Current Issues 2020

FRM二级培训讲义-基础班

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Framework

Current Issues

- 1.The Impact of Blockchain Technology on Finance
- 2.FinTech and market structure in financial services
- 3.Fintech credit markets around the world
- 4.Implications of fintech developments for banks and bank supervisors
- 5.The Rise of Digital Money
- 6.Big Data
- 7.Machine Learning
- 8.Artificial intelligence and machine learning in financial services
- 9.Climate Change and Financial Risk
- 10.Beyond LIBOR

1. The Impact of Blockchain Technology on Finance

A. Blockchain Technology Basics

Blockchain

- Computerised ledger; relies on cryptographic techniques; consensus to capture and secure the data.
- The ledger is shared among distrusting participants; no one has control.
- A growing chain of ledger links the history; past records cannot be rewritten.

A. Blockchain Technology Basics

A Brief History of Consensus

- Distributed Consensus
  - How multiple computers can reliably agree on common data in the presence of faults?
  - Blockchain uses distributed consensus to agree upon transactions.
- Bitcoin
  - Participants can agree upon a continually updated history of all transactions.
  - Users have control over their bitcoin via a digital signature.
  - Digital signatures are public, cannot be forged, and can be verified by anyone.

A. Blockchain Technology Basics

- The Proof-of-Work Design
  - Miners collect outstanding transactions, while competing to find a randomly chosen string of numbers and letters.
  - Miner broadcasts his findings; claim his reward.
- The Adjustment on the Difficulty of the Competition
  - An algorithm automatically adjusts the difficulty of mining.
  - As more miners join the network, the difficulty rises.
  - Costs: computer hardware, electricity.
- Bitcoin Full Nodes
  - Computers only validate the Bitcoin blockchain, but do not mine new blocks.
  - When accepting a large payment => run a full node to validate the transaction.

A. Blockchain Technology Basics

Blockchain Technology and Distributed Databases

- Permissionless blockchains
  - Anyone can join the Bitcoin network and become a miner.
- Permissioned blockchains
  - Only a limited set of entities allowed to write to the blockchain.
  - ie. distributed ledger technology (DLT)

Smart Contracts

- Enforce the transfer of digital assets.
- Do not require a trusted third party to intermediate.
- The blockchain network enforces the execution of the contract on its own.

A. Blockchain Technology Basics

Tokens

- Companies issue a new token managed by a smart contract underlying an existing blockchain network.
- The blockchain network's computers validate the token's transactions.

A Spectrum of Decentralisation

- On the decentralised end: permissionless systems; no restrictions on who can join the system.
- On the other end: a traditional centralised database
- Costs from Introducing a Blockchain
  - Decentralised security is quite costly.
  - If a trusted third party to secure the ledger => much lower.
  - Must weigh the potential to reduce the 'cost of trust' against the high operational costs of blockchain.

B. Blockchain Technology's Opportunities and Challenges

Impediments to Broad Adoption

- Benefits
  - Participants don't need to trust a particular person to maintain that record.
  - Open the door to peer-to-peer transactions.
  - Reduce overall friction.
- Challenges
  - Blockchains are complex; with attendant latencies.
  - Concerns about privacy and security.
  - Hacking.
  - Who to trust in coordinating the transfer of assets?
  - For software updates, there is no controlling entity.
  - Cryptocurrency speculation.
  - Public policy and legal frameworks.

B. Blockchain Technology's Opportunities and Challenges

A Framework for Understanding Transaction Costs and Trade-offs

- The Trade-offs Worth Consideration
  - Trade-offs between the benefits and costs of centralised market structures vs distributed networks.
  - The financial sector is choosing security and scalability over decentralisation
    - ✓ Most financial sector applications still rely on trusted intermediaries.
- Basic Economic Properties of Blockchains
  - More users, higher benefits of blockchain application.
  - For permissioned blockchains, reduce overall transaction costs.
  - In digital identity or medical records: centralised systems may be inferior because they incur many of the costs.

C. Blockchain Technology and Finance

Where Could Blockchain Technology have an Impact?

