On Interdisciplinary Approaches in Financial Engineering during Economic Transition Period in China

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Abstract Financial Engineering (FE) is a vigorous interdisciplinary field that studies the concepts and techniques found in three major fields of study: finance, mathematics and computer science. Using an interdisciplinary approaches, this paper shown that the essence of FE is financial innovation and financial creativity, including the design, development and application of innovative financial instruments. With China’s entry into WTO, domestic financial market faces the great challenges. The conclusion is that we must recognize the situations and make good use of the various financial tools to serve China's transition economy.

Keywords Financial Engineering; interdisciplinary; financial products; financial innovation

1. Introduction

Financial engineering is concerned with the creation and valuation of financial instruments. It is a vigorous interdisciplinary field that studies the concepts and techniques found in three major fields of study: Finance, Mathematics and Computer Science. Since 1970s we have seen a significant growth in the use of analytical tools in the design, modeling and analysis of existing and new financial products (Finnerty, 1988; Zhao, 2000; Zhang and Xu, 1999), these are typically dubbed Financial Engineering. FE not only synthesizes finance, engineering methods and modern information technology but also has integrated into a knowledge system (Zhao, 2000; Mao, 2003). FE mainly comprises three parts: Firstly, a conceptual tool, that is, basic theory of modern finance. Secondly, a substantive tool which includes financial instruments and financial measures for fulfillment of certain purposes. Available standardization formats or forms can be adopted; customized instruments and means in accordance with particular requirements can be made; what’s more, different methods can also be combined for this purpose (Finnerty, 1988). These instruments are not only objects of financial transactions but also elements capable of being combined to be more complex FE, specifically comprising: basic securities (including shares, fixed income securities and currency, etc.), derivative instruments (including future transaction, futures, option, swap and other derivative instruments) and mixed instruments. Once financial innovation is combined with modern science and technology and finance with industry, financial engineering comes into being (Zhao, 2000). According to Zhao (2000), new financial tools and products according to the need of financial and economic development arise, which play and important role in tapping financial resources reasonably and effectively and keeping financial sustainable development. Finnerty (1988), Zhang and Xu (1999), Gao et al. (2003), and Liu (2006) also reported similar results.

Thirdly, a finance strategy, which refers to basic methods for solving practical financial problems, mainly comprising asset-liability management, hedging, interest arbitrage, speculation and tax avoidance strategies, etc. FE is a new subject to design, develop, implement innovative financial production and service by using engineering principle and method (Mao, 2003). Economic entities in China’s transition economy can make full use of various engineering methods provided by FE, such as future transaction, futures, option, swap and other derivative instruments to carry out recombination or stripping according to the risks resulting from asset combination and liability combination, thus realizing effective financial risk management. Advanced FE technology can be introduced and used to establish and develop our national FE to provide solutions for urgent practical problems, such as enterprise merger and recombination, bank-enterprise debt restructure and agency-commission project design of state-owned enterprises, etc.
The development of FE will surely diversify the financial products and financial instruments of capital market and makes value formation of financial asset based on transaction mechanism; therefore, market transaction will be more transparent, market operation efficiency will be improved and market behavior will be more standardized, thus giving full play for the resource allocation function of capital market. What’s more, FE development will be of help in national macro-control and the application of FE will improve financial operation efficiency in our country and deduce transaction costs.

According to Mao (2003), it is an important task for the people working on finance to study and develop financial engineering according to national conditions and solve practical problems of the financial innovation and development creatively in China.

2. Research Orientation and Prospects for the Development

1. Based upon basic features of interdisciplinary subject, the construction of FE subject should be based on financial economics and supported by engineering methods and information technology to provide innovative service for development of capital market, financial agency and company finance.

2. Based on engineering-oriented financial science, the experimental type auxiliary teaching method should be actively promoted. As an engineering-oriented financial science, FE is called high-tech in financial field. The main research methods are empirical research and even experimental research, relying on real data from enterprises and market. Universities and colleges should establish FE laboratories and simulation banks to make students face directly financing decision-making and investment decision-making through simulating enterprise and market environments.

3. Based on localized development direction, scientifically make objectives to cultivate high-class talents. It is required that the students should have solid knowledge on finance, mathematics, computer and higher English level as well as stronger innovative awareness, exploration spirit and higher capacity in solving practical problems; also, they should make full use of the knowledge and capacity to satisfy requirements of finance reformation and economic development of our country.

4. Based on current condition of capital market in our country, build the FE subject with Chinese characteristics. At present, capital market in our country is still in a emerging and transformation phase. At this phase, the market is significantly lack of hierarchy, multi-variation and diversification with barriers from legal, technical and supervising aspects.

To carry out the building of FE subject in our country, we should not only borrow available FE theories and technical methods from abroad but also should infuse new content in various theories and technical methods based on present condition of capital market in our country to establish FE subject with Chinese characteristics which should be developed and adjusted in time with the deepening of market system reformation and the ever-increasing marketization degree.

