Applied Risk Management: Valuation of Derivatives under AI and Data Science Technologies

Introduction to Risk Management and Derivatives

- *Data Science in Risk Management*
- *Risk*
- *Historical Taxonomy of Risk*
- *Derivative Markets*
- *Derivative Instruments*
- *The Role of the Derivative Markets*
- *Derivative Market Size*
- *Derivative Instruments*
- *Contemporary Regulatory Issues*
- *Risk Management: A Career Choice*

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Sixth Edition

Supported by:
WinORSe-AI

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Part I: Financial Assets and Risk Management

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Introduction to Risk Management and Derivatives

Risk has a significant impact on the human experience. Some individuals take more risks than others, whether it comes to financial planning, daring sports activity, or dating. But, neuroeconomists have linked several socioeconomic and demographic factors with the degree to which the individual can tolerate risk (Gaudecker et al., 2011). Every time you confront a decision with an uncertain outcome, you essentially enter the equivalent of a scientific experiment. An experiment where the brain can change and adapt due to experience. Neuroscience refers to this ability as neuroplasticity (brain plasticity). The brain demonstrates its adaptability by creating new neural pathways to accommodate the evaluation of risky decisions. We introduce the risk management principles applied to financial markets from this perspective.

This introductory Chapter of **A**pplied **R**isk **M**anagement: Valuation of **D**erivatives under **A**I and Data Science **T**echnologies, or ARMDAT, establishes the book's framework for studying risk mitigation using financial derivative securities and products. As we begin the journey, it is helpful to note that the ARMDAT presentation is intended for student learners interested in a ubiquitous and experiential learning experience that involves using both the book and topic-specific application software in the global derivatives community. In that regard, the ARMDAT presentation is specifically designed to consider the impact of Artificial Intelligence (AI) on risk and financial derivative management (see [Amplification](#) of a derivative on Wikipedia). The approach is not restricted to a narrow space. On the contrary, the presentation incorporates the latest thinking from the Association to Advance Collegiate Schools of Business (AACSB). According to a recent AACSB report on "*Technologies with the Potential to Transform Business and Business Education: Artificial Intelligence,"* Artificial Intelligence can be utilized in four ways: (1) as automated intelligence, (2) as assisted intelligence, (3) as augmented intelligence, and (2) as autonomous intelligence. ARMDAT integrates AI and the study of financial derivatives in a manner that exploits some, if not all, of these AI-based contributions. However, implementing AI models without grasping the full power of AI can lead to unexpected or even disastrous results. ARMDAT presentation adds a detailed introduction to "Explainable AI" (XAI) to bring trustworthiness to the AI predictions. Why must you extend your understanding of AI applications to include XAI? For an expert opinion, see [Why neural net pioneer Geoffrey Hinton is sounding the alarm on AI](#).

Against this backdrop, the chapter discussion begins with a formal introduction the field of Data Science. Understanding, the process of planning, organizing, managing, and evaluating the activities associated with live "Big Data" is crucial. We then introduce the derivative trading markets and the overlay of regulation that guides and controls the functioning of these markets. Next, we present the different instruments traded in these markets. We conclude the Chapter by examining professional opportunities and discussing career choices for the student learner.

Data Science in Risk Management

Before starting the formal presentation, let's get a formal definition of data science from ChatGPT, a generative artificial intelligence model.

Figure 1: ChatGPT on Data Science

ChatGPT 4.o: **What is Data Science?**
ChatGPT response (abbreviated and with Grammarly updates):
Data science is an interdisciplinary field that involves extracting insights and knowledge from structured and unstructured data. It combines statistical techniques, mathematics, programming, and domain expertise to understand and analyze data. The focus of data science centers on:
--- Collecting, processing, and cleaning data
--- Exploring and visualizing data to derive insights.
--- Creating models that explain phenomena or predict outcomes
      using statistical and computational methods.

Next, we define some often-used terms in data science (Table 1) that a data scientist would encounter.

Table 1: Glossary of Terms

Term	Definition
Artificial Intelligence (AI)	Computer science is responsible for creating machines or systems capable of performing tasks that typically require human intelligence, including reasoning, learning, problem-solving, perception, and language understanding.
Generative AI (GenAI)	GenAI learns using AI algorithms to learn from existing data and evidence and then generate new, realistic data and evidence that reflects the characteristics of the input. As a result, it can create various novel content, including generative data, images, video, music, speech, text, codes, product designs, and software code. Today, generative AI most commonly creates content in response to natural language requests (LLM) — it doesn't require knowledge of or entering code.
Ethical AI	Merriam-Webster defines ethics as "*a set of moral principles: a theory or system of moral values.*" Moral values help us discern between right and wrong. Most academic researchers leverage the Belmont Report to guide experimental research and algorithmic development, even for AI models. IBM defines Ethical AI as a multidisciplinary field that studies how to optimize AI's beneficial impact while reducing risks and adverse outcomes. See more at https://www.ibm.com/topics/ai-ethics.
Hallucination	AI can sometimes generate inaccurate or misleading information, a phenomenon known as "hallucination."
Machine learning (ML)	A subset of AI that focuses on algorithms and models to learn patterns and make decisions or predictions from data without being explicitly programmed for a specific task.
ANN	Artificial neural network

AI and GenAI

Artificial Intelligence (AI) is no longer considered a new phenomenon. AI technology is already deeply ingrained in the financial service sector. Some argue that AI has already taken a toll on Wall Street jobs. According to Opimas (http://www.Opimas.com), by 2025, AI technologies will reduce the number of employees in the capital markets worldwide by 230,000 people. A lower-IQ form of AI replaces process-oriented jobs where small software programs perform simple tasks like looking up a document or a piece of information. More analytical jobs in finance will continue to fall victim to machine learning (ML). These AI methods can quickly digest large volumes of real-time data and learn to find telling patterns with a speed the human brain cannot match. These trends have implications for front-office jobs and risk management employment. But there is good news – AI will also create new jobs that are more than entry-level ones. Let's present some relevant questions to put the discussion in a learner context.

- What do I need to know about AI?
- What are the ethical considerations in higher-ed and professional employment?
- How are students using AI tools, and how can I partner with fellow students?
- Do I need to rethink exams, papers, and projects I assign?
- How do I redesign my courses in the wake of AI disruption?
- What other AI tools or capabilities are coming, and how can I prepare for them?
- How will AI tools affect the courses in financial derivatives?

We begin by clarifying the concepts of AI vs GenAI. SearchUnify has provided a very detailed definition of both (Figure 2).

Figure 2:
AI v/s
GenAI

Traditional AI	Basis of Distinction	Generative AI
Utilizes pre-defined rules and patterns.	Approach	Creates original content and responses.
Often trained using rule-based approaches, these AI models may struggle with answering queries outside of these set rules.	Training basis	Leveraging extensive large language models (LLMs) on huge amounts of data, Gen AI offers domain-specific functions.
Limited ability to learn and evolve, especially when new types of cases emerge.	Adaptability	Learns and adapts over time through continuous learning of support interactions.
Provides consistent but less dynamic responses.	Response Quality	Has the ability to have human-like conversations.
Faster setup due to fixed patterns.	Learning Speed	May take longer to train initially.
Pre-defined rules determine the sentiment of text, to classify it as negative, positive, or neutral.	Sentiment Analysis	Prompts and transfer learning to enhance performance, and enable domain-specific adaptability and sentiment patterns.
Easier to scale with existing frameworks.	Scalability	May require more resources for scaling.
Quite cost-effective to set up and run, but may lag behind in terms of accuracy in the long term.	Cost-effectiveness	Requires upfront investment for graphics processing units (GPUs) but in the long run, it proves beneficial.
Lesser privacy concerns due to data use.	Privacy	Potential concerns due to data usage.
Pre-determined responses that may sometimes miss the mark of personalization.	Personalization	Offers highly tailored interactions, that lead to hyper-personalized and effective support.

Source: www.searchunify.com

GenAI in Finance

This course will use GenAI models such as ChatGPT to provide definitional clarifications. However, GenAI models are used in many finance applications, as shown in Figure 3 below.

Figure 3:
GenAI in
Finance
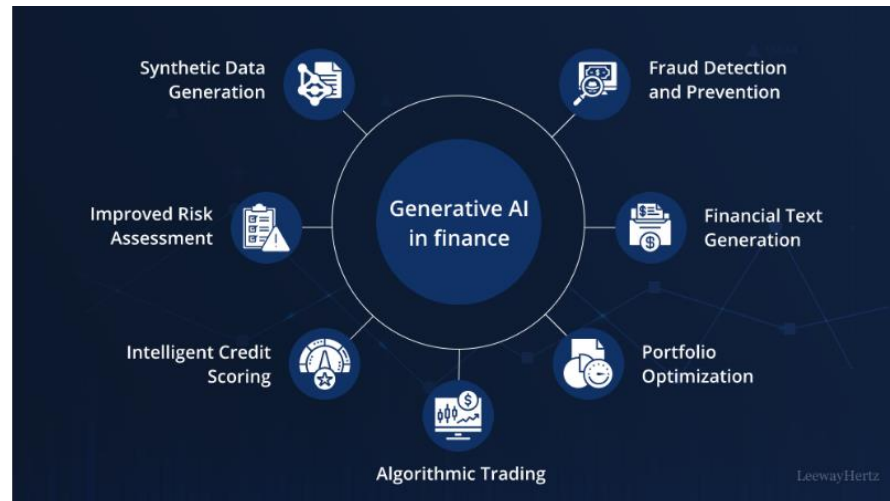
LLMs: Hype and Reality

As we enter into the more technical developments that form this Chapter, the intense interest in using Gen AI, especially LLM (Large Language Model), requires a bit of a reset. Understandably, the contemporary analyst wants to join the crowd embracing this new technology. The ARMDAT use of LLMs encourages financial econometricians and decision-makers to think critically before trusting complex evaluations to single-query (vs. multiple-query) LLM responses. The natural language human-computer interface that simplifies your use of these powerful methods may obscure the identification of other complexities in the overall modeling process.