- Payments
  - The existing approach to cross-border payments is slow and expensive.
  - Remittances and foreign currency payments were one of the first potential applications of blockchain technology.
- Digital Identity/Know Your Customer
  - Verify numerous data points about their customers.
  - Banks use DLT as the cross-institution source of proof.
- Primary Securities Issuance
  - Blockchain-based systems can issue corporate loans.
    - ✓ All parties have a shared record of the transaction and any updates.
    - ✓ Auto distribution of cash flows.

C. Blockchain Technology and Finance

- Securities Clearing and Settlement
  - A shared ledger may enable real-time clearing and settlement.
- Derivatives Clearing and Processing
  - Many clauses can be coded directly into smart contracts.
    - ✓ Auto execution.
- Post-trade Reporting
  - Distributed ledgers include a full audit trail for each transaction.
    - ✓ Facilitate post-trade regulatory reporting.
- Trade Finance
  - Give lenders greater confidence in the veracity of exporter claims and make letters of credit more available.

C. Blockchain Technology and Finance

Finance Starting at the Centralised End of the Spectrum

- Permissioned blockchains mitigate the governance, privacy and scalability challenges that public blockchains face.
- Critics
  - Closed systems face a security risk because the validators can collude to change the ledger.
  - Members may limit the innovations challenging their business models.

C. Blockchain Technology and Finance

Crypto-finance

- Token Sales
  - Have led to a new means of raising capital for blockchain-based projects.
    - ✓ ICO
  - Purchasers are bearing risk of the eventual success of the new network.
- ICOs
  - VCs see ICOs as a new way to fund start-ups.
  - A high failure rate for ICOs, due to a considerable amount of fraud.
- Cryptoexchanges
  - Enable investors in the tokens to trade.
  - Offer market-making, advisory and custodial services.

2. FinTech and Market Structure in Financial Services

A. Background and Definitions

Financial Innovation Influences Market Structure

- The emergence of providers of bank-like services may impact markets.
- The entry of BigTech firms into financial services => increased competition.
- The reliance on third-party service providers may increase over time.
- A shift to open banking: greater competition.

Key Elements of Market Structure

- Concentration
- Contestability
- Composition

A. Background and Definitions

Tech Innovation Affects these Elements

- Lower barriers to entry.
- Increase competition.
- Incumbents: be constrained by legacy IT systems.
- BigTech firms: possess up-to-date technology and funds => have a competitive edge.
- Unbundle many services offered by incumbents.

B. Financial Innovation and Links to Market Structure

Supply Factors – Technological Developments

- The use of APIs allows different software applications to communicate with each other.
- Mobile devices expand the availability of financial services.
- Cloud computing offers advantages.

Supply Factors – Regulation

- Changes in licensing and prudential supervision frameworks.
- Ensuring contestability and a level playing field is an explicit policy objective.

B. Financial Innovation and Links to Market Structure

Demand Factors – Changing Customer Expectations

- The digitisation of commerce => more convenient experiences across the services.
- Younger cohorts may be more likely to adopt FinTech.
- A desire for higher returns => provide FinTech platforms with a larger investor base.
- The convenience of investing through mobile.

C. The Current Landscape

Impact to Date of FinTech Firms

- FinTech firms have found new niches and underserved clients.
- The Case of Lending Platforms
  - Competitive pressures on incumbent lenders appear limited.
- Cooperation between Incumbents and FinTech Firms
  - Incumbents outsource to FinTech firms their business.
  - FinTech firms can access to incumbents' client base.

C. The Current Landscape

Impact of BigTech Firms

- Client data allows them to carry out risk assessments.
- Acquire market share in the high-revenue area.
- BigTech Firms Differ from FinTech Firms
  - BigTech firms already have established networks and a large customer base.
  - Well capitalised.
  - Have ready access to the forefront technologies to process big data.

C. The Current Landscape

Third-Party Service Providers

- The level of reliance on cloud computing providers may be low.

How Firms Utilise Cloud Computing

- Cloud computing has the potential to improve the security and resilience.
  - Avoid vendor capture.
  - More affordable.
  - Promote greater security.
  - Enable small FIs access to sophisticated architecture.

