UpperMark™ Study Handbook

CAIA® Level I

Volume 2

Topic 3: Real Assets

Topic 4: Private Equity

Topic 5: Private Debt

UpperMark™

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2027.1026

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It is recommended that candidates use any exam preparation product together with the original CAIA curriculum readings.[1]

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Preface

Volume 2 of the UpperMark™ *Study Handbooks* provides a comprehensive and concise account of each learning objective (L.O.) in Topics 3-5 of the CAIA Level I Study Guide. The *Study Handbook* is compiled using the reference materials recommended by the CAIA Association and, as in Volume 1, is organized as follows.

- Each Reading in the Study Guide is presented as a separate chapter, keywords are indicated in ***bold italics***, and learning objective sub-bullets are indicated by underlined, capitalized subheadings (e.g., ROLE OF INVESTMENT OBJECTIVES AND CONSTRAINTS).
- The lists of learning objectives and keywords are provided at the start of each chapter.
- Space is provided at the end of each chapter for you to record your *Personal Study Notes*.
- A set of sample exam questions with a detailed answer key is presented at the end of each chapter.

Supplementary information is included in footnotes.

We wish you the best with your exam preparation.

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Topic 3

Real Assets

Topic 3 comprises five chapters on real assets, which are economic resources that create or add to consumption opportunities (in contrast to financial assets that are conduits of value).

1. Reading 3.1 discusses natural resources, land, timberland, and farmland as alternative assets.
2. Reading 3.2 covers investing in commodities and components of commodity investing.
3. Reading 3.3 discusses infrastructure investing.
4. Reading 3.4 reviews real estate, including different investment styles and real estate sectors.
5. Reading 3.5 discusses real estate assets, and describes forms of financing and real estate investment vehicles for private market commercial real estate.
6. Reading 3.6 describes real estate valuation methods.

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Reading 3.1

Natural Resources and Land

This Reading discusses institutional-quality investments in natural resources and land, with a focus on undeveloped land, timberland, and farmland. The Reading also reviews historical performance of timberland and farmland.

Learning Objectives

3.1.1 Demonstrate knowledge of natural resources other than land.

i. Discuss natural resources as an exchange option
ii. Discuss the concept of moneyness as it pertains to the development of natural resources
iii. Discuss why some in-the-money development options should not be immediately exercised
iv. Describe the relationship between the moneyness of natural resource options and short-term financial risks

Keywords

1. Exchange option
2. Pure play
3. Split estate

3.1.2 Demonstrate knowledge of land as an alternative asset.

i. Describe the three types of land lots (i.e., paper lots, blue top lots, and finished lots)
ii. Discuss investment in undeveloped land as a call option
iii. Apply the binomial option pricing technique for valuing land as a call option
iv. Describe the risks and returns of investing in land
v. Calculate the expected return of land investments

Keywords

1. Binomial option pricing
2. Blue top lots
3. Broken lots
4. Entitled lots
5. Finished lots
6. Land banking
7. Negative survivorship bias
8. Paper lots
9. Raw land
10. Risk-neutral probability

3.1.3 Demonstrate knowledge of timber and timberland as alternative assets.

i. Discuss the characteristics of timber and timberland
ii. Discuss the role of timberland investment management organizations (TIMOs)
iii. Describe the risks and returns of timberland investments
iv. Identify methods of gaining exposure to timberland
v. Explain benefits and disadvantages of timber investment

Keyword

1. Timberland investment management organizations (TIMOs)

3.1.4 Demonstrate knowledge of farmland as an alternative asset.

i. Discuss the characteristics of farmland investments
ii. Calculate the value of farmland based on annual operating income and the cap rate
iii. Understand the structure of farmland ownership and management
iv. Discuss supply and demand factors of agricultural products

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v. Identify three key benefits and three key disadvantages of farmland investment
vi. Identify methods of obtaining exposure to farmland
vii. Discuss the value and importance of assets with multiple purposes

Keywords

1. Agency risk
2. Cap rate

3.1.5 Demonstrate knowledge of contagion, price indices, and biases in real estate values.

i. Discuss the reliability of market prices versus appraisal-based data
ii. Define contagion

Keyword

1. Contagion

3.1.6 Demonstrate knowledge of observations regarding historical returns of timberland and farmland.

i. Summarize the key observations on historical timber and farmland returns that are consistent with economic reasoning

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L.O. 3.1.1 **DEMONSTRATE KNOWLEDGE OF NATURAL RESOURCES OTHER THAN LAND.**

Natural resources are real assets that have not or barely been altered by human activity. Examples include undeveloped land, timberland, and raw materials (e.g., oil, natural gas, coal, water, and wind) provided by or part of the earth that generally remain in a natural state and location. Commodities are not classified as natural resources by the CAIA text, since commodities are typically processed or otherwise modified.[1]

Many natural resources are used as inputs in production processes, with most related to energy production due to energy's role in the global economy. For instance, energy consumption represents 8%–10% of the U.S. gross domestic product. Other large sectors of natural resources include land and metal ores.

Most natural resources are under the earth's surface. Globally, most private land ownership is limited to surface rights, with subsurface rights (e.g., mineral and energy) owned by governments.

- An exception is in the U.S., where private land ownership typically includes mineral rights. In the case of privately-held land, some U.S. states permit ***split estates***, which entails surface and subsurface rights being owned by different parties.
- Owners of natural resources typically lease the natural resource rights to operating firms for resource development and extraction. Thus, effective economic ownership of natural resources is often attained by buying or leasing rights (not by direct property ownership).

Institutional ownership of natural resources may be achieved through land ownership that includes underground rights, ownership of mineral rights, or leasing of mineral rights.

While most global natural resources are owned by governments or leased to operating firms, some opportunities for ***pure plays*** (i.e., investment vehicles that provide direct exposure to an investment's risks and returns without exposure to other risks) on natural resources exist through private partnerships or listed partnerships (MLPs).

