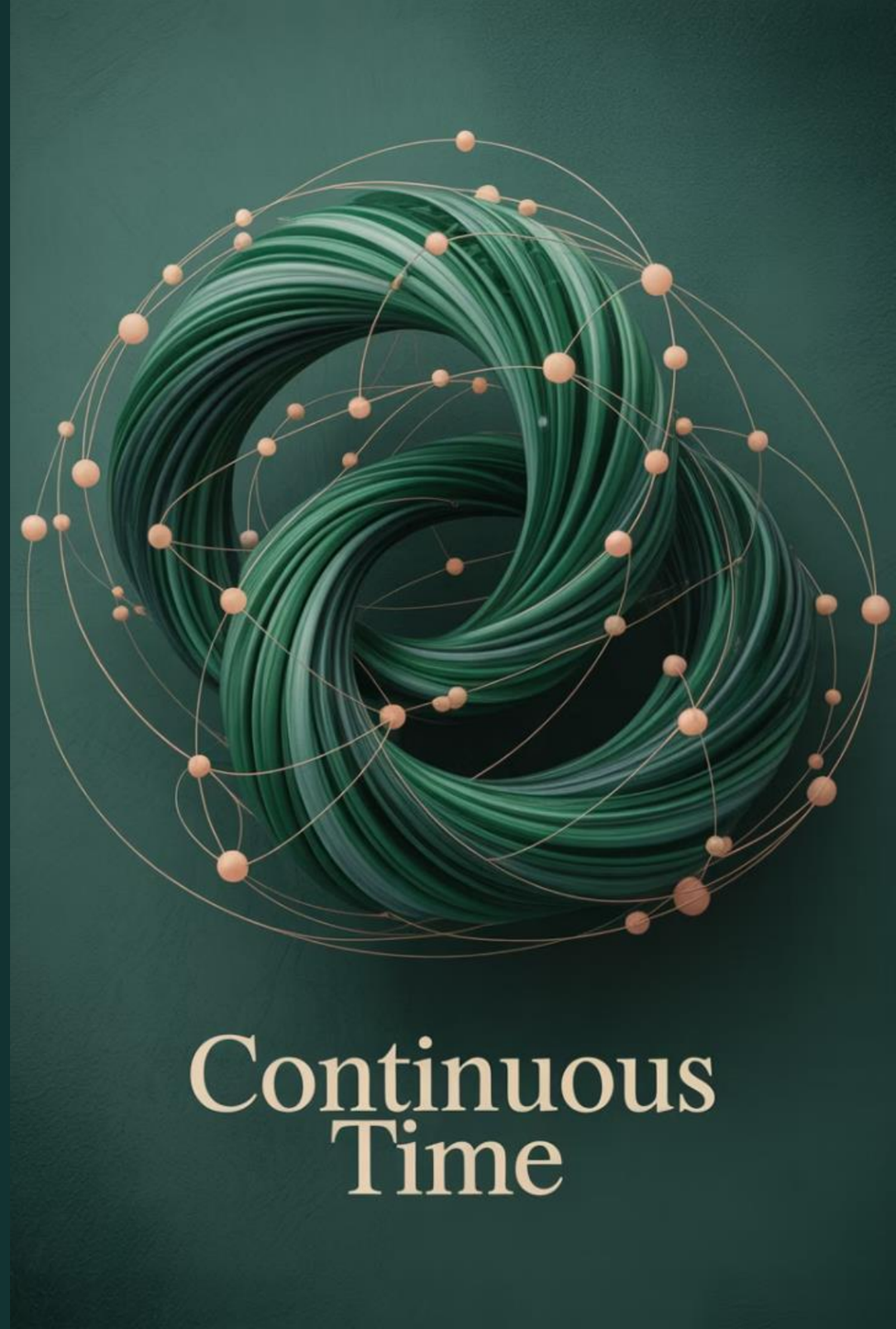
Fee simple land ownership rights are perpetual, and the right to build an as-of-right development never expires.

Samuelson-McKean Formula

Provides exact of perpetual options in continuous time without artificial discretization.

Nobel Prize-Winning

Developed by economist Paul Samuelson and mathematician Henry McKean in 1965.



The Samuelson-McKean Formula

Required Inputs

Built property's current cash yield rate, volatility in built property value, and construction cost yield.