D. Conclusions on Financial Stability and Implications

Summary of Findings

- Implications for Financial Stability
  - FinTech firms may partner, complement, or compete with existing FIs.
- The Benefits for FinTech Firms
  - Compete more effectively in some narrow product areas.
  - Reduce the stickiness of existing customer relationships.
  - Greater decentralisation of financial services.
  - An enhancement of financial stability through wider access to financial services.

D. Conclusions on Financial Stability and Implications

- Macro-Financial Risks
  - The effects of competition.
  - Disruption of business models on profitability.
  - Loosening of lending standards.
- Micro-Financial Risks
  - Cyber incidents.
  - Heightened legal risk.

D. Conclusions on Financial Stability and Implications

Implications

- Vigilance by Supervisors
  - Monitor the impact of heightened competition on profitability and lending standards.
  - Monitor cyber risk.
  - Understand the incentives and barriers to entry by BigTech firms.
  - Manage third-party risks.

3. Fintech Credit Markets Around the World

A. How does Fintech Credit Work?

Fintech Credit

- Credit activity facilitated by electronic platforms that are not operated by commercial banks.
- Use digital technologies to interact with customers online.
- Lie outside the prudential regulatory perimeter.

P2P

- The online platform provides a low-cost standardised loan application process and facilitates direct matching and transacting of borrowers and lenders.
- The credit platform services the loan in return for ongoing fees.

Risk Spread and Default Risk

- Spread their investments across multiple loans.
- Platforms maintain a contingency fund for borrower defaults.

A. How does Fintech Credit Work?

Revenue Sources

- Retain and attract an investor base to generate fee revenue.
- Some platforms retain loans on their balance sheet.

The Digitalisation of Customers and Loan Origination

- An assessment of borrowers' credit quality: a credit grade => set a loan interest rate.
- Many platforms tend to assess non-traditional data.

How Banks Embrace Fintech Credit?

- Banks' use of new digital techniques is not yet as advanced.
- Fintech is distinct from lower-yielding, but safer, bank deposits.

B. Fintech Credit Market Development

Market Development

- China was by far the largest market.
- But a slowdown in many major jurisdictions.
- Fintech credit represents a very small share of overall credit flows.

The Composition of Fintech Users

- Individuals or institutional investors.

C. What Drives Fintech Credit?

Three major factors

- Fintech credit volume per capita is positively associated with GDP per capita.
- A less competitive banking sector => more fintech credit activity.
- More stringent banking regulation deters fintech credit activity.

D. Implications for Credit Availability and Risk

Benefits

- Promise greater convenience, lower transaction costs and better credit risk assessments.
- Greater financial inclusion.
- Greater diversity in the sources of credit.

Risks

- Could weaken lending standards.
- More procyclical than traditional credit.
- More vulnerable to investor pullback.
- Erode incumbent banks' profitability.
- Higher platform default rates.
  - Investor confidence has also been shaken.

E. Regulatory Frameworks

Regulatory Forms

- Licences to operate fintech credit platforms.
- Minimum capital requirements.
- Prohibit some high-risk business models.
- Mandated filing.

E. Regulatory Frameworks

Forms to Encourage Innovation

- Regulatory sandboxes.
- Innovation hubs.
- Funding support.
- Specific tax incentives.

Impacts on the Supervision of Existing Financial Intermediaries

- Banks interact with platforms => present new reputational and operational risks.
- Monitor potential related macro-financial vulnerabilities.

4. Implications of Fintech Developments

A. Fintech Developments and Forward-looking Scenarios

What is Fintech?

- Technologically enabled financial innovation; result in new business models; with an associated material effect on financial markets and institutions; the provision of financial services.

What Are the Key Fintech Products and Services?

- Three Product Sectors
  - Credit, deposit and capital-raising services; Payments, clearing and settlement services; Investment management services.

A. Fintech Developments and Forward-looking Scenarios

How Big is Fintech?

- Fintech has reached the initial peak of the “hype cycle”.
- But volumes are currently still low.

