

Research on Financial Engineering and Financial Efficiency

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Abstract: The relevant issues between financial engineering and financial efficiency are related to the long-term development of the financial industry. By reviewing and analysing the concept and development history of financial engineering, the impact of financial engineering on financial efficiency is explored. Meanwhile, the role and limitations of financial engineering in improving financial efficiency are assessed through empirical studies and case studies. The findings suggest that financial engineering can improve financial efficiency to a certain extent, but there are potential risks and uncertainties. Therefore, regulation and risk control should be strengthened in the development and application of financial engineering in order to achieve the stability and sustainable development of the financial market.

Keywords: Financial Engineering; Financial Efficiency; Risk Control; Financial Markets; Sustainable Development

1. Introductory

Financial engineering, as a cross-discipline, is dedicated to the use of tools such as mathematics, statistics and computer science to solve complex problems in financial markets. In recent years, with the rapid development of the financial market and the deepening of globalisation, the research and application of financial engineering have received widespread attention and importance. At the same time, financial efficiency has become a topic of great concern. Financial efficiency refers to the degree of efficiency of financial markets in resource allocation and risk management. An efficient financial market can improve the efficiency of resource allocation, reduce transaction costs, and promote economic development and growth^[1]. Therefore, the study of issues related to financial engineering and financial efficiency is of great significance to the stability and sustainable development of financial markets.

2. Definition and Characteristics of Financial Engineering

Financial engineering is a comprehensive discipline that aims to improve the efficiency of financial markets and risk management through the application of methods and techniques such as mathematics, statistics and computer science to model, analyse and optimise financial markets, financial products and financial institutions.

Characteristics of financial engineering include: (1) Comprehensive: financial engineering involves knowledge and techniques from multiple disciplines, and requires the comprehensive use of knowledge and methods from multiple fields, such as mathematics, statistics, computer science, economics, etc. (2) Modelling and analysis: financial engineering emphasizes the modelling and analysis of financial markets and financial products, and describes and predicts the behaviour of the financial market through mathematical modelling and statistical analysis, in order to make risk management and investment decisions. (3) Risk management: One of the important objectives of financial engineering is to provide effective risk management tools and methods to help financial institutions and investors identify, measure and manage risks and reduce the risk of financial transactions. (4) Innovative: Financial engineering is closely related to financial innovation, and promotes the development and innovation of the financial market through the introduction of new financial products, trading strategies and risk management tools. (5) Technology-driven: Financial engineering emphasises on the modelling and analysis of financial markets and financial products to describe and predict the behaviour of financial markets through mathematical models and statistical analysis, in order to make risk management and investment decisions. Technology-driven: financial engineering relies on advanced computer technology and big data analysis to process financial data and conduct financial

analyses through high-speed computation and complex modelling. (6) Financial market-oriented: the research and application of financial engineering is based on the context and goals of financial markets, aiming to improve the efficiency, liquidity and risk management capabilities of financial markets.

3. History of Financial Engineering

The evolution of financial engineering can be traced back to the late 1970s and early 1980s.

3.1 Early Stage (Late 1970s-Early 1980s)

The origins of financial engineering can be traced back to the break-up of the Bretton Woods system in 1973, when the internationalisation of financial markets accelerated. At this time, scholars began to investigate how mathematics and statistics could be used to solve problems in financial markets, such as option pricing and portfolio management.

3.2 The Birth of the Option Pricing Model

In 1973, Fisher Black and Merton Miller proposed the famous Black-Scholes option pricing model, which provided a theoretical framework for option pricing. The emergence of the option pricing model laid the foundation for financial engineering and stimulated research and innovation in financial derivatives.