One of the more intriguing decisions you encounter when considering LLMs is the technique selection decision. The choices may be viewed as 'Use Case' families. Consider the 12 Use Case Families of Gartner (https://www.gartner.com/en) shown in Figure 4.

Figure 4:
Typical AI
Use Cases
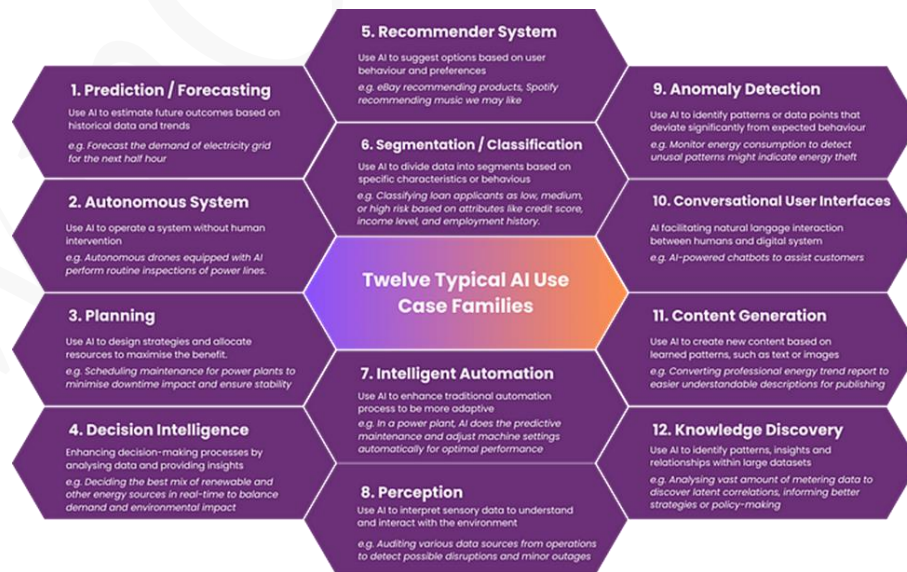
Source: Tao, Christopher, "*Do not use LLM or Generative AI for these use cases,*" Towards AI, 2024

For the Prediction / Forecasting and Segmentation /Classification use cases, the ARMDAT presentation extensively introduces LLMs and supervised learning techniques. However, ARMDAT will demonstrate how these two use cases are best modeled outside the traditional LLM natural language format. Why? Because the most accurate data-driven solutions require a bit more modeling knowledge than that contained in the generalized algorithms that underlie LLM approaches. Finally, to promote the ethical use of an AI model, we introduce Explainable AI for the Decision Intelligence use case.

Before we close the discussion of using LLMs in financial analytics, we summarize and abbreviate Diamond and Allan (2024) by listing different queries (prompts) and identifying elements of a good query.

Different Types of Queries

From Table 2, we can summarize the four elements of a good prompt. They are:

- Give the AI a persona
- Delineate boundaries and provide detail
- Provide demographic information
- Define tone

Table 2:
Types of
Queries for
GenAI

Type of Prompt	Description	Example
Open-ended	Produces a creative response	"How can I use a predicted stock return?"
Closed-ended	Produces the equivalent of a yes/no response	"Did the VIX index drop below 40 today?"
Leading	Produces a specific viewpoint	"List the advantages of using a neural network over an exponential smoothing model to predict next-day stock price."
Contextual	Creates a role for the AI to assume or provide background information to set the context.	"As a student in a management team in a portfolio management class, how would you evaluate IBM's past and future financial performance?"
Instructional	Task-oriented, performs a specific action.	"Generate a list of meeting dates for the Open Market Committee of the Federal Reserve."
Conditional	Based on a condition often used for decision-making.	"If today's close of the VIX is lower than yesterday, should I short IBM?"
Exploratory	Choose to explore a topic in depth.	"Analyze the growth prospects of Tesla in Brazil."

ChatGPT

ChatGPT (http://chat.openai.com) is a powerful new language model OpenAI developed in 2022. It is based on the GPT (Generative Pre-trained Transformer) architecture. Versions of the GPT model are constantly updated. ChatGPT is designed

to understand and generate human-like text. The model's primary strength is engaging in interactive conversations with users, hence "ChatGPT." It can understand user queries and provide relevant and coherent responses, making it suitable for chatbot applications and interactive dialogue scenarios. We will use ChatGPT as a vital support tool to enhance critical thinking for derivative security professionals. Critical thinking is a necessary skill that employers look for within their teams and the candidates they seek to recruit. In the study and practical use of derivative securities, critical thinking will help you to analyze received information, draw conclusions from the information, and make better decisions. Critical thinking is essential to efficiently managing risk, trading, and hedging in a complex and dynamic financial marketplace. Here is what ChatGPT had to say about the role of critical thinking for derivative security professionals (Figure 5).

Figure 5: ChatGPT on Critical Thinking

ChatGPT 3.5: **How critical thinking impacts derivative market participants (edited and revised)**

1. Risk Assessment: Critical thinking helps participants assess and analyze the risks of different derivative products. Participants need to understand the complexities of these instruments, their potential for gains and losses, and their correlation to underlying assets. This enables them to make informed decisions and manage risk effectively.

2. Strategy Development: Derivative market participants, such as traders and investors, must develop effective strategies to achieve their financial goals. Critical thinking allows them to evaluate various strategies, consider the pros and cons, and adapt them to changing market conditions.

3. Analyzing Market Data: In derivative markets, a vast amount of data is available, including historical price movements, volatility, and market sentiment. Critical thinking helps participants process and interpret this data to identify trends, patterns, and potential opportunities.

4. Identifying Mispriced Derivatives: Derivative markets can sometimes exhibit mispricing due to market inefficiencies, informational gaps, or behavioral biases. Critical thinking lets participants spot these mispriced derivatives and potentially exploit them for profit.

5. Hedging Decisions: Many participants use derivatives for risk management and hedging purposes. Critical thinking allows them to assess their risk exposure accurately and determine the appropriate derivatives to hedge against adverse price movements.

6. Emotion Control: Emotions can often influence decision-making in the financial markets, leading to irrational choices. Critical thinking helps participants remain rational, objective, and disciplined, reducing the impact of emotional biases on their trading and investment decisions.

7. Evaluating Counterparty Risk: In derivative transactions, participants often deal with counterparties, and assessing their creditworthiness is crucial. Critical thinking aids in evaluating the financial stability and reliability of counterparties to minimize the risk of default.

8. Compliance and Regulation: Derivative markets are subject to various regulatory frameworks, and participants must adhere to compliance rules. Critical thinking helps participants understand and comply with these regulations to avoid legal and financial consequences.

9. Scenario Analysis: Derivative market participants must anticipate different market scenarios and their potential impact on their positions. Critical thinking allows them to perform scenario analysis and stress testing to assess their portfolio's resilience.

What is Machine Learning

We expand on the definition of machine learning using ChatGPT (Figure 6).

Figure 6:
ChatGPT
on Machine
Learning

ChatGPT 4.o: **What is Machine Learning?**

ChatGPT response (abbreviated and with Grammarly updates):

Machine learning is a subset of artificial intelligence (AI) focused on developing algorithms that allow computers to learn from data and make predictions or decisions without being explicitly programmed for a specific task. The focus of ML centers on:
- --- Building models that improve over time as they are exposed to more data.
- --- Developing algorithms like supervised learning (e.g., regression, classification), unsupervised learning (e.g., clustering), and reinforcement learning.
- --- Model training, evaluation, and optimization.

Machine learning is often one of the techniques used within data science, specifically for predictive modeling and automation of tasks.

In summary, data science is a broad discipline that analyzes and interprets data. In contrast, Machine Learning is a tool within the AI discipline focused on using algorithms to build predictive models based on data.

Risk

To the business decision-maker, risk is a numerical estimate of uncertainty. Understanding how decision-makers measure (quantify) a perceived risk is of interest. History argues that the vital component of ethical decision-making is the underlying process by which managers convert uncertainties to quantifiable possibilities. At this point, a statement of the perceived uncertainty is reduced to a measurable form ready for subsequent action. As the study progresses, the ARMDAT presentation identifies and uses financial modeling, intelligent and traditional, to produce unambiguous statement(s) concerning the path to follow to achieve a successful outcome in the face of uncertainty.

Uncertainty → Risk

Traditionally, two types of risks were featured in business decision-making: **business risk** (systematic) and **financial risk** (unsystematic). The consequences of indecision or incorrect quantification of possible outcomes often lead to paralyzing effects for the firm. How is this so? For example, consider the scenario where a global competitor faces today's volatile foreign exchange market (forex). The forex volatility can be attributed to varied sources: Brexit (Britain's exit from the European market), the unexpected victory by Donald Trump in the 2016 presidential election, the attempted 2016 Turkish coup d' état, or other market-affecting events. By employing a management team that understands how to predict, hedge, and otherwise manage international orders in the face of unexpected exchange rate volatility, the firm has its best chance at minimizing the devaluation effect on the dollar revenues occurring from an adverse exchange rate change.