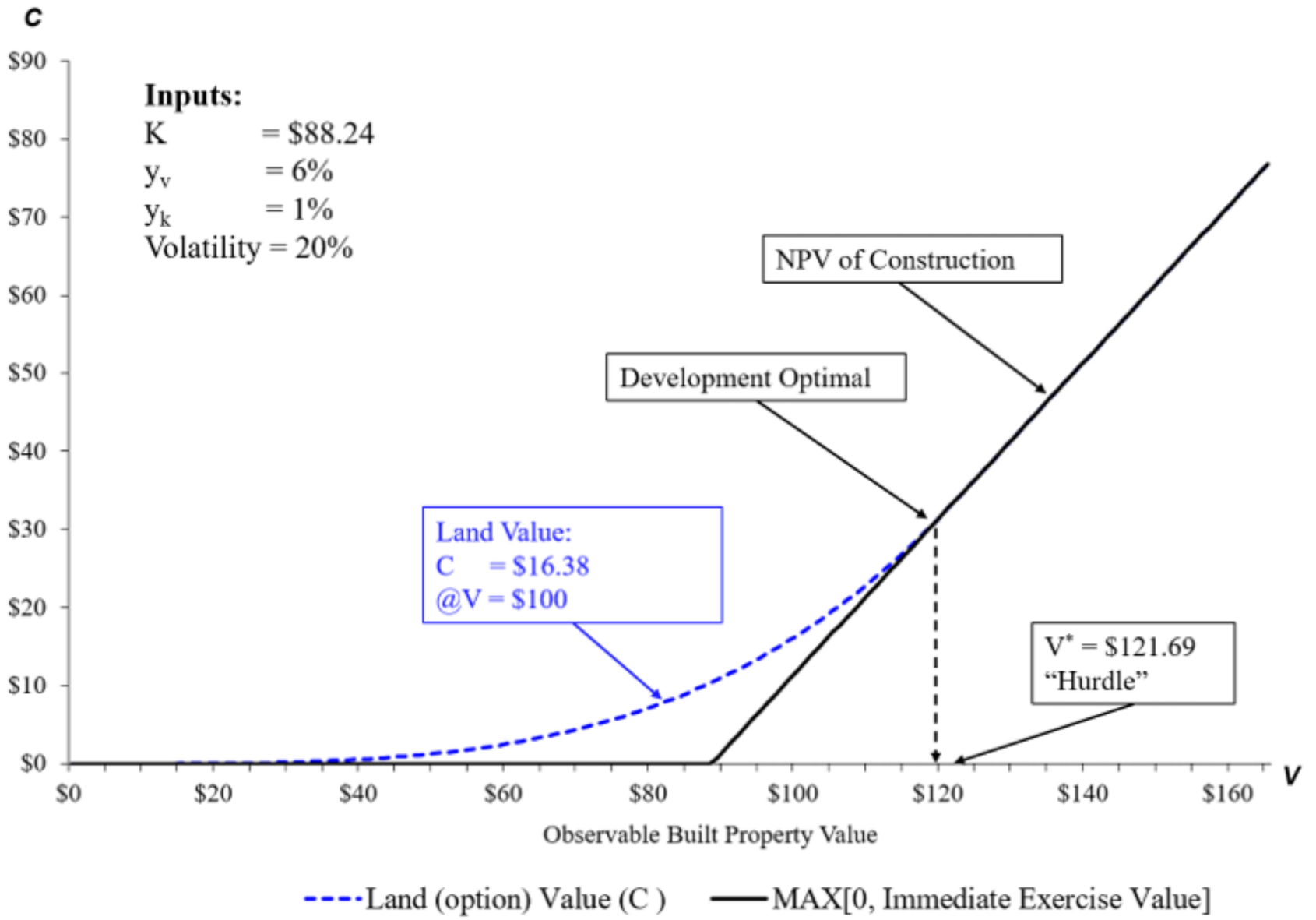
Option Elasticity

Measures percentage change in land value associated with 1% change in built property values.

Hurdle Value

Identifies the critical value of developed property above which immediate development is optimal.

EXHIBIT 16-7 Samuelson-McKean Model Land Value as a Function of Current Built Property Value



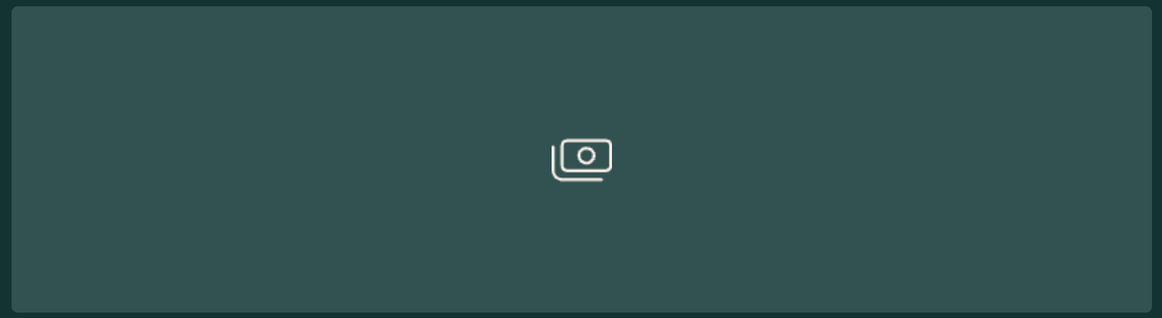
Implications for Development Timing

Higher Volatility

Greater market risk increases land value but raises development hurdle

Urban Configuration

Cities with volatile economies tend to have smaller, denser spatial configurations



Investment Returns

Land speculation requires higher returns to compensate for greater risk

Key Takeaways

Development Threshold

Completed development value must exceed costs by a sufficient margin to induce development.

Option Value

The call option concept explains land value and why delaying development can be beneficial.

Valuation Models

Binomial models and the Samuelson-McKean formula provide practical tools for land valuation.

Investment Insights

Option theory illuminates' development timing, land speculation, and opportunity costs.