- Pure plays on private investments in natural resources are not common. Most underground natural resources are not privately owned and most U.S. privately-owned natural resources are combined with surface rights. Therefore, few institutional-quality investments have returns based almost entirely on the values of underlying natural resources.
- A public market example of a somewhat pure play on natural resources is Natural Resource Partners LP (with ticker NRP on NYSE), an MLP that owns, manages, and leases mineral reserve properties, including coal, industrial materials, and other natural resources in the U.S.
  - NRP's performance during the global financial crisis was similar to that of the overall market; however, its subsequent performance is linked to potential profits from its coal properties. This exemplifies the issue of using public markets to access pure plays on natural resources. Further, lack of publicly-traded investments limits the evidence on market prices of natural resource investments.

[1] Commodities are discussed in Reading 3.2.

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NATURAL RESOURCES AS AN EXCHANGE OPTION

Developing a natural resource involves acquiring mineral rights and using equipment, materials, labor, fuel, and management to extract a real asset or commodity and bring it to market. Prices of deliverables (i.e., mineral rights and production inputs) and receivables (i.e., processed natural resources) are both stochastic. Costs of developing natural resources change due to factors such as technological advances and environmental and regulatory issues.

Since developers exchange production inputs to retrieve real assets, natural resources may be characterized as ***exchange options***, which are options to exchange one risky asset for another (i.e., production inputs for processed natural resources) at a stochastic strike price. This contrasts with standard options that provide the right to buy or sell an asset at a fixed strike price.

- The value of an exchange option (like all options) depends on volatility. In the case of an exchange option, volatility depends on the following.
  1. Volatility of the delivered asset(s)
  2. Volatility of the received asset(s)
  3. Correlation between the two prices in 1 and 2.
- The volatility of the exchange option can be described as the volatility of a two-asset portfolio. If development costs and commodity prices are not highly positively correlated, all else equal, the option value and its volatility are high. However, the option is considerably less valuable when development costs and commodity prices are highly correlated.

MONEYNESS AS A FACTOR IN DEVELOPING NATURAL RESOURCES

The payoff diagram for development of natural resources as an option is depicted in Figure 1. As indicated, the payoff resembles that of a call option, with a number of exceptions.

- The horizontal axis in Figure 1 represents the ratio of the price of the developed real asset to the cost of developing the natural resource. Since the price of a developed natural resource and the cost of developing the resource are both stochastic, the option's moneyness depends on the spread between development benefits and costs.
- Thus, moneyness reflects the benefit-cost ratio of developing the natural resource, with the three categories of moneyness indicating the following about the benefit-cost ratio.
  - In-the-money (ITM) – Benefit-cost ratio is greater than one, which means that revenues from selling the commodity exceed costs of developing the commodity.
  - At-the-money – Benefit-cost ratio equals one.
  - Out-of-the-money (OTM) – Benefit-cost ratio is less than one.

The option to develop rights to a natural resource is generally a perpetual option or may be leased on a temporary basis.[2]

- In theory, most options should be held until expiration (except deep-ITM puts and calls prior to ex-dividend dates, which should be exercised early). Since, as a perpetual option, a development option has no expiration date, the option holder needs to decide when to exercise the option.

[2] A perpetual option is an American option with no expiration date. American options can be exercised at any time before or at expiration; whereas European options can only be exercised at expiration.

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- A natural resource should only be developed (i.e., the option exercised) when the option is substantially ITM.
  - How far ITM the option should be to justify it being exercised is governed by option theory and depends on three factors: volatility of the commodity price, volatility in the cost of extracting the commodity, and correlation between the two volatilities.
  - As indicated in Figure 1, above point X, the option value is greater if the option is exercised immediately than if the decision to exercise is deferred. In other words, in that range, developers generate more wealth by immediately developing the natural resource than delaying development.
  - Therefore, the development option is adequately ITM and should be exercised at values at and above point X.

Different natural resource properties have different development benefit-to-cost ratios. The order in which these properties are developed is typically governed by the low-hanging-fruit principle, which states that the development project with the highest benefit-to-cost ratio should be undertaken first. For instance, a property rich in a mineral and located in a jurisdiction supportive of development is deep ITM and should be mined before a similar property that has low concentrations of the mineral and strict environmental regulations.

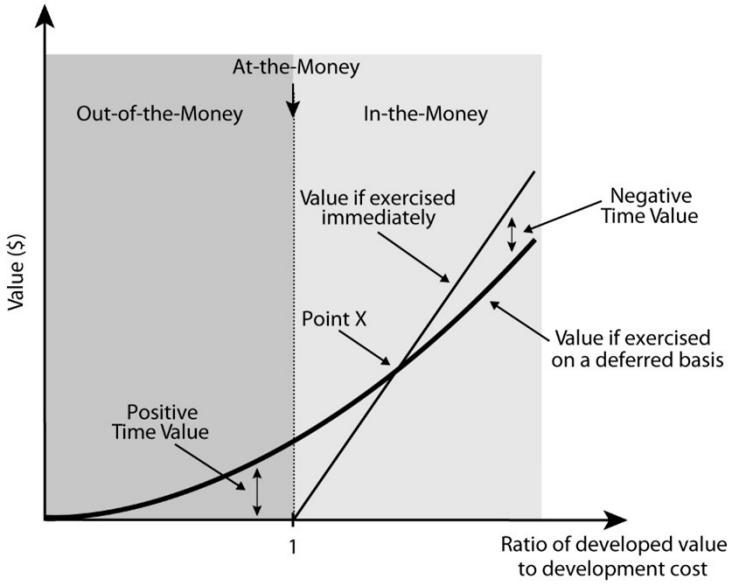


Figure 1: Payoff Diagram for Natural Resource Development Call Option

WHY SOME ITM OPTIONS SHOULD NOT BE EXERCISED IMMEDIATELY

The value of delaying a decision to exercise ITM options is based on the time value of money and assessing the benefit of waiting for new information. Thus, to determine the optimal time to exercise an option, option holders consider the benefit generated by volatilities of market prices and the option's convexity.

- The convex nature of an option's payoff diagram represents the asymmetric nature of the option's payoffs: long option positions increase in value at an increasing rate (going from left to

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right on the payoff diagram; i.e., as the benefit-to-cost ratio in Figure 1 increases) and decrease in value at a decreasing rate in the other direction.