A global view of risk: the Chinese characters to express the dual nature of risk.

風
險

The first symbol expresses "risk or danger" in the context of business venture or the risk you might take when investing in the stock market. The second holds the meanings of "dangerous and rugged." It is an expression of gambling, or the taking of extreme risks.

Lastly, we might point to a portfolio manager for a relevant example of why risk management is essential. Consider the manager of an equity-based portfolio who faces the risk of a meaningful decline in stock prices. He needs to know how to cope with the expected decline in value. The most astute portfolio managers learn to hedge their views by creating hedge fund portfolios. Although we have not defined or explained the concept of a hedged portfolio, it is sufficient to state that it is a portfolio where the manager has introduced financial instruments designed to offset any negative trend in the held equity securities. By advancing to the use of a hedge portfolio, the fund manager faces a new opportunity and a new risk.

On one hand, it is good to know that financial risk can be offset. On the other, there is a need to understand an additional source of variability belonging to the hedging instrument. It is this latter topic that commands our attention in this textbook.

Our discussion brings us to the interesting question: how does the ARMDAT book define and use the word risk? As we progress with the presentation, it will become evident that a simple definition of the word 'risk' will not support the totality of our learning objectives. A simple definition would undoubtedly facilitate our task. Still, it is impossible to reduce the study of risk to a static or straightforward concept across

the dynamic finance systems in the global markets. Instead, we will benefit by treating the definition of risk as an ongoing and evolving process driven by any number of complex interactions in the global economy. With this thought in mind, we begin the study of risk by setting a foundation for an appropriate description and definition.

Risk and ARMDAT

In financial decision-making, it is not uncommon for the decision-maker to link the probability of an event occurring with the consequences of the event itself. At this introductory stage of the learning process, let us put energy into 'the containment of the risk management process. ARMDAT defines and elaborates on the key concepts: risk, risk management, risk assessment, mitigation, and contamination.

› Risk assigns a probability to a threat vulnerability that has escalated to a hazard. It is a dangerous level capable of producing meaningful adverse outcomes.

› Risk assessment represents deciding the hazard to the desired outcome(s) associated with a decision-making choice.

› Risk management is a contemplated set of actions that result in a sustainable business and operating environment.

› Risk mitigation represents the collection of actions that, when taken together, help to reduce the vulnerabilities to disastrous outcomes. In practice, one defines a *risk mitigation period* during which the collection of actions is valid.

› Risk contamination is a process whereby a failing or depreciating asset depletes the value of an otherwise healthy asset. In finance theory, this is better known as financial contagion.

The rewards for learning how to identify, measure, and mitigate risk usually result in positive outcomes – outcomes that can be significant when compared to the naïve or do-nothing approach. We can argue that competency in risk management skills is often associated with managers who are better positioned to experience innovation and accept sophisticated decision-making alternatives.

Risk and Artificial Intelligence Models

Artificial Intelligence (AI) methodologies have been widely adopted across academia and the business community. The pursuit and deployment of AI is growing from trading companies to retail organizations. Today, AI modeling systems predict stock and commodity prices, make credit decisions, and 'explain' outcomes. In subsequent chapters, the ARMDAT presentation makes substantial use of ANNs to understand risk in asset price forecasting better, devise optimal hedging strategies, and compute AI stock betas. In the study of derivatives, emergent technologies utilizing ANNs, machine learning, and other novel techniques are becoming the new standard prediction risk management and optimal equity portfolio management (Gu, Kelly, and Xiu, 2019; Kelly and Pedersen 2020). Here, we mention how the widespread use of AI has also resulted in several new fields of study that explain these AI models.

Neuroinformatics

One goal of using AI more extensively is to exploit biases in massively large data structures. While the models and discussion presented in ARMDAT lend themselves to large data sets, the objective of this course does not extend to this application. Instead, we briefly mention that this deployment type is part of the growing field of neuroinformatics. Neuroinformatics deploys novel and emergent technologies on

large-scale data collection and analysis to understand biases in data that can be replicated and perpetuated.

Neuroeconomics

With an emphasis on brain science, AI is interconnected with the interdisciplinary field of neuroeconomics. Neuroeconomics relies upon neuroscience studies to explain human decision-making. Economists, biologists, psychologists, and social scientists employ neuroeconomic studies to understand how individuals approach decision-making. Inside ARMDAT, the study of neuroeconomics is engaged to help risk managers tackle risk in complex decision-making problems.

Explainable AI.

Explainable AI is a set of tools and frameworks used to understand and interpret the predictions made by AI models. The goal is to increase the transparency of the AI models and build trust in the AI model's prediction. In ARMDAT, the student will be exposed to the Shapley Value, a widely used explainable AI model. The Shapley value is named after the Nobel Prize-winning mathematician Lloyd Stowell Shapley.

Risk in a Sustainable World

Apart from identifying and discussing sustainable finance, the ARMDAT presentation explores alternative approaches to managing and reducing various sources of risk associated with sustainable activities. You may ask, "*Why sustainability in a risk management book?*" Sustainability in finance offers hope that the study of financial risk-and-return concepts can facilitate meeting an economy's needs without compromising the ability of future generations to meet their needs. Financial crises reveal weaknesses and, subsequently, cause industry-wide reflection. After the financial crisis of 2008, a focal point emerged. The financial community realized there are definite limitations to maximizing profit without a plan to assure long-term stability and sustainability.

ESG Risk

ESG is the acronym that describes firm performance effects from adaptations to *environmental*, *social*, and *governmental* policy factors. Table 3 provides a categorization of some of the more recognizable impact dimensions.

Table 3: ESG Sustainable Impact Dimensions

Environmental	Social	Governance
Environment Policy	Human Rights	Corporate Governance
Environment Performance	Labor Standards	Code of Ethics
Climate Change	Health and Safety	Bribery and Corruption
Nuclear Energy	Employee Development	Death Penalty
Biodiversity	Supply Chain Standards	Military Expenses

Source: Invesco, Vigeo Eiris, https://www.invesco.com/corporate/about-us/esg

Is this the only recognized definition of the ESG domain? As the world settles on a need to generalize a formal definition as your authors, we asked ChatGPT (http://chat.openai.com) to provide "a definition of the term ESG." Figure 7 displays the response from the open AI resource.

Figure 7: ChatGPT response to "ESG Definition"

> ESG stands for Environmental, Social, and Governance. These three categories encompass the three central factors that investors and analysts use to measure the sustainability and societal impact of a company.
>
> Environmental factors include a company's impact on the natural world, including issues like climate change, natural resource depletion, and pollution. Social factors include a company's impact on society, including issues like labor practices, human rights, and community relations. Governance refers to a company's leadership, executive pay, and the overall structure of the organization.
>
> The term ESG has gained increasing attention in recent years as investors have become more interested in the long-term sustainability and ethical performance of the companies they invest in. Many investors believe that companies with strong ESG ratings are more likely to be financially successful over the long term, as they are better positioned to manage risks and opportunities.

As indicated in the last part of the ChatGPT response, investors and firm managers alike are known to ponder the question of what impact, if any, ESG organizational goals have on a firm's value. Cho et al. (2019) examined the relationship between corporate social responsibility (CSR) performance and corporate financial performance. The authors support the hypothesis that CSR performance positively affects financial performance. Additionally, CSR activities are investments that can enhance both corporate performance and value. Earlier in this contribution, the relationship between firm size and sustainability was also reported in the literature by Tarmuji et al. (2016). The research said that investors preferred firms that improved their ESG practices. The investors in the study also believed that ESG-oriented firms perform best at asset deployment and generating risk-adjusted market returns.

Modernized portfolio managers increasingly seek to reconcile behavioral biases during asset diversification. With financial analysts swarming to consider ESG dimensions in the portfolio diversification process, ESG goals now represent behavioral bias – *affinity bias*. Given the myriad of public and proprietary firm-level ESG scores, deciding how to incorporate ESG dimensions in behavioral portfolio management (BPM) is not so straightforward. New ESG factors derived by Dash and Kajiji (2020) demonstrate how to use financial networks and traditional portfolio optimization models with layered goals to manage the BPM problem. In practice, managing ESG-related risk through efficient diversification and risk mitigation using financial derivatives produces longevity in achieving risk-mitigated growth.
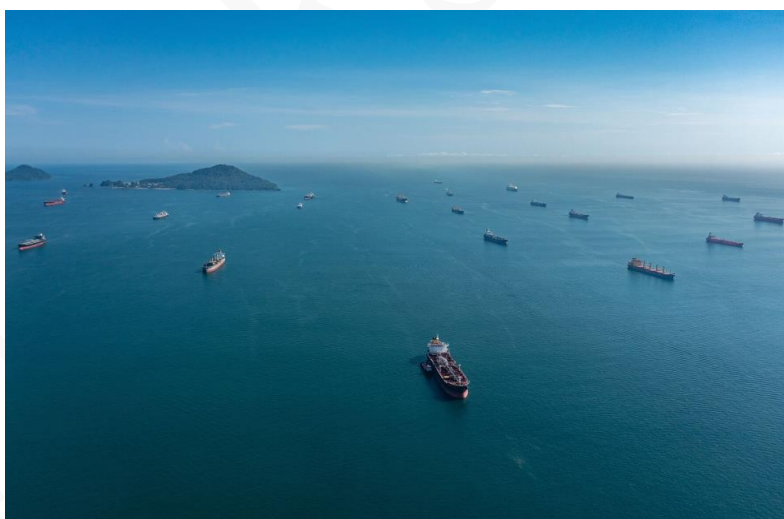
Climate Risk
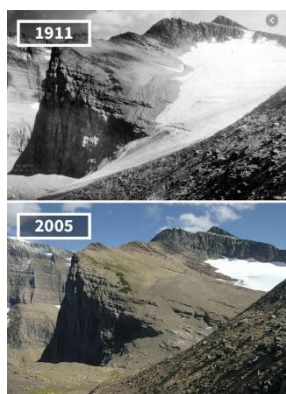
Does climate change pose a risk to firm performance? Responding to a question at the 2019 G7 meeting, US President Donald Trump said, "…*American wealth is based on energy, and he will not jeopardize that for dreams and windmills.*" Accordingly, the US exited the 2015 Paris Climate Accord and declared global warming a "hoax," However, the financial markets expressed a degree of nervousness about future firm performance. The financial market expresses uncertainty about the unknown impact of warming oceans, higher sea levels, increased greenhouse gasses, more frequent and severe weather, higher wildlife extinction rates, and other manifestations of climate change. With a fast-forward move of the timeline to the beginning of 2024, the nervousness expressed by financial markets proved well-founded. On 05-Jan-2024, the Bloomberg Green Daily newsletter reported the following:

At specific points in the ARMDAT presentation, we explore some of the latest ways to

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There's no better way to see how climate change can choke global trade than a visit to the Panama Canal…The drought-stricken waterway, which handles $270 billion a year in global trade, is in trouble. With water levels languishing at six feet (1.8 meters) below normal, the canal authority capped the number of vessels that can cross to just 24 — from the usual 38…Its travails are just part of a wider story about how global warming is altering the flow of goods around the world.

Source: www.bloomberg.com

---

mitigate climate risk. For example, Engle et al. (2019) use third-party ESG scores of firms to model (hedge) climate risk exposure using a novel approach.

A more detailed examination of climate risk would explore the following: carbon, energy, waste, and water risk. ARMDAT introduces sustainable investing, but time considerations limit the further development of each type of risk and associated management issues.

Reputational Risk

Upwards of 63% of a firm's market capitalization is attributable to the firm's reputation. When the firm's reputation is at risk due to the behaviors of aggrieved, dissatisfied, and viscerally charged stakeholders, it is possible reputation attacks can threaten the firm value. Derivative security analysts develop risk-mitigating derivative-based securities to offset value depreciation due to reputational damage. Unlike pre-crisis signaling, acts of corporate social responsibility, and directed marketing communications, derivative securities are a pure market-instrument mitigation strategy.
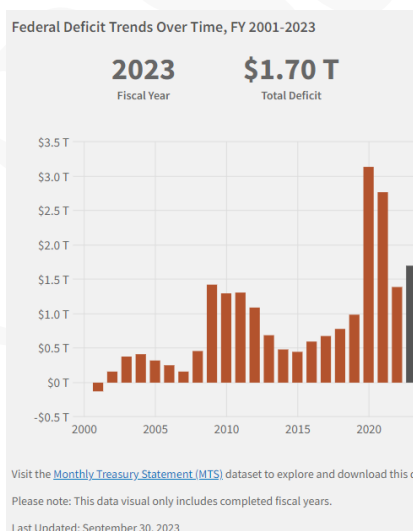
Macroeconomic Risk

Macroeconomic risk describes the impact of macro variables, such as political events, taxation, climate refugees, etc., on the financial markets. The shift in the national and international economic status can affect the individual financial status of states, districts, and regions and the valuation of company assets such as stocks and bonds. Let's look at two of the most recent macroeconomic risks.

Government Deficit Spending

Even before the pandemic, the federal deficit was large by historical standards and projected to rise. The sharp recession and spending increases that Congress and the president approved in response to the pandemic have increased the deficit (Figure 8).

Figure 8: USA Budget deficit

Federal Deficit Trends Over Time, FY 2001-2023

2023
Fiscal Year

$1.70 T
Total Deficit

Visit the Monthly Treasury Statement (MTS) dataset to explore and download this da

Please note: This data visual only includes completed fiscal years.

Last Updated: September 30, 2023

Source: https://fiscaldata.treasury.gov/americas-finance-guide/national-deficit/#us-deficit-by-year

Post-COVID-19, interest rates were extraordinarily low until March 2022. The low-interest rate environment allowed the US to increase the debt burden as the cost of doing so was low. As the second half of 2022 evolved, the Fed began a series of rate hikes that immediately raised the cost of public and private borrowing. Continued government borrowing at higher interest rate levels will eventually dampen economic activity and possibly lower stock prices as consumers and businesses adjust to higher financing costs.

Climate Refugees

A climate refugee is a person who has been forced to leave their home as a result of climate change in their environment. In the previous section, we have already established that climate change is of growing concern. More importantly, it is estimated that by the year 2050, there could be 1.2 billion climate refugees. While most climate refugee syndrome occurs within a country, this is not so often. For example, two category four hurricanes hit Honduras, Guatemala, and El Salvador in November 2020. People poured across the border into Mexico and headed towards the US as torrential rains and landslides meant they lost their homes, livelihoods, and access to clean water (https://www.zurich.com/en/media/magazine/2022/there-could-be-1-2-billion-climate-refugees-by-2050-here-s-what-you-need-to-know).

A Historical Taxonomy of Risk

This section sets the stage for studying "risk" by looking back in time. We are reminded by the great US General George S. Patton that we should *"prepare for the unknown by studying how others in the past have coped with the unforeseeable and the unpredictable."* However, *"To history, human nature must be a stubborn and tiring student. No matter how many times history tries to show it the error of its ways, it never learns from its mistakes."* (Kelseyleigh Reber, *If I Resist*.)

Derivatives matter because they can reduce uncertainty for those investors who find it undesirable. Derivatives provide businesses and investors with a mechanism to increase or decrease exposure to four common types of risk: commodity, stock market, interest rate, and credit. For example:

- A farmer whose crops and profits depend on the cooperation of the weather.
- A pension fund manager who is concerned with maintaining portfolio value during bearish times.
- A Coindesk bitcoin trader subject to presidential tweets (Casey, 2019).

Derivatives cannot change the weather or predict a presidential tweet, but they can change the financial implications of a drought or politically initiated market-changing sentiment.

Table 4 presents a brief annotation of major risk-related events from the mid-1930s. The table recounts at least one significant risk event per decade, resulting in market-wide price volatility across commodities, stocks, interest-denominated contracts, and institutional credit. For more details, see Appendix A.

Table 4: Some Major Risk Events

Year	Event
1933	The US Congress passes the Glass-Steagall Act. The Act prohibited common ownership of banks, investment banks, and insurance companies. Revoked in 1999 the Act slowed the development of financial institutions and fragmented the risk management process.
1952	The Journal of Finance publishes "*Portfolio Selection*" by Harry Markowitz. The first unification of return and variance in the management of investment portfolios.
1973	Myron Scholes and Fischer Black publish their seminal paper on option valuation in the Journal of Political Economy.
1987	"Black Monday." October 19, 1987. The shock waves of the US stock market collapse reverberated globally.
2001	The terrorism of September 11 and the collapse of Enron remind the world that nothing is too big for a failure.
2008	Fannie Mae & Freddie Mac agencies go bankrupt and are absorbed by the federal government. Lehman Brothers filed for bankruptcy after investing in bad mortgages. The bankruptcy was the largest casualty of the credit crisis. AIG receives $85 million in loan guarantees after insuring bad loans and projects.
2008	Investment bank Bear Stearns fails due to excessive leveraging and overweight exposure to junk mortgage-backed securities.

Table 4 (Cont.): Some Major Risk Events

Year	Event
2009	US inflation hits zero, with US unemployment reaching 15% in April. Fannie Mae bailout disbursements reach $59.9B. Freddie Mac bailout disbursements reach $63.1B Quantitative Easing (QE 1) is when the US Federal Reserve expands its control over monetary policy by directly intervening in the short-term bond markets to purchase securities. By March, the FED held $1.75 trillion in bank debt, mortgage-backed securities, and Treasury notes. QE is designed to reduce systemic risk and improve market confidence.
2009-10	US Bank failures skyrocketed to 140 and 157 in 2009 and 2010, respectively, and the "Flash Crash" of 06-May (DJIA falls 900+ pts).
2011	MF Global, a futures and derivatives brokerage, fails after executing ultra-risky and proprietary trades. Former N.J. Governor Jon Corzine led the firm.
2012	In May, JP Morgan Chase admitted losing at least $2B on lousy credit derivative transactions. CEO Jamie Dimon said JPMorgan's trading losses were due to "egregious and self-inflicted mistakes" from trades that were "poorly executed and poorly monitored."
2013	The self-regulatory organization Financial Industry Regulatory Authority (FINRA) reported significant losses nearing $90 million for the second straight year. FINRA is an association of securities dealers – not a government regulator.
2015	The market capitalization for Volkswagen dropped $18.6B in just one day after the company was caught falsifying emissions on certain cars sold in the US. The Clean Air Act allows the EPA to charge up to $37,500 per vehicle for the 482,000 affected cars, or $18B.
2016	• Taketa Airbag flaws and vehicle recalls in the millions • The growth and spread of organized terrorism
2017	• Cyber risk and data breaches • Geopolitical risk (e.g., hard Brexit). • Conduct risk; wrongdoing by high-profile senior personalities.
2018	Exploding risk events: IT disruption, data compromise, financial modeling risk, theft, and fraud.
2019-20	• Data compromise (unlawful encryption and ransom) • Election tampering risk • Talent risk (ability to attract, train, and retain the best) • Model risk • Personal identity risk • Identification and global spread of the Novel Coronavirus
2020-21	• The demise of LIBOR; transition to alternative risk-free rates • On 31-Jan-2020, Britain formally exited the European Union. • Global pandemic: Coronavirus / COVID-19
2021-22	• Post-COVID management of public-private collaboration
2022-23	• The global rise of inflation and enterprise risk management • Cyber attacks, automated malware, and AI privacy risks