Comparison with Previous Waves of Innovation and Factors Accelerating Change

- The pace of adoption has increased.
- A generation of digital natives is growing up with a technological proficiency.
- The effects of innovation and disruption can happen quickly.

A. Fintech Developments and Forward-looking Scenarios

Forward-looking Scenarios

- The better bank: The incumbent banks digitise and modernise themselves.
- The new bank: Incumbents are replaced by challenger banks.
- The distributed bank: new businesses emerge to provide specialised services without attempting to be universal retail banks.
- The relegated bank: incumbent banks become commoditised service providers and customer relationships are owned by new intermediaries.
- The disintermediated bank: Banks have become irrelevant as customers interact directly with individual financial services providers.
- Future evolutions may be a combination of the five scenarios: with both fintech companies and banks owning aspects of the customer relationship.

B. Implications for Banks and Banking Systems

Opportunities

- Financial inclusion.
- Better and more tailored banking services.
- Lower transaction costs and faster banking services.
- Improved and more efficient banking processes.
- Potential positive impact on financial stability due to increased competition.
- Better Regtech.

B. Implications for Banks and Banking Systems

Key Risks

- Strategic risk: rapid unbundling of bank services to non-bank firms => increases risks to profitability at individual banks.
- High systemic operational risk: more IT interdependencies between market players => cause an IT risk into a systemic crisis.
- High idiosyncratic operational risk: innovative products may increase the complexity of financial services delivery => hard to control operational risk.
- Compliance risk with regard to data privacy.
- Outsourcing risk
- Cyber-risk.

B. Implications for Banks and Banking Systems

Implications of Using Innovative Enabling Technologies

- AI: gain greater insight into customer needs and the provision of more tailored services.
- DLT developments facilitate value transfer exchanges between parties without the need for intermediation.
- Cloud Computing
  - Incumbent banks can develop new solutions and migrate away from legacy systems.
  - New players can fit scenarios that challenge the current banking system.

Focus on Outsourcing and Partnering Risk

C. Implications for Bank Supervisors and Regulatory Frameworks

Increased Need for Cooperation

- Ensure that banks using innovative technologies are complying with the relevant laws.

Bank Supervisors' Internal Organisation

- Ensure that the knowledge, skills and tools of their staff remain relevant and effective.

Suptech Opportunities

- New technologies to improve the supervision methods and processes.

C. Implications for Bank Supervisors and Regulatory Frameworks

Continued Relevance of Regulatory Frameworks

- Supervision of Third-party Service Providers
- Licensing Regimes
  - Consider new regulations related to emerging fintech services.

Facilitation of Innovation

- Eg. innovation hubs, accelerators and regulatory sandboxes.
  - Help companies navigate the supervisory regulations.
  - Help regulatory agencies explore new technologies for internal supervisory purposes.

5. The Rise of Digital Money

A. New Digital Forms of Money

A Taxonomy—The "Money Tree"

- Four Attributes of Payment Means
  - 1. Type
    - ✓ An object: such as cash.
    - ✓ A claim: such as swiping a debit card.
  - 2. Value
    - ✓ Fixed value claims.
    - ✓ Variable value claims.
  - 3. Backstop
    - ✓ Backstopped by the government, or by private?
  - 4. Technology
    - ✓ Is settlement centralised or decentralised?

A. New Digital Forms of Money

Five Different Means of Payment

1. **Central Bank Money**
   - Cash.
   - Central bank digital currency or CBDC.
2. **Crypto-currency**
   - Object-based means of payment.
   - Issued on a blockchain.
   - An example is Bitcoin.

A. New Digital Forms of Money

3. **B-money**
   - Claim-based money.
   - Its redemption guarantee is backstopped by the government.
4. **E-money**
   - A debt-like instrument.
   - The redemption guarantees are not backstopped by governments.
   - Alipay and WeChat Pay.
5. **i-Money**
   - Equivalent to e-money, but offers variable value redemptions into currency.
   - Example: Libra.

B. Adoption of E-money Could be Rapid

How Stable is E-money?