- Not exercising an option immediately gives the option holder a chance for the option to become more valuable or become less valuable (possibly out-of-the-money [OTM]) but with the possibility of later increasing in value.
  - For instance, consider an option with an intrinsic value of $50. If the option's moneyness increases, its intrinsic value may increase to $110. However, if its moneyness decreases by the same amount (i.e., $60), the option's intrinsic value will only decline to $0 (it will not decline to –$10). Therefore, if the option holder has a reasonably good chance of receiving $110 or receiving an OTM option that may become valuable in the future, he would be reluctant to exercise the option.

MONEYNESS OF DEVELOPMENT OPTIONS AND SHORT-TERM FINANCIAL RISKS

Factors that drive short-term financial risks of natural resources development options depend on whether the options are far ITM or OTM.

- Far-ITM development options
  - Risks of these options are primarily driven by the underlying commodity price.
  - Figure 1 shows that the option curve has a steep slope when options are far ITM, which suggests that changes in commodity price are the leading source of short-term volatility in the option value.
  - The greater the option's moneyness, the shorter the time before the option is exercised and the lower the chance that the option's price will change significantly due to changes in development costs.
- OTM development options
  - These options are sensitive to factors other than the underlying commodity price. The longer the time horizon for possible development, the greater the sensitivity of the natural resource's price to changes in development costs, interest rates, and other factors.

L.O. 3.1.2 **DEMONSTRATE KNOWLEDGE OF LAND AS AN ALTERNATIVE ASSET.**

Land, in economic terms, is a real asset whose value is strongly tied to its ability to generate valuable resources such as food, shelter, or timber. Most of the world's land is currently undeveloped and must be valued according to its potential to be productive. In addition, rights associated with land ownership vary by governmental jurisdiction. Claims to natural resources under the land (e.g., minerals) may be titled separately from the land.

Land development value chain

Land banking involves investing in undeveloped land in the hopes of price appreciation or for the purpose of development. Homebuilders, for instance, buy lots of land for future home developments. Key risks and land values are determined by the location of the land and the extent to which it has been developed or improved.

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TYPES OF LAND LOTS

Land must complete several stages of preparedness or improvement before it can be developed. Its value, all else equal, should increase from one level of improvement to the next. A value chain for land or lots may be viewed as follows.

1. ***Raw land*** – This type of land has no obvious signs of development. It may be clear of trees and brush, but it is not prepared for development. It may also lack zoning or permits required for development.
2. ***Paper lots*** – These are vacant plots of land that have been approved for development by the local zoning authority, but construction of infrastructure (e.g., streets and utilities) has not yet begun.
3. ***Entitled lots*** – These have little/no physical improvements, but have met all local regulatory requirements for development (e.g., zoning, permitting, surveys, entitlements, assessments, and other aspects of the planning stage).
4. ***Blue top lots*** – These are lots for which construction has begun but that are not yet ready for homebuilding. This means infrastructure has begun to take form. The rough grading of the lots has been completed, including undercutting the street section and interim drainage facilities, and required fees have been paid. At this stage, a homebuilder can obtain a building permit.
5. ***Finished lots*** – These lots are completely ready to begin construction of a home or building. They are the final stage of the value chain. All entitlements are complete, including grading, utilities, and other infrastructure for the lot, streets, and common areas. Development fees (except building permits and inspections) have been paid.

Some investment strategies may purchase raw land and navigate up the value chain with the objective of reselling it for a high value to an investor who wants to develop it. In some cases, typically due to economic hardship, the result may be a ***broken lot***, which is lot that has had some pre-development (e.g., grading and infrastructure), but has not been completed and has fallen into disrepair.

Development requires significant time and costs, which makes land investment a risky, long-term strategy. The greater the cost of preparing the lot for homebuilding, the riskier the investment. Thus, finished lots near a metropolitan area are safer investments than paper lots and lots far from metropolitan areas, and unfinished lots are sold at discounts to their potential value.

Advancements in land banking have promoted the efficient flow of capital among players in the undeveloped land market. In the past, homebuilders would buy land strictly for their own use in development. Now, it is not uncommon for a third party to bank land for development companies. In fact, homebuilders increasingly rely on institutional investors to hold and provide paper lots and finished lots when needed.

INVESTING IN UNDEVELOPED LAND – A CALL OPTION

Like investing in land with mineral rights, investing in undeveloped land may be viewed as a call option on development. The value of the call option depends on a number of factors.

1. Underlying asset – The land and its development/construction or improvement
2. Strike price – Cost of development or improvements (i.e., building a house)
3. Time to expiration – Typically unlimited

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4. Payoff – The spread between the value of the completed development and the cost of development
   - The value of a call option is positively correlated with the payoff. In other words, the value of land increases as the potential payoff increases.
5. Volatility – The volatility of the spread between the value of the completed development and the cost of development/construction
   - The value of land is positively correlated with the anticipated volatility in the potential payoff.
   - Development costs are also positively correlated with the value of the completed project, since more developers enter the market as prices rise, which results in higher prices of materials used in construction. This positive correlation implies that the option value may instead decrease as the expected sales price increases (if the construction costs rise faster than the expected sales price).
6. Risk-free rate
7. Dividend yield (i.e., income) of completed project
8. Costs of holding undeveloped land (e.g., maintenance, taxes, and insurance)

Land is a perpetual call option that should be exercised (i.e., the land should be developed) when the net benefits of development exceed the value of keeping the option. The decision to develop land depends on the moneyness of the option and can be modeled using option theory. All else equal, a unit of land is more valuable and has higher expected payouts if it can be used for multiple purposes, as long as the values to the purposes are not perfectly correlated.

VALUING LAND AS A CALL OPTION – BINOMIAL OPTION PRICING

Binomial option pricing is a technique that constructs a series of binomial trees, where each node has two outcomes corresponding to two states of the economy (e.g., economy improves or weakens). The current value of the option is determined as an average of the outcomes, each weighted by the probability of its occurrence.

The binomial tree for the value of an instrument is shown in Figure 2. Each node in the tree represents a level of the instrument's value. The initial node represents the current value, V_0, and nodes V_u and V_d represent the two values at the end of period 1 that correspond to up and down moves, respectively, in the economy.