Derivative Markets

Two different markets are discussed throughout the book. One is the **cash market,** and the other is the **derivatives market**. The cash (i.e., spot) market is immediate. The spot market is utilized whenever a sale is made, payment is remitted (or credit arrangements have been secured), and the good is delivered. The performance of derivative security does not take place in a disassociated space. All derivatives are linked to an **underlying instrument** (e.g., stock, bond, credit portfolio). The value of a derivative derives directly from the value of the underlying. It is expected to hear – "…*a derivative is written against an underlying.*"

Exchange Markets

Derivatives that trade on organized exchanges are said to be "*exchange traded.*" Option exchanges provide a location and framework for trading standardized options contracts. Exchange-traded derivatives are written against the broadest of topics – from news on climate change to heating-degree days to cryptocurrencies. Two crucial exchanges influence the ARMDAT presentation on options contracts – the CME Group and the CBOE.

CME Group

The history of the CME Group dates back to the founding of the Chicago Board of Trade (CBOT) in April 1848. In July 2007, the CBOT merged with the Chicago Mercantile Exchange to form the CME group. It is the world's largest financial derivatives exchange. The exchange trades various asset classes, including stock indexes, currencies, interest rates, energy, agricultural products, and metals.

CBOE

The CBOT established the Chicago Board Options Exchange in April 1973 as the first exchange to list standardized stock options. The CBOE is the largest US options

exchange, with a trading volume of over 1 billion contracts for options on over 2000 companies. The exchange also offers options written against exchange traded funds (ETFs), stock indices such as the S&P 500 (SPX), Dow Jones Industrial (DJX), Nasdaq Composite (ONEQ), and more. Additionally, the CBOE produces broad market volatility indices. Two of the most frequently used

volatility indices are VIX and VXN. The VIX tracks the volatility in the S&P 500, whereas the VXN tracks the volatility of the Nasdaq 100. The CBOE is regulated by the Securities and Exchange Commission (SEC).

International Exchanges

Options exchanges are some of the more popular places to provide a location and framework for trading standardized contracts. Although not listed in Table 5 below, the CBOE is considered an international exchange.

Table 5: Some International Exchanges

International Options Exchanges	Description
Boston Options Exchange	This automated exchange is also known as BOX Options Exchange. The exchange is operated by TMX Group, a public financial services company (Canada).
Montreal Stock Exchange	A derivatives exchange based in Montreal, Canada. Trades in futures contracts and options on equity instruments.
Eurex Exchange	Eurex is an international exchange that features the trading of European-based derivatives. It is the largest European options and futures market.
NYSE Arca	A popular international exchange for trading stocks and options owned by the International Exchange (Chicago). The trading platform blends open outcry with a trading floor with electronic trading technology.
International Securities Exchange (ISE)	A wholly-owned subsidiary of NASDAQ, the exchange was launched as a fully electronic U.S.-based options exchange for equity, index, proprietary index, and FX options.

The Over-the-Counter Market (OTC)

Unlike an exchange, which is a physical location, the OTC is a decentralized market where participants trade directly by using an electronic network rather than a physical trading floor. By the 1980s, a new derivatives era arrived – the age of credit derivatives. This era marked the growth of swaps and other types of complex OTC derivatives (e.g., non-standard option contracts).

The Role of the Derivative Markets

Technological advances in finance and computer science drive the evolution of financially engineered derivative instruments. As the global technological revolution unleashed profound transformations in the financial sector, derivatives became a crucial tool to help facilitate the growth in private capital flows. Derivatives mitigate changes in the risk profiles associated with these flows. Today, derivatives provide three economic functions: a) risk management, b) price discovery, and c) operational efficiency and liquidity.

Risk Management

At its core, risk is the possibility of loss, injury, disadvantage, or destruction. Risk management is a fundamental part of managing the revenue stream from a producing asset. For there to be an environment where it is possible to manage risk, we need a better understanding of the following:

1. Often, the risk results from managers pushing the envelope of their experience (e.g., seeking higher returns from an untested investment strategy).

2. Risk measurement requires the application of standardized and well-known statistical methods.

3. The engineering of an enterprise-wide risk management system is central to achieving consistent institutional risk-adjusted performance.

Price Discovery

How would you like a *'free'* forecast of a market price that is expected to materialize at a defined point in the future (20 minutes, day, week, etc.)? Forward and futures markets provide valuable information about cash or spot market prices. Both markets collect information relevant to the formation of expected spot market prices.

You may be surprised that futures and spot prices contain the same rudimentary prediction information. The information set (of factors) that explain how these prices vary is not always universally understood and may be subject to different interpretations by alternative market professionals. Still, the fact remains that understanding one type of price volatility will assist in explaining the price volatility of other similar market instruments. In short, it is often argued that forward and futures markets provide price discovery.

Operational Efficiency and Liquidity

Previously, we stated that derivatives are inextricably linked to the underlying. It is this linkage that helps investors to achieve greater operational efficiency in day-to-day derivative trading practices. For many years, derivatives presented a lower transaction cost than the costs associated with the underlying. This differential is primarily erased today because of recent trends in electronic markets. Consider a recent posting of transaction costs by Interactive Brokers. In Figure 4, the cost of trading options contracts is presented. The first box shows that trading one contract costs $0.70, with a minimum value per order of $1.00. However, as we will learn in a subsequent chapter, one traditional option contract trades 100 individual options. Hence, the cost per option is 1/100 of the listed amount, a minimum of $0.01. As shown in Figure 5, the cost of trading *US stocks, ETFs, and Warrants*, is now $0.0035 per share, which is

significantly lower. Today, both the derivatives market and the markets in which the underlying trades indicate increasing operational efficiency.

Figure 9:
Cost of Trading
- Options

United States			
Tier	**Commissions**	**Minimum per Order**	**Example**
Smart Routed: <=10,000 Monthly Contracts			
Premium => USD 0.10	USD 0.70 per contract	USD 1.00	1 Contract @ USD 2 Premium = USD 1.00 2 Contracts @ USD 5 Premium = USD 1.40
USD 0.05 =< Premium < USD 0.10	USD 0.50 per contract	USD 1.00	3 Contracts @ USD 0.075 Premium = USD 1.50
Premium < USD 0.05	USD 0.25 per contract	USD 1.00	5 Contracts @ USD 0.03 Premium = USD 1.25

Source: http://www.interactivebrokers.com/en/accounts/fees/commission.php

Figure 10:
Cost of Trading
– Stocks, ETFs,
and Warrants

Volume (per month)[1]:	IB Commission per Share
	US Stocks, ETFs, and Warrants[2]
<=300,000 Shares	USD 0.0035
300,001-3,000,000 Shares	USD 0.002
3,000,001-20,000,000 Shares	USD 0.0015
>20,000,000 Shares	USD 0.001

Source: http://www.interactivebrokers.com/en/accounts/fees/commission.php

Derivative markets also have potentially superior liquidity than the spot markets. Liquidity risk arises whenever a party interested in a trade cannot execute that trade as no counterparty exists that wants to trade the same asset. In the equity markets, for example, the liquidity is relatively high for the securities of major companies. But, even for the securities of large companies, sometimes it is impossible to trade as the markets might need to cope with a growing imbalance between large and small investor transactions.

Derivative Market Size

The news stories of 2008 indeed prove the surging popularity of derivative contracts as a fundamental hedging tool. Worldwide derivative exchanges are some of the most active (Figure 11, left). EconomyWatch reports the derivative markets reached just under $370 trillion by the first half of 2007. EconomyWatch noted that the derivative market size almost quadrupled over the decade beginning in 2000. In the over-the-counter markets alone, the increase was just under 25% in the face value of all derivative contracts for 2007, with equity derivatives reaching about $114.1 trillion. In the fall of 2008, the credit derivative markets took center stage as they became the primary focal point of a severe meltdown for several financial service firms. In 2001, the credit derivatives market stood at approximately $0.7 trillion. By 2008, the credit derivatives market was trading at roughly $52 trillion. Much of this increase was attributed to new synthetic collateral debt obligations that traded alongside more traditional markets using the efficiency of electronic trading systems.