- Cryptocurrency
  - Its value can fluctuate significantly.
- Central Bank Money
  - Cash or CBDC: is perfectly stable.
  - The government's solvency underpins the value.
- i-Money
  - I-money backed by Treasury bills will be less risky than i-money backed by stock market shares.

B. Adoption of E-money Could be Rapid

- E-money
  - Does not benefit from government backstops.
- E-money is Exposed to 5 Types of Risks
  - OP, liq, def, market, fx rate risks
- Options to Minimise Exposure to These Risks
  - Invest in safe and liquid assets.
  - Control the creation of e-money.
  - Sufficient capital.

B. Adoption of E-money Could be Rapid

E-money Adoption Could Be Fast for Its Attractiveness as a Means of Payment

- Why E-money Grows Rapidly?
  - Convenience.
  - Transaction costs.
  - Users trust telecommunications and social media.
  - Network effects.

C. Effects of E-money on the Banking Sector

Risks of Rapid E-money Adoption

- E-money providers may be natural monopolies.
- Risks to monetary policy transmission could emerge from currency substitution. cfa frm cpa cma video,weixin : 804283381

Scenario 1: e-money and b-money will coexist; the battle will wage on.

Scenario 2: e-money providers could complement commercial banks.

Scenario 3: commercial banks' deposit-taking and credit functions could be split.

D. The Role of Central Banks and Synthetic CBDC

Today's World

- All banks hold accounts at the central bank.

Tomorrow's World

- Some central banks already offer special purpose licenses that allow nonbank fintech firms to hold reserve balances.
  - Allow e-money providers to overcome market and liquidity risk.
- Massive Runs from Bank Deposits into E-money in Times of Crises
  - As clients seek the protection of banks' deposit insurance: flow from e-money to b-money.
  - Uninsured deposits might migrate from banks to e-money providers.

D. The Role of Central Banks and Synthetic CBDC

Potential Advantages

- Benefits from Offering E-money Providers Access to Central Bank Reserves
  - Stability of e-money.
  - Central banks could protect consumers from the growth of e-money monopolies.
  - Monetary policy transmission could be more effective.

Synthetic Central Bank Digital Currency

- The central bank: offer settlement services to e-money providers, including access to central bank reserves.
- E-money providers: all other functions.
- Dual comparative advantages.

6. Big Data

A. Tools to Manipulate Big Data

Why Big Data is Useful?

- More powerful data manipulation tools.
- Variable selection.
- To model complex relationships.

SQL and NoSQL Databases

Cloud Computing

B. Tools to Analyse Data

Pre-Processing Data

Categories of Data Analysis

- Prediction
- Summarisation
- Estimation
- Hypothesis testing

Machine Learning

- To find some function that provides a good prediction of y as a function of x.
- CART, random forests, Neural nets, Deep learning, SVM...

C. General Considerations for Prediction

Overfitting Problem

- Works well in-sample but fails miserably out-of-sample.
- Ways to Deal with Overfitting
  - Simpler models.
    - ✓ Regularisation.
  - Divide the data into training, testing, and validation sets.

D. Classification and Regression Trees

Classification and Regression Trees (CART)

- To predict a 0 or 1 outcome.

Example: Classification for Survivors of the Titanic

- CART vs Logistic Regression
  - Logistic regression: better for smaller data sets.
  - Trees: better for larger data sets.
  - Trees don't work very well for linear relationship.
- Pruning Trees
  - To provide the best out-of-sample predictions.

D. Classification and Regression Trees

Example: Home Mortgage

- Bootstrap: choose with replacement a sample from a dataset.
- Bagging: average across models.
- Boosting: repeat estimation.
- Random Forests
  - Use multiple trees.
  - Produce good out-of-sample fits.
  - A black box.

E. Econometrics and Machine Learning

Collaboration between Econometrics and ML

- Time Series Models
  - Bayesian Structural Time Series model.
- Causal Inference
  - ML dealt with pure prediction.
  - Econometricians: causal inference.
- Causality and Prediction
  - A big difference between correlation and causation.