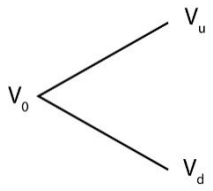


Figure 2: Binomial Tree

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The current value in a binomial tree may be expressed as the present value of its expected future values as:

$$V_0 = \frac{1}{1+r}\left[pV_u + (1-p)V_d\right],$$

where r is the one-period risk-free rate, p is the risk-neutral probability of an up move in the value, and $(1 - p)$ is the risk-neutral probability of a down move.[3] A ***risk-neutral probability*** can be used to value assets if, all else equal, all market participants are risk neutral. A risk-neutral probability can be considered a statistical probability adjusted for risk so that it can be used to price risky assets in a risk-neutral environment. When the risk-free rate is zero, the current value becomes:

$$V_0 = pV_u + (1-p)V_d.$$

Therefore, when the risk-free rate is zero, the current value equals its end-of-period expected value based on risk-neutral probabilities.

Pricing land as a call option using the binomial technique involves two key steps.

1. Write the current value of a comparable improved property as the present value of the expected future improved property values and use this expression to determine the risk-neutral probability that the economy improves.
2. Calculate the current option value (i.e., the land) as the present value of its expected future payoffs using the risk-neutral probability found in Step 1.

Example 1

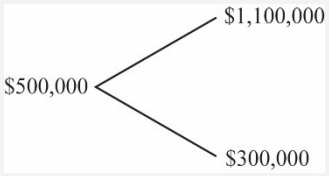
Construction costs for improving a parcel of land depend on the state of the economy. If the economy improves, the land can be improved at a cost of $700,000, which will result in an improved property worth $1,100,000. However, if the economy weakens, the cost is $400,000 and the improved property will be worth $300,000. Since, in the down state, the developer would lose $100,000 if he developed the land, he opts to abandon it rather than suffer a cash loss. A comparable improved property currently sells for $500,000 and the risk-free rate is 0%. What is the current value of the land?

Step 1

Use the current price of the comparable improved property and the two values of improved properties at the end of the period to determine the risk-neutral probability that the economy improves (i.e., p).

With 0% risk-free rate, current value of the comparable improved property is:

$$\begin{aligned} V_0 &= pV_u + (1-p)V_d. \\ \$500,000 &= \left[p \times \$1,100,000\right] + \left[(1-p) \times \$300,000\right] \\ &= \$1,100,000p + \$300,000 - \$300,000p \\ &= \$800,000p + \$300,000 \end{aligned}$$



$$\$800,000p = \$500,000 - \$300,000 \quad \Rightarrow \quad p = \frac{\$200,000}{\$800,000} = \frac{1}{4}$$

Thus, risk-neutral probability that economy improves is $p = 1/4$ and that economy weakens is $(1 - p) = 3/4$.

[3] To understand how this comes together, think of $(1 + r)$ as a discount factor and $\left[pV_u + (1-p)V_d\right]$ as a weighted average of the firm's two values in period one, where the weights are the risk-neutral probabilities p and $(1 - p)$.

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Step 2

Using the risk-neutral probabilities found in Step 1 and a 0% risk-free rate, the current value of the land as a call option is:

$$V_0 = pV_u + (1-p)V_d = \left(\frac{1}{4} \times V_u\right) + \left(\frac{3}{4} \times V_d\right).$$

In the up state, the value of the development outcome is:

V_u = \$1,100,000 – \$700,000 = \$400,000.

In the down state, the land is abandoned so it has no value. Thus, $V_{1,d}$ = \$0.

$$\Rightarrow \quad V_0 = \left(\frac{1}{4} \times V_u\right) + \left(\frac{3}{4} \times V_d\right) = \left(\frac{1}{4} \times \$400,000\right) + \left(\frac{3}{4} \times \$0\right) = \$100,000$$

Therefore, current value of the land is \$100,000.

Example 2

Continuing from Example 1, if the construction costs are fixed at \$475,000, what is the current value of the land?

With fixed construction costs, the payoffs in the up and down states need to be re-calculated. The payoff in the up state is \$1,100,000 – \$475,000 = \$625,000 and in the down state is \$0 since the land is abandoned.

Therefore, the value of the land as a call option is:

$$V_0 = \left(\frac{1}{4} \times V_u\right) + \left(\frac{3}{4} \times V_d\right) = \left(\frac{1}{4} \times \$625,000\right) + \left(\frac{3}{4} \times \$0\right) = \$156,250.$$

This call option value of \$156,250 is higher than the \$100,000 option value in Example 1 because the fixed construction costs in this example increase the variability of the payoff and, therefore, increase the value of the option.

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INVESTING IN LAND – RISKS AND RETURNS

Traditional real estate investing by institutional investors typically involves buying leased commercial real estate that provides a cash flow and capital appreciation. In contrast, an undeveloped land investment does not typically provide income from lease payments and has a longer holding period, making it a riskier investment. On the positive side, undeveloped land does not need regular maintenance to maintain its value in the way developed real estate does. Therefore, the downside risk of owning undeveloped land can be low. The relationship between land and developed real estate is analogous to an equity call option and the underlying equity.

From an option perspective, land that remains undeveloped is often considered a poor investment since the option to develop the land remains unexercised (and the land's value does not increase substantially), whereas land that is developed is generally a good investment since the option is exercised. However, historical indices of undeveloped land likely understate returns (falsely portraying undeveloped land as a poor investment) since the indices ignore land that benefited from development.

- Historical returns of undeveloped land may be subject to ***negative survivorship bias***, which results when indices exclude the high returns of successfully developed properties that are no longer in a database. Negative survivorship bias causes a downward bias in returns.
- In contrast, survivorship bias of other investment returns is typically positive since indices of those investments exclude the poor returns of failed investments.

LAND INVESTMENTS – EXPECTED RETURN

The expected return on a land investment is the probability-weighted average of the expected return on the land if it remains undeveloped, $E(r_{undev})$, and the expected return on the land if it is developed, $E(r_{dev})$, and may be expressed as:

$$E(r) = \left[p \times E\left(r_{dev}\right)\right] + \left[\left(1-p\right) \times E\left(r_{undev}\right)\right] ,$$

where p is the probability of the land being developed. The expected return of land, like any financial option, depends on its systematic risk.