Figure 11: Left: Volume by Markets; Right: Which derivatives are most active in the US?
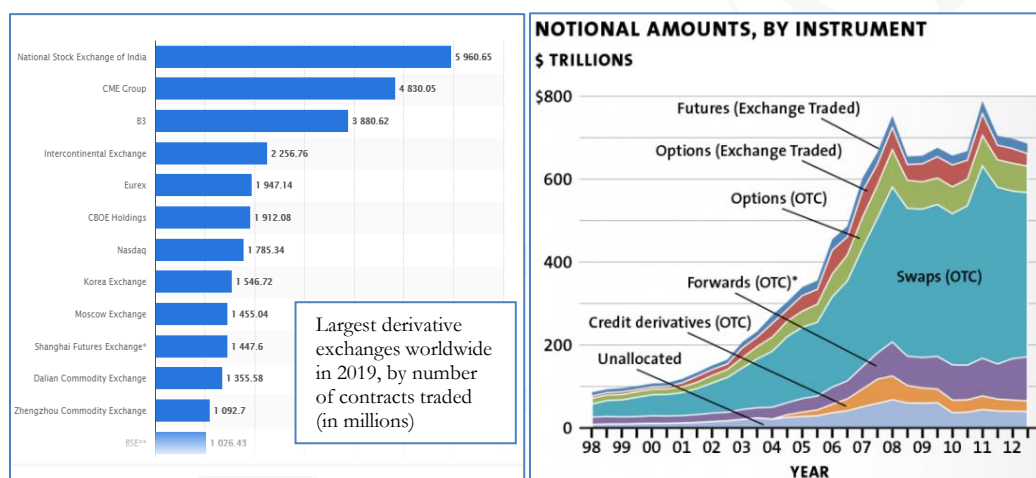
Source: Statista, 2020;   Source: BIS, June 2013

To help visualize the relative importance of various derivative contracts, consider how these contracts are used by insured US commercial banks and savings associations from 2001 through quarter 3, 2012. Reference is made to Figure 11 (right), showing that swap contracts are three times more active than futures and forwards. Options contracts are the next most popular within these depository institutions, followed by a fast and continually growing area of credit derivatives.

The growth in the derivatives market did slow down between 2008 and 2019. But, as of 2020, the derivatives market is estimated at over $1 quadrillion. But this seems to be grossly exaggerated, say some experts. The Bank of International Settlements (BIS) estimated that in the first half of 2019, the notional value of the outstanding contracts was about $640 trillion, a significant jump from the 2007 figure of $370 trillion. They also estimate that all contracts' total gross market value is approximately $12 trillion – a more realistic picture. When narrowing down to the OTC market, the notional value in 2019 was estimated to be its highest since 2014. The notional value of all interest-rate contracts traded on the OTC was estimated at $200 trillion.

But, as the derivative markets have grown, so have the leverage debacles (Appendix B). History now documents several notable and unfortunate cases where derivative contracts were misused.

Derivative Instruments

Option Contracts

An option is a contract between two parties. One party is the buyer, and the other is the seller. An options contract gives the buyer the right, but not the obligation, to purchase or sell something at a later date at a price that is agreed upon today. The option buyer pays the seller of the option contract a price referred to as a **premium**. When the option confers the right to buy something, it is called a **call** option.

Conversely, when the option contract confers the right to sell something, it is called a **put** contract. A call option holder has the right to purchase the underlying (stock, grain, etc.) at an agreed (strike) price. The put states the same, except it is the right to sell.

Exchange-traded option contracts dominate the ARMDAT presentation. The use of standardized terms tightly defines these options. But options traded on the OTC are not ignored! Often, OTC options are tailor-made derivatives. That is, the defining characteristics of these options are not standardized. Is there a market for uniquely specified options? You bet! Tracked by the Bank for International Settlements, look at the growth (and volatility) of the OTC derivatives notional amount. There is a substantial market for derivative instruments that trade privately between two parties.

Notional is the dollar value of the underlying instrument

Case Study – McDonald's Chicken McNuggets

Before introducing Chicken McNuggets, McDonald's found it necessary to hedge against the cost of chickens. An uncontrollable risk in chicken prices could jeopardize the introduction of the new food item. McDonald's research uncovered two primary items determining the cost of raising chickens: grain and water. McDonald's risk management objective was to obtain chicken at a fixed price. The risk management strategy led to the company purchasing a grain option. The strategy gave McDonald's the right, but not an obligation, to buy grain at a known price – the strike or exercise price. The approach ensures that McDonald's is protected against the risk that grain prices may rise. But, risk management is not free. The cost of the grain option resulted in a more considerable cost for the chicken served as nuggets. A hedging strategy always adds expense, but it does reduce risk.

Forward Contracts

As we introduce the forward contract, you will find that the instrument sounds a lot like an options contract. But, there is one essential difference. As previously stated, an option contract carries the right to exercise the contract terms but not the obligation. The requirement is different for a forward contract. The terms of the forward contract must be carried out.

A **forward contract** is a contract between a buyer and a seller to purchase or sell a good (commodity) at a later date at an agreed-upon price. This definition does not confer any decision-making authority to the buyer. The description of the forward contract clearly states that the holder (buyer) of the agreement must be prepared to buy the goods, and the seller must be prepared to sell the commodity on some

specified date at the agreed-upon price on the day the contract was established.

Forward markets lack an identifiable physical facility where trades take place. All trades of forward instruments take place on the over-the-counter market. Hence, it is a market where direct communication among the primary participants is required to execute a contractual relationship. One of the more visible examples of the forward market is that for trading foreign exchange.

Futures Contracts

A **futures contract** is a financial instrument that trades on an organized exchange. Like a forward contract, it is a contract between two parties to buy or sell an underlying commodity at a future date for a price agreed upon today. A futures contract is subject to a daily settlement process by trading on an organized exchange. The settlement requires those investors who have incurred losses to pay them to those investors who have experienced gains in the futures market. This process is essential for maintaining an orderly futures market.

Relatively new to the futures market are Bitcoin futures. The underlying is the cryptocurrency Bitcoin. Cryptocurrency is a secure digital currency that relies on blockchain technology. Spread across many computers, a Blockchain is always decentralized. The underlying technology manages and records transactions. Bitcoin futures enable investors to gain exposure to Bitcoin without taking a stake in the underlying Bitcoin. As a derivative contract, Bitcoin futures allow investors to speculate on the underlying cryptocurrency's future price.

Options on Futures

An essential synthesis between the two derivative security types occurs when an option contract is written against a futures contract. The integration is commonly referred to as a **futures option.** In essence, an option on a futures contract gives the buyer the right to buy (call option) or sell (put option) a futures contract at the exercise (strike) price anytime on or before the expiration of the option. Because futures options differ by the context of the underlying security (a futures contract), it is not surprising to learn that they bear a striking resemblance to traded commodity options—for example, the futures option trades on an organized (futures) exchange like a commodity option. As a hedging instrument, options on futures contracts are not as popular as using standardized futures contracts. Still, the futures option offers an additional degree of risk control. We shall explore this in more detail in a later chapter.

The Exchange-Traded Note (ETN)

An **exchange-traded note** (ETN) is a senior, unsubordinated debt security issued by an underwriting bank (e.g., Credit Suisse). ETNs are listed on exchanges such as the NYSE ARCA, trade like a stock, and provide investor returns by tracking a market benchmark or strategy index. The transaction is achieved by the underwriting bank promising to pay the amount reflected in the index (less the fees on maturity). Although the ETN is not an equity instrument, it shares characteristics of equity as it is traded on an exchange and can be sold short. But, as a debt security, the instrument does not have an ownership share in the underlying. Like equities, ETN values may fall (to zero) if the issuing underwriting bank goes bankrupt. Major issuers of ETNs include iPath (Barclays Bank PLC), BNP Paribas, Deutsche Bank, Morgan Stanley, and Credit Suisse.

Swaps and Other Derivatives

A swap instrument differs in legal and financial structures compared to an option or futures contract. According to some prearranged formula, a **swap contract** involves a private agreement between two parties to exchange one stream of cash flows against another over a future period. The streams of cash flows are often referred to as the "legs" of the swap. Most swaps are traded in the OTC market, which is "tailor-made" for the counterparties. Innovations have produced swaps that also trade in future markets. Swap contracts have become an essential instrument in risk management and control. With swap contracts in interest rates, currency, credit, commodity, and equities, the notional size of swap instruments now measures in the trillions of dollars.

The first swap contracts were entered into in 1981. In 1985, several prominent participants in the privately negotiated derivatives industry chartered ISDA, the International Swaps and Derivatives Association, Inc. Today, ISDA has over 800 member institutions from 56 countries on six continents. The main objective of ISDA remains to identify and reduce risk in the derivatives and risk management business.

So, how does a basic swap contract work? Here is a short example. First, the cash flows may be in any traded currency. Second, there must be a formula for determining the size and magnitude of the cash flows – this is usually an interest rate such as the 6-month LIBOR (**L**ondon **I**nter-**B**ank **O**ffered **R**ate). However, with the phasing out of LIBOR, it is recommended that the SOFR (**S**ecured **O**vernight **F**inancing **R**ate). A hypothetical basic swap arrangement proceeds as follows:

> *One party, let's say you through your bank (let's call you party X), agree to pay the other party, your vendor in London (let's call this party Y), cash flows equal to interest at a floating rate on a pre-determined notional principal for a given period of time.*

> *At the same time, party Y agrees to pay party X cash flows equal to interest at a fixed rate on the same notional principal over the exact same period.*

> *The swap term generally ranges from 2 to over 15 years. On each interest anniversary date, the swap agreement requires one party to send a payment for the difference between the two respective interest payments to the other party.*

Interest Rate Options: Caps and Floors

Interest rate standard options are *caps* and *floors*. *Caps* and *floors* are options. The *cap* guarantees a maximum rate to the buyer. The *floor* guarantees a minimum rate to the buyer. Borrowers seek caps because they set a maximum paid interest cost. This option has value only when the current rate is above the guaranteed rate. Investors seek *floors* because they offer protection against declining interest revenues. The floor option has value only when the current rate is below the guaranteed rate. Whenever either of these two options does not have value, it is considered worthless.