3.3 The Rise of the Derivatives Market

Financial engineering was further developed in the 1980s with the rise of the financial derivatives market. Financial derivatives such as options, futures and interest rate swaps began to be widely used in financial markets, providing investors with more investment and risk management tools.^[2]

3.4 Applications of Mathematics and Computer Science

With the rapid development of computer science, financial engineering has begun to use technologies such as big data, artificial intelligence and machine learning to perform financial modelling and risk management in a more efficient and accurate way. The application of computer simulation and high-speed algorithms has made the study and practice of financial engineering more convenient and accurate.

3.5 Increased Importance in the Wake of the Financial Crisis

The outbreak of the global financial crisis in 2008 made financial engineering more important. The crisis exposed the risks and uncertainties that existed in financial markets, and financial engineering was widely used in risk management and financial innovation to improve the stability and risk resistance of financial markets.

3.6 Strengthening of Regulation and Norms

With the development of financial engineering, regulators have gradually strengthened their supervision of risk management and financial engineering products in financial markets. Regulators have put forward higher requirements for the development of financial engineering to ensure the stability of financial markets and the protection of investors.

4. Relationship between Financial Engineering and Financial Efficiency

Financial engineering is closely related to financial efficiency and there is a mutually reinforcing relationship between the two.

Firstly, the research and application of financial engineering can improve the efficiency of financial markets. By establishing reasonable mathematical models and risk management tools, financial engineering helps financial market participants to better understand and cope with market risks, thus improving the efficiency and liquidity of transactions. Financial engineering techniques and methods can optimise portfolio allocation, risk diversification and asset pricing, improving the efficiency of resource allocation and promoting the development of financial markets and economic growth.

Secondly, the improvement of financial efficiency can also promote the research and innovation of financial engineering. The improvement of financial efficiency means that the operation of the financial market is more efficient and effective, which provides a better practical environment for the research and application of financial engineering. Against the background of improved financial market efficiency, financial engineering can better respond to market demand and risk

challenges, and promote the continuous innovation and development of the theory and practice of financial engineering.

Finally, financial engineering research and applications also need to consider the issue of financial efficiency. One of the goals of financial engineering is to improve the efficiency and risk management capabilities of financial markets, but there is also a need to avoid over-financialisation and financial market instability.^[3]Therefore, financial engineering researchers need to focus on the balance of financial efficiency, pursuing efficiency while ensuring the stability and sustainability of financial markets.

There is a mutually reinforcing relationship between financial engineering and financial efficiency. The research and application of financial engineering can improve the efficiency of the financial market, while the improvement of financial efficiency also provides a better environment and opportunity for the development of financial engineering. By continuously promoting the interconnection between financial engineering and financial efficiency, the stability and sustainable development of the financial market can be promoted.

5. Role and Limitations of Financial Engineering

5.1 The role of Financial Engineering in Improving Financial Efficiency

Financial engineering is a financial activity that uses financial instruments and techniques, such as derivatives, to innovate and combine them to meet the needs of financial markets, reduce risk and improve efficiency. Financial engineering has the following roles in improving financial efficiency: risk management and hedging: financial engineering provides a series of derivatives and other tools to reduce and manage risks in the financial market through hedging and arbitrage. For example, through the trading of derivatives, financial institutions can effectively hedge the risks of interest rates, exchange rates, commodity prices, etc., which helps in risk management and risk control and improves the stability of the financial market. Capital market development: financial engineering promotes the development and innovation of the capital market, providing diversified financing and investment channels for enterprises and investors. For example, the introduction of derivatives such as stock index futures provides investors with more trading options, improves market liquidity, and promotes the healthy development of the capital market. Improvement of capital allocation efficiency: Financial engineering channels capital from inefficient areas to efficient areas, promoting the optimal allocation of resources. Through innovative financial products and services, financial engineering can provide more diversified and personalised investment choices to meet the needs of different investors and improve the efficiency of capital utilisation.