Example 3

A parcel of land is expected to generate a return of 7.5% if it remains undeveloped and a return of 72.5% if it is developed. If there is a 5% probability that the land will be developed over the next time period, what is the overall expected return on the land?

$$\begin{aligned} E(r) &= \left[p \times E\left(r_{dev}\right)\right] + \left[\left(1-p\right) \times E\left(r_{undev}\right)\right] \\ &= \left[0.05 \times 0.725\right] + \left[0.95 \times 0.075\right] = 10.75\% \end{aligned}$$

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Example 4

Historically, land is expected to yield a 6% return if it remains undeveloped and a 24% return if it is developed. If 30% of land in a database is developed in a given year, by how much will an index based on land that remains undeveloped understate the average return on all land?

Historical return of land that remains undeveloped is 6%.

Expected return of a portfolio with 30% land development is:

$$E(r) = \left[p \times E\left(r_{dev}\right)\right] + \left[(1-p) \times E\left(r_{undev}\right)\right] = [0.30 \times 0.24] + [0.70 \times 0.06] = 11.4\%$$

Thus, the index understates the average return on land by 11.4% – 6% = 5.4%. This measure represents the negative survivorship bias of historical returns of undeveloped land.

L.O. 3.1.3 **DEMONSTRATE KNOWLEDGE OF TIMBER AND TIMBERLAND AS ALTERNATIVE ASSETS.**

TIMBER AND TIMBERLAND

A timber investment is an investment in forestland for long-term harvesting of wood. Forest ownership falls into two broad categories.

1. Public ownership – This represents ownership rights to forests by government entities.
   - About 86% of the world's 4 billion hectares of forests are publicly owned. Africa, Asia, and Europe have the highest percentage of public forestland by continent at 90% or higher.
2. Private ownership – This represents ownership by individuals, companies, and non-government entities.
   - In contrast to most countries, the U.S. has large forest endowments due to the dominant role of private forests: in the U.S., ~60% of forests are privately owned, and forests make up about one third of the total land mass.

Early in its history, the U.S. forest products industry was vertically integrated, with companies involved in all stages of the process (i.e., forest ownership and manufacturing [e.g., pulp and saw mills]). Over the past 30 years, the different stages of production have steadily been separated and timberland is now viewed as a unique business that represents inputs for other businesses. The dismantling of the integrated companies (i.e., reduced integration in the forest products industry) resulted in a change in timberland ownership, which was spurred for two reasons.

1. Increased leveraged buyouts (LBOs) in the 1970s and 1980s
   - LBO firms would buy companies with several operating divisions and would then break up the companies and sell the component parts.
   - In the 1980s, undervaluation of timberland owned by forest products companies was exploited by corporate raiders.[4] To prevent corporate takeovers, some forest product companies (e.g., International Paper) took preemptive action and sold off their timberland and established long-term wood supply agreements with the new owners.

[4] For instance, in 1985, the Crown Zellerbach Corporation owned ~1.6 million acres in the U.S. After a bitter eight-month battle, British corporate raider Sir James Goldsmith forcibly acquired Crown Zellerbach. He subsequently dismantled the company, selling off its other assets (e.g., its mills) but retaining its timberland.

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ROLE OF TIMBERLAND INVESTMENT MANAGEMENT ORGANIZATIONS

2. Increased ***Timberland Investment Management Organizations (TIMOs)***
   - TIMOs are firms that specialize in managing forest lands. Institutional investors (e.g., pension plans) that purchase timberland rely on TIMOs to advise on and manage the investments in return for a management fee and a share of the profits from the harvest.
   - The increased number of TIMOs facilitated the shift of timber ownership from manufacturers of timber-related products to institutional investors, and has been a key reason for changes in timberland ownership.

A key concept in timber management is the rotation period (i.e., time needed to grow the tree from planting to harvest).

- Pine trees have a rotation of 45-60 years, while hardwoods require a rotation of 60-80 years.
- While the rotation may be reduced with intensive management (e.g., to 25-30 years for planted pine), a timber investment is a long-term investment that exposes investors to the risks of natural disasters (e.g., fire and flooding) and obsolescence from changing technologies and government restrictions on ownership rights (e.g., harvesting).

Investing in timber has advantages, some of which have an option component.

- Timing option – Timber's harvest schedule is flexible in that it can be accelerated or postponed by several years. This timing option can be optimally exercised to coincide with liquidity needs or to improve pricing.
  - Given that trees grow each year (e.g., northern hardwood grows 1%-3.3% per year), postponing a harvest during periods of low timber prices provides both additional timber and time for timber prices to increase.
- Multiple-purpose option – Timber has multiple uses (e.g., firewood, chip-n-saw, and pulpwood).[5] This option may add considerable value if prices of timber-related products are not perfectly correlated.

TIMBERLAND – METHODS OF GAINING EXPOSURE

There are four key publicly-traded ways to invest in timber in the U.S.

1. Direct ownership of shares in publicly-traded timber-related firms
2. Exchange-traded funds (ETFs)
   - There are two major ETFs (with ticker symbols WOOD and CUT) that track timber firm values. The ETFs, which have a total market value of ~$330 million, track different indexes and thus can have quite different returns, as indicated in Table 1.
   - Real estate investment trusts (REITs)
   - REITs are the most popular way for retail investors to gain exposure to timber.
3. Futures contract
   - Random Length Lumber futures contracts trade on the CME and offer exposure to timber prices, which are part of (but not perfectly correlated with) timberland prices.

[5] Pulpwood is timber grown for the purpose of making wood pulp for producing paper. Chip-n-saw trees produce chips for pulpwood and small dimension lumber.

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Ticker Symbol	Mean	Volatility
WOOD	4.6%	22.5%
CUT	3.9%	22.6%
MOO	2.8%	20.3%
NRP	0.9%	49.2%
RUA (Russell 3000)	11.3%	16.2%

Table 1: Annualized Returns Based on Market Price (June 2008 – Dec. 2025)[6]

TIMBER INVESTMENT – BENEFITS AND DISADVANTAGES

There are three key potential benefits of timber investments.

1. Diversification potential – This is due to low returns correlation with stocks and bonds.
2. Timing option – Flexibility in the timing of timber harvesting may reduce its risk exposure to short-term economic fluctuations.
3. Inflation hedge.

There are three key disadvantages to timber investments.