E. Econometrics and Machine Learning

Model Uncertainty

- Averaging over many small models can give better out-of-sample prediction.
- Model uncertainty: how an estimated parameter varies as different models are used?

7. Machine Learning

A. Introduction

The Driving Forces

- More details of reporting.
- High-frequency, unstructured consumer data.

Machine Learning and Artificial Intelligence

- Model complex, non-linear relationships.

B. Background to ML

Supervised Learning

- Dependent variable y is known.

Unsupervised Learning

- Dependent variable y is lacking.

Non-parametric Analyses

- Flexible to fit any model.
- Hardly make an assumption about the relationship.
- Infer non-linear relationships.

B. Background to ML

Machine Learning Methods

- Regression
  - A supervised ML problem.
  - To predict a continuous dependent variable y.
  - A factor is added to penalise complexity in the model.
- Classification
  - A discrete problem.
- Clustering
  - An unsupervised ML problem.

B. Background to ML

Prediction versus Explanation

- Statistical methods are good for explanation.
- ML is good for prediction.

B. Background to ML

Tackling Overfitting: Bagging and Ensembles

- Overfitting
  - Fit the data sample very well; perform poorly when tested out-of-sample.
  - Having too many parameters.
- Ways to Deal with Overfitting
  - Boosting: overweight scarcer observations in a training dataset.
  - Bagging: a model is run thousands of times, each on a different subsample of the dataset.
    - ✓ Average all the runs.
  - Random forest: a model consisting of many different decision trees.
  - Ensemble: average the resulting model with many other ML models.

B. Background to ML

A Theory-free Approach to Analysis?

- ML: not understanding the relationship.
- A backward-looking way of prediction.

Deep Learning and Neural Networks

- Multiple layers of algorithms are stacked to mimic neurones in the layered learning process of the human brain.

Application within Financial Services

- Massive Data
  - High-quality, structured supervisory data.
    - ✓ Conventional ML is applied.
  - High frequency, low quality “big data”.
    - ✓ Deep learning.

C. Four Use Cases

1. Credit Risk and Revenue Modeling

- Difficulties in Usage
  - Models can be sensitive to overfitting the data.
  - Hard for any human to understand.

2. Fraud

- Detection of Credit Card Fraud
  - Clear historical data with relevant fraud labels to train classification.

C. Four Use Cases

3. Detection of Money Laundering and Terrorism Financing

- Current Challenges
  - Unable to detect complex patterns of transactions.
  - Significant human capacity is required.
  - Impediments to data sharing.
- ML's Role
  - Money laundering is hard to define.
  - No feedback from law enforcement agencies.
  - Unsupervised learning (clustering) can be used.

C. Four Use Cases

4. Surveillance of Conduct and Market Abuse in Trading

- Application
  - Monitor the behaviour of traders.
- Challenges to Applying ML
  - No labeled data to train algorithms.
  - Black boxes: hard to explain to a compliance officer.
  - Countermeasure: incorporates human decisions.
- Barrier to the Implementation of Automated Surveillance
  - Information from different sources could be mutually incompatible.

8. AI and ML in Financial Services

B. Drivers

On the Supply Side

- FIs benefited from AIML tools developed for other fields.
  - Hardware costs, computing power, algorithms, storage...
- Infrastructure construction
  - E-trading platforms, social media, credit scoring...

B. Drivers

On the Demand Side

- For FIs: cost reduction, risk management gains.
- Regulatory compliance.
- Growth in the number of data sources, data granularity.
- Enhanced data quality.
- Improvement in hardware.
- Open source libraries.

The Legal Framework

- Breaches of personal data
- New data standards & reporting requirements.