5.2 Risks and Challenges to Financial Engineering

Despite the positive role of financial engineering in improving financial efficiency, it also faces a number of risks and challenges: Complexity of financial innovations: The complexity of financial engineering innovations increases risks in financial markets. Some complex financial products and trading strategies may have problems such as flaws in theoretical models and challenges of data uncertainty, which can easily trigger market volatility and risk contagion. Information asymmetry and market incompleteness: financial engineering requires full information disclosure and market transparency, but in reality there is information asymmetry and market incompleteness. The design and trading of some financial engineering products may increase reliance on information and market conditions, which can easily trigger market uncertainty and instability. Operational risk and market manipulation: Operational risk and market manipulation of financial engineering activities is another challenge to financial engineering. Some financial engineering activities may be subject to manipulation and manipulation, leading to unfair and unstable markets. Financial bubbles and systemic risk: Financial engineering innovations may lead to financial market bubbles and systemic risk. Some financial engineering products may trigger over-leveraging and overheating of markets, which ultimately leads to financial crises and systemic risks.

6. Regulation and Risk Control

6.1 Strengthening the Regulation and Supervision of Financial Engineering

In order to protect the stability of the financial market and the interests of investors, it is necessary to strengthen the supervision and regulation of financial engineering. Improving the review and approval system for financial engineering products: A review and approval system for financial engineering products has been established to strengthen the regulation and risk assessment of financial engineering products. The review and approval system can prevent some high-risk and

inappropriate financial engineering products from entering the market. Increase information disclosure and transparency in the financial engineering market: Enhancing information disclosure and transparency in the financial engineering market improves the information acquisition and decision-making ability of market participants. Through increased transparency, the risks associated with information asymmetry can be reduced and the fairness and effectiveness of the market can be enhanced. Strengthen the supervision and training of financial engineering practitioners: establish a sound qualification and supervision system for financial engineering practitioners, strengthen the training and supervision of practitioners, and ensure that practitioners have appropriate professional knowledge and ethical conduct. The standard behaviour and high quality level of practitioners are crucial to the healthy development of the financial engineering market.

6.2 Risk Control and Financial Market Stability

In order to safeguard the stability of the financial market, the work of risk control needs to be strengthened. Sound risk management system: Establish a sound risk management system, including risk identification, measurement, monitoring and control. Through effective risk management, potential risks can be identified and responded to in a timely manner to avoid risk spreading and contagion. Strengthen capital supervision and liquidity management: Strengthen capital supervision and liquidity management of financial institutions to ensure that they have sufficient capital adequacy as well as the ability to cope with risks. Systemic risks of financial institutions can be reduced through reasonable capital requirements and liquidity regulation. Sound Market Risk Monitoring and Early Warning System: Establish a sound market risk monitoring and early warning system to detect and warn of abnormal market fluctuations and risks in a timely manner. Systemic risks in the financial market and investor losses can be reduced through proactive risk warning and preventive measures. Promote international co-operation and information exchange: Strengthen international co-operation and information exchange to enhance risk identification and response capabilities. By sharing information and experience, international financial risks can be better addressed and the stability of the global financial market maintained.^[4]

Strengthening the supervision and regulation of financial engineering, as well as risk control and financial market stability, is the key to ensuring the healthy development of financial engineering and the safe operation of financial markets. Only by strengthening supervision and risk control can we give full play to the role of financial engineering and promote the stability of the financial market and the sustainable development of the economy.

7. Conclusion

Financial engineering plays an important role in improving financial efficiency, promoting capital market development and optimising resource allocation. However, it also faces risks and challenges, such as complexity, information asymmetry and market manipulation. In order to protect the stability of the financial market and the interests of investors, there is a need to strengthen the regulation and supervision of financial engineering and to carry out effective risk control. Strengthening the regulation and supervision of financial engineering can be achieved by improving the product review and approval system, increasing the disclosure of market information and upgrading the quality of financial practitioners. Meanwhile, risk control requires measures such as improving risk management systems, strengthening capital regulation and market risk monitoring and early warning systems. Through these measures, the good operation of financial engineering can be ensured, the stability and development of the financial market can be promoted, and the sustainable development of the economy can be realised.

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