1. Timber values tied to cyclical industries (e.g., housing) – These industries can suffer prolonged recessions (e.g., the housing crisis that began in 2007).
2. Long growth cycle – This exposes timber's value to risks of changes in technology and other factors affecting demand that may occur during the long rotation periods.
3. Risk exposure to natural disasters or adverse changes in legal standards – This can lead to significant losses.

L.O. 3.1.4 **DEMONSTRATE KNOWLEDGE OF FARMLAND AS AN ALTERNATIVE ASSET.**

FARMLAND INVESTMENTS

A farmland investment represents ownership in land (a real asset) that has a steady, renewable cash flow stream from crop income. In contrast to traditional real estate, the cash flows and values of which are tied to rental income, farmland's cash flows and value may be linked to commodity (i.e., crop) prices.

[6] WOOD is the ticker symbol for the iShares Global Timber & Forestry ETF and CUT is the ticker for the Invesco MSCI Global Timber ETF. The Russell 3000 Index is a capitalization-weighted index composed of the 3,000 largest U.S. companies.

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VALUING FARMLAND BASED ON ANNUAL OPERATING INCOME & CAP RATE

The value of farmland is the sum of discounted future cash flows. Since farmland is a potentially perpetual asset, its value may be modeled as the value of a real estate property using the perpetuity formula expressed as:

$$\text{Value of property} = \frac{\text{Annual operating income}}{\text{Cap rate}},$$

where the ***cap rate*** (i.e., capitalization rate) or yield is the return on assets (ROA) for real estate investments, which is given by:

$$\text{ROA} = \frac{\text{Operating income}}{\text{Total assets}} = \frac{\text{Income} - \text{Expenses}\left(\text{except financing costs}\right)}{\text{Total assets}}.$$

As indicated in the ROA formula, operating income is income before financing expenses.

Another common performance measure is return on equity, which may be expressed as:

$$\text{Return on equity (ROE)} = \frac{\text{Net income}}{\text{Total equity}} = \frac{\text{Operating income} - \text{Annual financing cost}}{\text{Purchase price} - \text{Total financing costs}}.$$

Example 1

An investor borrows $150,000 at 8% per year and purchases 20 acres of farmland at $15,000 per acre. He leases the land at $2,000 per acre. Property taxes are $500 per acre and annual insurance costs are $2,500. What are the ROA and ROE of this farmland investment?

$$\text{ROA} = \frac{\text{Operating income}}{\text{Total assets}} = \frac{\text{Income} - \text{Expenses}}{\text{Total assets}}$$

$$= \frac{\text{Income} - \left(\text{Taxes} + \text{Insurance costs}\right)}{\text{Total assets}}$$

$$= \frac{\left(20 \times \$2{,}000\right) - \left(\left[20 \times \$500\right] + \$2{,}500\right)}{\$300{,}000} = \frac{\$27{,}500}{\$300{,}000} = 9.17\%$$

$$\text{ROE} = \frac{\text{Net income}}{\text{Total equity}} = \frac{\text{Operating income} - \text{Annual financing cost}}{\text{Purchase price} - \text{Total financing costs}}$$

$$= \frac{\$27{,}500 - \left(8\% \times \$150{,}000\right)}{\left(20 \times \$15{,}000\right) - \$150{,}000} = \frac{\$15{,}500}{\$150{,}000} = 10.33\%$$

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Example 2

Continuing from Example 1, assume the annual revenue is expected to increase to $50,000 and the cap rate increases to 9.9%. If the other values remain constant, what would be the value of the farmland investment?

$$\text{Value of property} = \frac{\text{Annual operating income}}{\text{Cap rate}} = \frac{\text{Income} - \text{Expenses}}{\text{Cap rate}}$$

$$= \frac{\text{Income} - (\text{Taxes} + \text{Insurance costs})}{\text{Cap rate}}$$

$$= \frac{\$50,000 - (\$10,000 + \$2,500)}{0.099}$$

$$= \frac{\$37,500}{0.099} = \$378,787.88$$

Thus, the value of the farmland would increase to $378,787.88.

Example 3

What is the cap rate of a property valued at $640,000 if its annual operating income is $59,000?

$$\text{Value of property} = \frac{\text{Annual operating income}}{\text{Cap rate}}$$

$$\$640,000 = \frac{\$59,000}{\text{Cap rate}} \quad \Rightarrow \quad \text{Cap rate} = \frac{\$59,000}{\$640,000} = 0.09219 = 9.219\%$$

STRUCTURE OF FARMLAND OWNERSHIP AND MANAGEMENT

Farmland is composed of row cropland and permanent cropland.

- Row cropland is land that produces row crops; i.e., crops that are replanted each year from annual seeds (e.g., corn, wheat, soybeans, and carrots). Row cropland comprises approximately 61% of the U.S. NCREIF Farmland Index.
- Permanent cropland is land cultivated with crops that occupy the land for long periods and do not need to be replanted each year (e.g., fruit trees, nut trees, vines, and cocoa). Permanent cropland comprises approximately 39% of the U.S. NCREIF Farmland Index.

Investors in farmland typically lease land to local farmers or agricultural corporations who use the land for crops and livestock. Therefore, farmland produces a steady cash flow stream based on lease payments, and not tied to a particular growing season.

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There are two key risks associated with farmland ownership.

1. ***Agency risk***
   - This is economic dispersion resulting from the agent (i.e., local farmer) not acting in the principal's (i.e., owner's) best interest (i.e., not maximizing the owner's economic benefits).
2. Political risk
   - This is economic uncertainty resulting from changes in government policy that may affect returns. It results when governments fail to take favorable actions or enact policies that have adverse effects (e.g., terminating subsidy payments for crops, ending ownership rights, or confiscating land).

Farmland differs from timberland in a number of ways.

1. Less flexible harvest schedule
   - Farm crops are harvested annually, usually within a few weeks to prevent the crop from spoiling. In contrast, timber can be harvested at any time after reasonable growth of the trees and the harvesting can be timed to take advantage of better pricing.
2. *S*horter growth cycle
   - Farmland has a shorter growth cycle between seeding and harvesting (e.g., one year). This provides annual cash flows and a valuable multi-purpose option (to plant different crops) not available with timberland.

DEMAND AND SUPPLY FACTORS OF AGRICULTURAL PRODUCTS

Future demand for agricultural products may be driven by three factors.