C. Selected Use Cases

Customer-focused Uses

1. Credit Scoring Applications
2. Use for Pricing, Marketing and Managing Insurance Policies
3. Client-facing Chatbots

Operations-focused Uses

1. Capital Optimisation Use Case
2. Model Risk Management and Stress Testing
3. Market Impact Analysis

C. Selected Use Cases

Trading And Portfolio Management

1. AIML in Trading Execution
2. Scope for the Use of AIML in Portfolio Management

AIML In Regulatory Compliance And Supervision

1. RegTech: Applications by Financial Institutions for Regulatory Compliance
2. Uses for Macroprudential Surveillance and Data Quality Assurance
3. SupTech: Uses and Potential Uses by Central Banks and Prudential Authorities
4. Uses by Market Regulators for Surveillance and Fraud Detection

D. Micro-financial Analysis

Possible Effects Of AIML On Financial Markets

- Improvement
  - Collect and analyse info on a greater scale.
  - Lower trading costs.
- Concerns
  - Similar AIML programmes => correlated risks.
  - Could be used by insiders to manipulate market.

D. Micro-financial Analysis

Possible Effects Of AIML On Financial Institutions

- Benefiting System-wide Stability
  - Increase revenues and reduce costs.
  - Earlier and more accurate estimation of risks.
  - Collaboration between financial institutions and other industries.
- Drawbacks
  - Miss new types of risks.
  - Black boxes in decision-making.
  - For intermediaries: a lack of clarity around responsibility.
  - Third-party dependencies.

D. Micro-financial Analysis

Possible Effects Of AIML On Consumers And Investors

- A Number of Benefits
  - Consumers: lower fees and borrowing costs.
  - Wider access to financial services.
  - Facilitate more customised financial services.
- Concerns
  - Data privacy and information security.
  - Avoiding discrimination.

Current Regulatory Considerations Regarding The Use Of AIML

- Have a robust development process in place.
- Be consistent with the firm's internal policies and procedures.

E. Macro-financial Analysis

Market Concentration And Systemic Importance Of Institutions

- Affect the degree of concentration
  - A small number of advanced third-party providers.
  - Technologies affordable only to large companies.
- Reduce the systemic importance of large universal banks.
- Universal banks' vulnerability to systemic shocks may grow.

E. Macro-financial Analysis

Potential Market Vulnerabilities

- Greater diversity in market movements.
- Less predictable trading algorithms.
- Increase liquidity.
- More effective hedging strategies.
- Reduce reliance on bank loans.
- Minimise capital => more risk.

Networks And Interconnectedness

- Greater interconnectedness in the financial system.
- Help to share risks.
- But also spread the extreme shocks.

E. Macro-financial Analysis

Other Implications Of AIML Applications

- Reduce the degree of moral hazard and adverse selection.
  - Higher premiums for riskier consumers.
- Entail biases.
- For RegTech and SupTech
  - 'Game' regulatory rules.

9. Climate Change and Financial Risk

A. Introduction

The Early Days of Climate Change in Finance

- Climate change was not a concern for the financial sector.
- The rise of carbon markets increases the knowledge about climate change.

An Important Issue for 'Responsible Investors'

- The development of socially responsible investment (SRI) put CC on the agenda of investors.

The Acceleration

- Since the 2015 COP21 in Paris.

Climate Policy Meets Finance

- The Paris Agreement
  - Fully decarbonise the global economy by 2050.
  - Need capital => the role of the financial system is acknowledged.

B. Climate Change as a New Source of Financial Risk

New Types of Financial Risks

- Transition Risks
  - The financial risks coming in the context of climate change mitigation.
  - Such as climate policies, technology evolutions, consumer preferences.
- Physical Risks
  - Such as temperature rise, variations in rainfalls.
  - Affect the operations of organisations.
  - But the impacts are delayed in the future.
- Indirect Impacts
  - Modifications of the climate regimes: heatwaves, droughts, floods...
  - Related impacts: fires frequency, sea level...
  - Acute risks: cyclone, flood.
  - Chronic risk: see level rise.

B. Climate Change as a New Source of Financial Risk

Are Those New Types of Risk Priced by Markets?

- Not currently captured, mis-priced by financial markets.

1. **Unprecedented Phenomena**
   - No record on how to react.
2. **Radical Uncertainty**
   - Unmeasurable, unquantifiable, and uninsurable.
3. **Non-normal Probability Distributions**
4. **Bounded Rationality**
   - May lead to a collective misread of the reality.
5. **Discrepancy in Time Horizons**
   - Impacts from CC will only happen in several decades.
6. **Climate Change Inefficiently Priced by Markets**

C. The Approaches to Manage Climate-related Financial Risks

Materialisation Channels of Climate-related Financial Risks

- CC can modify a firm's financial performance and risk profile.
- The propagation chain becomes more complex if the company is a multinational diversified one.