Contemporary Regulatory Issues Affecting Derivatives

The first few years of the 21st Century have brought surprises to global markets. In the United States, the election of Donald Trump was not certain until election night. With the US Presidency in hand, on election night, the nation expected his administration to seek changes in regulation, enforcement strategies, US trade policy, changes to the Affordable Care Act, augmentation of immigration laws and moves to reduce cyber risk and related attacks. How did these expectations interact with the US derivatives market? Let's highlight some expected changes to derivatives market regulations to answer these questions. We start with a review of the Dodd-Frank Act, passed in response to the economic crisis of 2008. Additional details on the financial regulations up to 2009 are presented in Appendix A.

Dodd-Frank Financial Reform Act

President Barack Obama addressed the recession of 2007-2010, the worst recession since the Great Depression years (1929-1939), by signing into law the <u>Dodd-Frank Wall Street Reform and Consumer Protection Act</u> (Pub L. 111-203, HR 4173). The Act has three primary goals:

- Minimize systematic risk of derivatives trading
- Create transparency in derivative markets
- Prohibit entities holding customer deposits from engaging in speculative derivatives activity

Proposed in December 2009, the final Act presents a significant paradigm shift in how the US deploys its financial regulatory system. This Act impacts all Federal financial regulatory agencies and every aspect of the financial services industry. Surprised? You should not be. The American public demanded a bold response to the devastating recession and got one. Table 6 highlights the Act.

Table 6: Dodd-Frank Highlights

Content	Summary of the Dodd-Frank Financial Reform Act
Derivatives	Major new regulations for OTC derivative contracts that were previously unregulated. Regulations target asset-backed securities, hedge funds, mortgage brokers, and payday lenders. New transparency rules address: • Closure of regulatory gaps by providing the SEC and CFTC with new authority to regulate OTC derivatives • Requires central clearing and exchange trading for derivatives that are pre-approved by the SEC and CFTC. • Requires new margin limits for un-cleared trades to offset the significant risk such contracts impose on the financial system. Swap dealers and major participants are now subject to capital requirements. • Requires stronger market transparency. Clearinghouses and swap repositories must provide improved clarity to assist regulators in monitoring risks.
Consumer Protections	Title X of the Act created a new independent watchdog agency: The Consumer Financial Protection Bureau. The Bureau was given the authority to ensure American consumers receive clear, accurate information about mortgages, credit cards, and other financial products. The Act also protects consumers from hidden fees, abusive terms, and deceptive practices. Administratively, the new agency is under the auspices of the Federal Reserve.

Content	Summary of the Dodd-Frank Financial Reform Bill
Too Big to Fail	Halts the practice of holding taxpayers liable to bail out financial firms that threaten the economy. The Act provides provisions for an orderly liquidation of failed financial firms. This is achieved by installing new and significant capital and leverage requirements that effectively retard the goal of expanding size beyond certain limits.
Volcker Rule	Named after former Fed chair Paul Volcker, the rule is published in section 619 of the Act. The Volker Rule prohibits banks from using customer deposits for their own profit. Additionally, banks cannot own, invest in, or sponsor hedge funds and private equity funds. The rule targeted former large investment banks (i.e., Goldman Sachs and Morgan Stanley) that became commercial banks to take advantage of taxpayer-funded bailouts.
Advanced Warning System	This section of the bill creates a council to formalize the application of systemic risk principles applied to large, diverse firms that could threaten the American economy.
Existing Regulation	The oversight powers of regulators are strengthened. Encourages the aggressive pursuit of financial fraud, conflicts of interest, and overall manipulation that may or does adversely affect the public.
Federal Bank Supervision	Additional support for community banks. Existing regulation is streamlined.
Investor Protection	The Act increased accountability and rules to achieve greater transparency for credit rating agencies.
Executive Compensation and Corporate Governance	Given a non-binding vote, shareholders now have input on compensation and corporate affairs.

Table 6 (cont): Dodd-Frank Highlights

Dodd-Frank Reform

In March 2018, the Trump administration started a process that "rolls back the crippling Dodd-Frank regulations crushing community banks and credit unions nationwide...those rules just don't work." Working with a predominantly Republican Congress in March, the US Senate passed the most significant loosening of financial regulations since the economic crisis of 2008. It only took until mid-May for the US House of Representatives to approve the Senate's March rollback. Although the bill stops short of unwinding Dodd-Frank oversight that prevents the nation's biggest banks from engaging in risky behavior, the Congressional approval represents a substantial watering down of rules governing a large part of the banking system.

Volcker Rule? Say Sayonara...

Interestingly, in this overhaul of Dodd-Frank, regulations are left untouched and directed at governing the nation's derivatives markets. Two significant changes include:

- They are making fewer banks subject to the strictest federal oversight. Currently, fewer than ten banks are subject to the most stringent regulations.

- Some loan companies are now exempt from specific requirements for disclosure established by the Home Mortgage Disclosure Act.

Deregulation of the Act continues. In August 2019, the FDIC and four other independent agencies dropped their proposal to tie the Volcker Rule to a strict accounting standard. Instead, regulators will give banks the benefit of the doubt on a much more extensive range of trades. As amended, the Volcker rule no longer imposes a meaningful constraint on speculative and proprietary trading by banks and bank-holding companies that benefit from insured deposits.

Jumpstart Our Business Startups Act of 2012

Signed by President Barack Obama in April and affectionately referred to as the "The Jobs Act," amended various provisions of federal securities laws (Table 7). It simplifies the sale of securities and increases the threshold number of record holders required by reporting requirements of the Securities Exchange Act of 1934, as amended. Although the Jobs Act does not explicitly target derivative securities, the risk management panorama will change by establishing a new corporate entity: Emerging Growth Company (EGC). Experts identify three key risks: a) frauds and investor scams are more likely to increase risk (less regulatory oversight); b) the low business failure rate may increase (lower capital requirements); and c) The Act may have little effect (reduced capital formation?)

Table 7: Jobs Act of 2012

Key Major Provisions	Description
Shareholders	Increases the number of shareholders a company may have before being required to register its common stock with the SEC, thereby becoming a publicly reporting company.
Solicitation	Lifts the ban on "general solicitation" and advertising in specific kinds of private placements of securities.
Emerging Growth Company (EGC)	A company is defined as an EGC if its initial public offering of common equity securities (IPO) was after 08-Dec-2011 and the company had less than $1 billion of total annual gross revenues during its last completed fiscal year.
Facilitation of Capital Formation by EGC	Title I is designed to facilitate capital raising by companies designated as EGC
Simpler Disclosure Requirements	A registration statement filed by EGC with the SEC will differ from a registration statement filed by other companies in the following respects: • Audited financial statements will be mandated for only two fiscal years in IPO filing. • Selected financial data will be required for only the audited fiscal years. • Management's Discussion and Analysis of the Financial Condition and Results of Operations will be required for only the audited years. • Executive compensation information will be presented in the limited format required for smaller reporting companies (a company with a public float of less than $75 million on the last day of its most recently completed second fiscal quarter).
Exemption from future PCAOB Rules	EGC's independent registered public accounting firm is exempt from any rules adopted by the Public Company Accounting Oversight Board (PCAOB).

Key Major Provisions	Description
Testing the Waters	The Act permits EGC to communicate with potential investors (qualified institutional buyers) to determine interest in contemplated securities offerings.
Research Reports	The Act permits research reports by a broker or dealer about the EGC regardless of whether the research report provides the information "reasonably sufficient" for making an investment decision, irrespective of whether such broker or dealer participates or will participate in the offering.
Crowdfunding	Title III, Capital Raising Online While Deterring Fraud and Unethical Non-Disclosure Act of 2012 (CROWDFUND Act), exempts from registration offers and sales of securities to the public that comply with new rules to be adopted by the SEC.

Table 7 (Cont): Jobs Act of 2012

Tax Cuts and Jobs Act of 2017

The *Tax Cuts and Jobs Act of 2017* (TCJA), Public Law 115-97, is an Act advocated by congressional Republicans and the Trump administration. In addition to the provisions that impact individuals, the TCJA is expected to change every aspect of the hedge fund industry.

Provisions Impacting Individuals

Presented to the American people to simplify the Internal Revenue Code, the Act increased the standard deduction and family credits. Still, it reduced the number of popular deductions and made itemizing deductions less beneficial. Eight key takeaways are:

1. Most significant tax overhaul in 30 years.
2. After considering its economic impact, it adds about $1 trillion to the nation's debt over the next decade.
3. Corporations own the majority of the long-term benefits.
4. Most Americans receive an immediate tax cut, while the wealthy receive a substantial one.
5. Over the long run, most Americans will not see a tax cut or a tax hike.
6. Blue states (those that voted for Democratic candidates) benefit less than red states (those that voted overwhelmingly Republican).
7. Some industries are favored within the Act.
8. The law reduces the impact of the Affordable Care Act.

Provisions Impacting Funds

1. Funds that invest in cryptocurrency (e.g., Bitcoin) cannot take advantage of the like-kind exchange rules (section 1031) to defer income on exchanges of one currency for another. The legislation only allows like-kind exchanges for real estate.