1. Global population growth
2. Rising incomes (leading to changing diets) in emerging markets
   - As personal wealth and disposable income increase, dietary habits tend to change to more consumption of agriculturally more intensive food products (e.g., animal proteins such as meat) and higher-value horticultural crops (e.g., fruit, vegetables, seeds, and nuts). This in turn increases demand for animal feed grains (e.g., corn and soybeans) and for land and infrastructure needed to produce horticultural crops, and production of feed grains requires more land than production of the same calories consumed in plant form.
3. Increased use of agricultural products in non-food-based end uses (e.g., biofuels)
   - Biofuels are fuels (e.g., transportation fuel) produced using agricultural products with food value (particularly corn and sugar). A significant amount of U.S. land is used to produce corn destined for ethanol plants.
   - Some controversy exists about the effect of biofuel production on food prices, particularly when commodity prices are high, and increased use of biofuels has created additional pressure on productivity. However, production of biofuels from non-food agricultural products (e.g., corn stalks) has not been successful.

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Future supply of agricultural products may be driven by three factors.

1. Changing agricultural yields
2. Changing quantities and qualities of agricultural infrastructure (including irrigation, transportation networks, and processing)
3. Quality of land under cultivation and/or changing use of aquaculture.[7]

Growth in agricultural yields, particularly in developed countries, is due to four key advances.

1. Improved technology (including advancement of seed stock through plant breeding and transgenic modification)
2. Improved agronomy (i.e., science of soil management, cultivation, and crop production and utilization).
3. Increasing use of inputs (e.g., fertilizer)
4. Increasing use of capital assets (e.g., machinery and agricultural infrastructure)

The primary economic function of agricultural infrastructure is to increase productivity of the agricultural value chain.

FARMLAND INVESTMENT – BENEFITS AND DISADVANTAGES

Farmland investment provides three key benefits.

1. Inflation hedge
   - Farmland provides an inflation hedge since it is a real asset; it is linked to food and energy production and prices.
2. Diversification
   - Farmland provides a diversifying return source since it is subject to distinct physical and economic dynamics and, in the short term, is not directly linked to financial markets.
3. Constrained supply
   - The supply of farmland may be more constrained than the demand for agricultural products.[8]

Farmland investment has three key drawbacks.

1. Illiquidity
   - Farmland, like other real estate investments, is illiquid and may have exposure to natural disasters.
2. High transaction costs
   - Farmland ownership is exposed to high transaction costs associated with searching for, buying, and selling farmland; with sales of farmland being made through brokers who charge fees of 3%-5% of the sales price for negotiating the sale.
3. Agency costs
   - Farmland ownership may have high levels of agency costs.

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[7] Aquaculture refers to breeding and harvesting animals and plants in water environments.

[8] The rationale here is that the supply of farmland is constrained in comparison to the demand for agricultural products, which is not constrained (e.g., due to increasing population growth); and the relatively limited supply of farmland results in pressure for farmland to appreciate in value.

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FARMLAND – WAYS TO GAIN EXPOSURE

Institutional investors have three primary ways to access agricultural asset returns.

1. Direct ownership of farmland for lease income
2. Direct ownership of listed equities in agricultural firms or via pooled funds
3. Long positions in agricultural futures contracts or similar financial derivatives
    - This use provides exposure to agricultural prices, not directly land prices, and thus may not be highly correlated with farmland values.

There are several stock indices that track the agribusiness industry and provide access to publicly traded pools related to agriculture and farmland, which vary in their exposure to publicly traded companies in four areas within the agribusiness industry.

1. Agricultural products
2. Seed and fertilizer
3. Farm machinery
4. Packaged foods

The VanEck Vectors Agribusiness ETF (with ticker MOO,), which began trading in August 2007, holds a portfolio of globally diversified agribusiness stocks. Publicly available REITs with farmland include Gladstone Land (LAND) and Farmland Partners

VALUE AND IMPORTANCE OF ASSETS WITH MULTIPLE PURPOSES

Given that the value of farmland is driven by the profitability of its agricultural use, which in turn is related to commodity prices and farming expenses, farmland that can be used for multiple purposes (e.g., to grow different crops) is less affected by unexpected increases in supplies of crops and is, thus, more valuable than one-crop farmland. The value of the multiple purposes of farmland is driven by three factors.

1. Similarity of the crops' profitabilities
2. Volatility of the crops' profitabilities
3. Lack of correlation between the crops' profitabilities

For instance, if corn and soybeans are the two main crops suitable for a farmer's land and equipment, the option to plant one crop or the other has high value if the following occur.

1. Each crop is at least periodically the best choice.
2. The profitabilities of corn and soybeans vary significantly over time.
3. The profitabilities corn and soybean are mildly or negatively correlated.

In other words, having several viable crops with volatile and uncorrelated prices is a valuable option.

However, in regions that specialize in one crop (since other uses of the land have lower profitability), the option for alternative uses has little value and the multiple-purpose option is considered to be OTM. In this case, farmland is best characterized as an ITM single-use option.

In addition to different agricultural uses, farmland may also be used for non-agricultural purposes, such as development and mining of natural resources. In fact, multiple-use options are most valuable when they include both agricultural and non-agricultural uses due to the low correlation in the profitability of the different uses.

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L.O. 3.1.5 **DEMONSTRATE KNOWLEDGE OF CONTAGION, PRICE INDICES, AND BIASES IN REAL ESTATE VALUES.**

SMOOTHED RETURNS VS. MARKET RETURNS

Earlier discussion implicitly viewed market prices as true indicators of risk and return and appraisals as flawed indicators that underestimate true risks. However, there is debate regarding the reliability of market prices versus appraisals of real estate assets. The question is whether the substantially higher volatility of market prices of listed real assets compared to the volatility of appraisal-based prices reflects true changes in the value of the real assets or whether it reflects trading conditions in the equity markets. For instance, if equity market prices, including real asset prices, experience a broad, substantial decline, do the losses of real asset values accurately reflect actual reduced value or do they overstate true losses? This L.O. discusses this concept: whether listed real assets accurately reflect risk or amplify risk.