Climate Scenario Analysis

- Why Scenario Analysis?
  - A what-if analysis.
  - Avoid attributing scenarios a probability of occurrence.
  - Lie in the comparison of different possible futures.
- The Difficulty for Scenario Analysis
  - How to translate the factors of climate risks into financial variables?

D. Climate Change Risks and Financial Regulation

Reporting and Disclosure of Climate-related Risks

- The Article 173 of the French Energy Transition Act
  - Require reporting on CC.
  - The implementation was unsatisfactory.
- Mark Carney's speech
  - Pointed out self-regulation via risk disclosure.

Beyond Reporting, an Enhanced Prudential Framework

- The European Commission Sustainable Finance Action Plan
  - Mobilise central regulation for CC.
  - Potential methods: through decreasing or increasing capital requirements.

10. Beyond LIBOR

A. Desirable Features of Reference Rates and Main Trade-offs

An Ideal Reference Rate

- Not susceptible to manipulation.
- Derived from actual transactions in liquid markets.
- Serve as a benchmark for both term lending and funding.

A. Desirable Features of Reference Rates and Main Trade-offs

The Practical

- LIBOR Fails to Meet the Criterion
  - Constructed from a survey of banks reporting.
  - Sparse activity in interbank deposit markets.
  - The dispersion of individual bank credit risk.
- The New Reference Rates Should Incorporate those Attributes
  - Shorter tenor
  - Interbank markets -> non-bank wholesale markets.
  - Drawing on secured transactions.

Trade-offs

- O/N RFRs + Risk Premium
  - O/N RFRs will form the backbone.
  - Another rate embeds a credit risk component.

B. A Taxonomy and Properties of the New Overnight RFRs

Alternative RFRs in Five Currency Areas

- US: SOFR, secured by repo.
- UK: SONIA.
- Euro area: ESTER.
  - All transaction-based, all overnight rates.
  - No longer limited to interbank.

Basic Characteristics of Overnight Reference Rates

- Characteristics of O/N Rates
  - Volumes underlying the new benchmark dwarf those of the overnight bank funding rate.

C. Developing RFR-Linked Financial Markets and Term Rates

Users of derivatives markets have been accustomed to using compounded O/N rates.

But participants in cash markets have been accustomed to using rates set for the entire term.

State of Market Development

- IBOR-linked business is still dominant.

C. Developing RFR-Linked Financial Markets and Term Rates

Towards Term Benchmark Rates

- Backward-looking Term Rates
  - Constructed from past realisations of O/N rates.
    - ✓ Less prone to volatility.
    - ✓ Do not reflect expectations about future interest rates.
    - ✓ Lag the actual movements in the O/N rate.
- Forward-looking Term Rates
  - Known at the beginning of the period.
  - Embed market participants' expectations.

C. Developing RFR-Linked Financial Markets and Term Rates

- Forward-looking Term Rates Based on Term Funding Instruments
  - Capture fluctuations in intermediaries' actual term funding costs.
- Forward-looking Term Rates Based on Derivatives
  - Reflect the market-implied expected path of future O/N rates.
  - Do not capture fluctuations in intermediaries' term funding risk.

D. Implications for Banks' Asset-Liability Management

A Benchmark for Term Funding and Lending

- Banks will still lack a benchmark that reflects their marginal funding costs.
- Banks could be exposed to basis risk.

In Search of Credit-sensitive Term Benchmarks

- Unsecured Wholesale Funding Rates
  - Unsecured term funding: bank -> non bank.
- A "Two-Benchmark" Approach
  - Complement the RFRs with reformed local IBOR-type rates.
  - Addresses the scarcity of underlying term transactions.

E. Transition Issues

The most pressing thing: the migration of legacy LIBOR-linked exposures to the new benchmarks after 2021.