2. Guaranteed income from Master Limited Partnerships (MLPs) and REIT dividends are eligible for the 20 percent pass-through income deduction.

3. Fund managers are forced to review their choice of an organizational entity given changes to the carried interest rules, the reduction of corporate tax rates, and the general unavailability of favorable pass-through treatment.

Risk Management: A Career Choice

Risk management is a "*hot*" employment destination. Whether it is the management of an equity portfolio, international transactions involving multiple currencies, or controlling unexpected performance in a credit portfolio, you will eventually need one or more derivative instruments to offset (hedge) the risk appropriately. One of the essential questions you may have is what types of jobs are available.

CLICK HERE to read about your future opportunities!

Figure 13: Risk Management Word Cloud

Summary and Conclusions

The study of risk and risk management is an exciting activity. The dynamic nature of society transmits directly into the behavior of the financial markets. This introductory Chapter provides an overview of how the derivatives markets are introduced in subsequent chapters. While several important topics are introduced to help explain the importance of derivative markets, the ARMDAT presentation is firmly committed to identifying the institutional structure and best use of domestic derivatives markets. This introductory Chapter demonstrated how notable risk events helped to evolve the derivative markets and the instruments used to trade in these markets. Important new factors in the study of derivatives include examining sustainability issues and the role of climate change. In every phase of derivative usage, ARMDAT makes you aware of academic and professional opportunities that may interest you.

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A Vook blends the written book with high quality video and an on-demand Internet connection into a seamless complete topic presentation.

The typical Vook is optimized for reading on both stationary and mobile digital devices.

Where this ARMDAT differs from the excellent alternative books available in the market is its ubiquitous learning platform and its aggressive incorporation of AI methods, including large language models like the ChatGPT technology. This text was written to meet the specifications and demands of an Internet-driven and wireless society that depends on unfettered access to digital display devices. That does not mean that this exposition abandons the traditional paper-based format. However, with the advent of digital reading tools such as the Apple iPad, Amazon Kindle, the Sony Reader, and high-definition large-display cell phones, it has become increasingly clear that an expanded view of pedagogy is needed to address the digitally aware students of today and tomorrow. The result is a new type of digital book that some refer to as a **Vook**.

In the Vook format, the reader expects to encounter rich multimedia-based videos, computational support for complex problems, and tight integration with the vast library known as the Internet. Also, the Vook format attempts to abridge the material to focus on the most relevant content while using videos and supporting computational methods to sustain a complete learning environment. The result is a book that is shorter in published pages but one that uses multimedia video and computational examples to fill any perceived void.

This first Chapter offers a view into the two-sided responsibility that evolves from ubiquitous learning using a vook. It is our sincere hope you will gain an appreciation for what should be an exhilarating learning experience.

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Appendix A: A Brief Taxonomy of Risk and Regulation: 1978-2016

Date	Act	Objective
1978	Marquette vs. First of Omaha	Supreme Court allows banks to export the usury laws of their home state nationwide and sets off a competitive wave of deregulation, resulting in the complete elimination of usury rate ceilings in South Dakota and Delaware, among others.
1980	Depository Institutions Deregulation and Monetary Control Act	The legislation increases deposit insurance from $40,000 to $100,000; authorizes new authority to the thrift institutions; and calls for the complete phase-out of interest rate ceilings on deposit accounts.
1982	Garn-St. Germain Depository Institutions Act	Bill deregulates thrifts almost entirely, allowing commercial lending and providing for a new account to compete with money market mutual funds. This was a Reagan administration initiative that passed with strong bipartisan support.
1987	FSLIC Insolvency	GAO declares the deposit insurance fund of the savings and loan industry to be insolvent as a result of mounting institutional failures.
1989	Financial Institutions Reform and Recovery Act	Act abolishes the Federal Home Loan Bank Board and FSLIC, transferring them to OTS and the FDIC, respectively. The plan also creates the Resolution Trust Corporation to resolve failed thrifts.
1994	Riegle-Neal Interstate Banking and Branching Efficiency Act	This bill eliminated previous restrictions on interstate banking and branching. It passed with broad bipartisan support.
1996	Fed Reinterprets Glass-Steagall	Federal Reserve reinterprets the GlassSteagall Act several times, eventually allowing bank holding companies to earn up to 25 percent of their revenues in investment banking.
1998	Citicorp-Travelers Merger	Citigroup, Inc. merges a commercial bank with an insurance company that owns an investment bank to form the world's largest financial services company.
1999	Gramm-Leach-Bliley Act	With support from Fed Chairman Greenspan, Treasury Secretary Rubin and his successor Lawrence Summers, the bill repeals the Glass Steagall Act completely.

Date	Act	Objective
2000	Commodity Futures Modernization Act	Passed with support from the Clinton Administration, including Treasury Secretary Lawrence Summers, and bipartisan support in Congress. The bill prevented the Commodity Futures Trading Commission from regulating most over-the-counter derivative contracts, including credit default swaps.
2004	Voluntary Regulation	The SEC proposes a system of voluntary regulation under the Consolidated Supervised Entities program, allowing investment banks to hold less capital in reserve and increase leverage.
2007	Subprime Mortgage Crisis	Defaults on subprime loans send shockwaves throughout the secondary mortgage market and the entire financial system.
December 2007	Term Auction Facility	Special liquidity facility of the Federal Reserve lends to depository institutions. Unlike lending through the discount window, there is no public disclosure on loans made through this facility.
March 2008	Bear Stearns Collapse	The investment bank is sold to JP Morgan Chase with assistance from the Federal Reserve.
March 2008	Primary Dealer Facilities	Special lending facilities open the discount window to investment banks, accepting a broad range of asset-backed securities as collateral.
July 2008	Housing and Economic Recovery Act	Provides guarantees on new mortgages to subprime borrowers and authorizes a new federal agency, the FHFA, which eventually places Fannie Mae and Freddie Mac into conservatorship.
September 2008	Lehman Brothers Collapse	Investment bank files for Chapter 11 bankruptcy.
October 2008	Emergency Economic Stabilization Act	Bill authorizes the Treasury to establish the Troubled Asset Relief Program to purchase distressed mortgage backed securities and inject capital into the nation's banking system. Also increases deposit insurance from $100,000 to $250,000.
Late 2008	Money Market Liquidity Facilities	Federal Reserve facilities created to facilitate the purchase of various money market instruments.
March 2009	Public-Private Investment Program	Treasury Secretary Timothy Geithner introduces his plan to subsidize the purchase of toxic assets with government guarantees.

Date	Act	Objective
2010	Dodd-Frank Wall Street Reform and Consumer Protection Act	This Act was passed in response to the Great Recession (2008). The Act made changes in the regulatory environment that affect all federal financial regulatory agencies and almost every part of the US financial services industry.
2012	Jumpstart Our Business Startups Act	A law intended to encourage funding of the US small business industry by easing various securities regulations.
2013	Jumpstart Our Business Startups Act	Title II went into effect on 23-September.
2015	Jumpstart Our Business Startups Act	On October 30 the SEC adopted final rules allowing Title III Equity Crowdfunding. The final rules and forms became effective 16-May-2016
2016	$20,000 Fine and Controls	Uber agrees to pay $20k fine and impose controls on how it handles sensitive user data (New York).
2016	Baxter International Product-quality issues	Firm issued at least five recalls on products from IV Solutions t vascular patches.

Appendix B: Derivative and Leverage Debacles

Consider the abbreviated list of a few notable derivative debacles (Table 4). In each case, the errors in derivatives deployment resulted in billions of dollars in losses. In some cases, the losses were due to wrong bets on the markets, and in other instances, some very knowledgeable users simply miscalculated the overall impact of large scale deployment.

Type of Derivative	Event
Interest Rate Derivatives / 1994	Orange County, CA. – a municipal bond fund transitioned into a hedge fund using leverage and interest rate derivatives. Loses of $1.65 billion were realized on an investment portfolio of $7.5 billion by inexperienced municipal fund managers.
Interest Rate Swaps / 1994	Procter and Gamble – Over $152 million in losses due to improper use of interest rate swaps.
Futures / 1995	The House of Baring – rogue trading of Nikkei futures.
Hedge Fund / 1998	Long-Term Capital Management – a hedge fund that was improperly capitalized was forced to absorb leverage induced losses that ultimately required the FED and private creditors to provide a bailout package of $3.6B.
Rogue Trading / 2008	Société Générale (SoGen) – fraudulent trading amounting to $7.2 billion in losses.
Futures / 2011	MF Global was a leading financial futures and derivatives brokerage firm that filed for bankruptcy on 31-Oct-2011. MF Global was the eighth largest corporation to fail in US history. The failure is attributed to overly aggressive proprietary trading strategies led by chairman and CEO Jon Corzine.
Credit Derivatives / 2012	A trusted trader implemented credit derivative transactions that cost JPMorgan more than $2B in losses.
Multiple Derivative Contracts / 2012	In July 2012, the National Futures Association initiated an emergency enforcement action to put funds "on hold" and warned the public that the Peregrine Financial Group may not have funds sufficient to meet obligations to clients. Problems arose from accounting irregularities.

As you might imagine, when losses are measured in the billions of dollars, this becomes a signal to regulatory authorities to examine what went wrong. There seems to be a global response to recognize both the complexity and specific nuances of a risk mitigation policy that involves the use of large-scale complex derivative contracts. Hence, the passing of several regulations as discussed in the Chapter.

End of Chapter 1