RELIABILITY OF MARKET PRICES VS. APPRAISAL-BASED DATA

Market data is presented in Table 2 as NAREIT (publicly-traded real estate held in REITs) daily closing prices and appraisal data is presented as NCREIF Property Index (NPI) quarterly returns (of U.S. commercial real estate).

- The market data indicates that the global financial crisis began driving down real estate prices in February 2007, the decline in real estate values lasted 25 months, and the total decline over the 25 months was 73%.
- The appraisal-based data indicates that a significant decline in real estate prices began on 30 June (more than a year after the market data), the decline in real estate values lasted only six quarters, and the full decline was only 24%.

Since REITs are typically highly leveraged (in contrast to unleveraged NCREIF properties), the difference in leverage may explain the difference in the size of the declines during the financial crisis. However, the timing of the declines is the key factor in distinguishing between the information being signaled.

	Market Data (NAREIT)	Appraisal Data (NCREIF)
Date of pre-crisis high	Feb. 2007	30 June 2008
Date of subsequent low	March 2009	31 December 2009
Duration of decline	25 months	6 quarters
Size of decline	−73%	−24%

Table 2: Market Prices and Appraisals during the Global Financial Crisis

The data clearly indicate different results from listed equity markets and from appraisals. However, reliability of the data is not known: did U.S. real estate values actually decline in these two time periods (Feb. 2007 to March 2009 or June 2008 to Dec. 2009), did U.S. commercial real estate sales prices begin to decline in 2007, and did unleveraged U.S. commercial real estate decline only 24% from the peak to the trough of the financial crisis? While there is no consensus, the result that is evident is that appraisal-based indices indicated declines on a delayed basis. In retrospect, market prices of U.S. equity REITs appear to have been driven at least in part by contagion.

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CONTAGION

Contagion refers to the tendency of major market moves (especially declines in prices or increases in volatility) to be passed from one financial market or sector to other financial markets or sectors. The high volatility of listed real asset prices may be due to temporary contagion effects from other listed securities (e.g., equities of operating firms listed on the same exchange) rather than an indicator of true volatility in the underlying property values.

The question of whether listed prices overstate underlying volatility due to contagion effects or appraised prices understate underlying volatility due to smoothing may be addressed with the definition of "fair market value" measured by appraisers. The definition is "the amount of cash that a property would bring if exposed for sale in the open market under conditions in which neither buyer nor seller could take advantage of the exigencies of the other…".[9]

- For instance, a liquidity crisis may cause property owners desperate for cash to sell their properties at deep discounts. However, this information would not be included in appraisals of the properties.
- In contrast, actual transaction prices would incorporate liquidity crises and are possibly a more reliable source of real estate returns in this situation.

These types of events clearly affect the values at which assets can be sold.

The next L.O. presents estimates of historical returns and volatility for appraised values of timberland and farmland.

L.O. 3.1.6 **DEMONSTRATE KNOWLEDGE OF OBSERVATIONS REGARDING HISTORICAL RETURNS OF TIMBERLAND AND FARMLAND.**

Note: In several Readings/sections of the curriculum, historical returns of different assets and strategies are presented in the following format.

1. Key observations of returns that are consistent with economic reasoning
2. Historical risk and return statistics
3. Histogram of returns
4. Graphs of maximum drawdowns, rolling 5-year returns, volatility, beta, correlation, Sharpe ratio, and Jensen's alpha.

For the exam, candidates should know the key observations regarding returns (i.e., #1 above). #2 is provided here for informational purposes. Some key results from #s 2 and 4 are included in #1. Since the graphs do not further comprehension for exam purposes, we include them only in this Reading for illustrative purposes so that you can see their layout and details.

You are not expected to memorize specific performance data (e.g., x% mean for Timber). However, you should know general characteristics of returns (e.g., whether skewness is positive or negative, or excess kurtosis is high or low) and general rankings of risk and return of strategies relative to those of equities.

[9] Assessors' Handbook, State of California Board of Equalization.

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This L.O. reviews quarterly returns of timberland and farmland observed from the first quarter of 2000 to the last quarter of 2024.

KEY OBSERVATIONS OF TIMBERLAND & FARMLAND RETURNS CONSISTENT WITH ECONOMIC REASONING

Key observations of timberland and farmland returns that are consistent with economic reasoning (and consistent with and driven by the use of appraisals for valuations) are presented in Table 3. The assets' return volatilities are artificially low due to their highly smoothed returns. Artificially low risk measures should be adjusted before they are used in asset allocation models.

	Return Observations[10]	
	Timberland	**Farmland**
Volatility	Low vs. world equities	
Sharpe ratio	Attractive (> 1)	Very attractive (~1.5)
Skewness	Positive	Markedly positive
Excess kurtosis	Markedly positive	
Maximum drawdown	Very mild (–6.5%)	Very small (–0.1%)
Clustering around mean	Tight	

Table 3: Key Timberland and Farmland Return Observations (Jan. 2000 - Dec. 2024)

A histogram of timberland monthly returns is displayed in Figure 3.

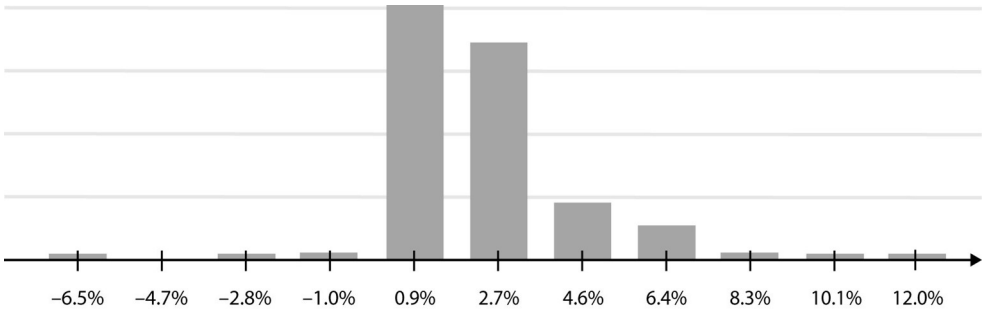


Figure 3: Histogram of Timberland Monthly Returns

[10] For brevity, we use "<" and ">" symbols in the return observation tables to denote "less than" and "greater than", respectively. Comparisons of returns are made relative to world equities.

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