3. Financial Innovation, FI and Financial Sustainable Development

With China’s entry into WTO, domestic financial market faces the great challenges. So we must recognize the situations and make good use of the various financial tools to serve our market economy (Gao et al., 2003). The research approach for the strategic conception to apply FE (Financial Engineer) to promote transformation and innovation of finance subject is that: introduce the thought of FE design into financial field of our country, develop new financial products that are suitable to current national conditions through comprehensively making use of the methods, such as probability analysis, mathematics modeling, computer simulation, etc. and creatively solve various problems emerging in the financial field since the economic system reform.

3.1 Six Principles

The purpose to promote the transformation and innovation of financial subject is not to repudiate the traditions of national finance subject but to continuously promote the traditional advantages of the national financial subject and thoroughly solve the existing problems, such as inadequacies in quantitative analysis and microcosmic financial analysis. Centered on this purpose, six principles should
be abided by:

1. On the aspect of research object, focus should not only be placed on macro-financial problems but also on micro-financial problems.
2. On the aspect of theoretical basis, we should not only depend on money and banking (bank as the main body), but also pay more attention to financial economics (financial market as the main body).
3. On the aspect of key points of research, we should not only emphasize on the research of theoretical basis but also pay more attention to the development, design, combination and application of new financial instruments and means, emphasize creativity and individuation to solve the problems of business finance in an individualized way.
4. On the aspect of service target, the research findings should not only be used to serve teaching units and macro decision-makers but also should have the practicality highlighted.
5. On the aspect of characteristic, technicality should be highlighted. Financial engineering involves the design, the development, and the implementation of innovative financial instruments and processes, and the formulation of creative solutions to problems in finance. Through creative combination of capital market and financial engineering, to make the financial instrument element organically integrate with modern financial theoretical elements and use financial instruments to recombine the available capital market, make it a more ideal combination for the customers.
6. On the aspect of research findings, to satisfy as much as possible the requirements for high-level, internationalized compound talents with solid and sound knowledge foundation on modern economic finance and mathematical statistics, capability of developing, designing and combining new financial instruments and exchange means and able to bring forth formulas creatively and individually to solve financial problems.

3.2 Interdisciplinary Approaches

Studies by Zhang (2000) indicated that from a basket of existing products, including swaps, futures, rate caps, rate floors, forward rate agreements, and so on, the team will piece together a solution, sometimes called a structured deal, to achieve the desired outcome.

Firstly, adopt the method to combine theoretical research with empirical research. Especially, visit and interview those colleges and research institutes that have made significant achievements in the subject research and adopt the theories and methods, which have been proved effective in practice.

Secondly, adopt the method of Chinese-Western comparative research. After all, FE is a concept borrowed and imported from Western culture; the content that can reflect modern market economy and its running regularities should be adopted and borrowed boldly. Thus, in the project research, we should abide by the principle of “Make the foreign things serve for China”. However, the project research must take into consideration on the concrete national situations and concrete social economic institutions; also, the project research should base on the history, present situation and long term potential of our own FE.

Thirdly, adopt the method of multi-crossed disciplines. Theoretically, FE should have profound mathematical hint; however, in our country, the vitality and development potential depend more on cross-reference with humanities in the FE research. In this light, in the research, we should comprehensively combine traditions of financial subjects with related subjects required by FE. At the same time, considering the cross-disciplinary characteristics of FE, in the process of advancing the project, talents from multiple subjects, such as mathematics, statistics, accounting, administration and computer, etc. should be organized to cooperate and coordinate to carry out multi-disciplinary research and finally form the basic pattern of multi-disciplinary and coordinated research.

Fourthly, adopt the research method of integration of instruments, study and research. That is to say, combine the development, consultation and application of FE project with the creation of direct economic benefits; combine the financial engineering development with the FE talent training; combine the development and consultation of financial engineering with theatrical research of FE.

Firstly, study how the following FE basic theories are applied in finance, such as MM theory, capital assets pricing theory, B-S option pricing theory, etc. as well as financial risk measurement theory (variance and its variation model, risk measurement model with reference points, VAR model and duration theory, etc.), etc. Secondly, study the following FE methods are applied in finance, such as
non-arbitrage balance method, engineering-oriented methods (mathematic modeling, numerical calculation, network diagram and analog simulation, etc.), computer technology as well as comprehensive method for mathematical statistics (management optimization technology, computer aided design CAD and computer aided manufacture CMD, etc.), etc. Thirdly, study the application of FE core technology--combinational decomposition technology in finance.

4. Conclusions and implications

Financial Engineering is the basic power of the development of modern finance, and represents the direction of the development of finance. It is greatly valuable to develop academic education, and pay attention to researches on Financial Engineering in China.

Firstly, equip finance with more technicalities. FE is a subject related with design, development and application of financial innovation products or combination of financial products as well as their procedures and the stylization of creative methods to solve financial problems. It is the creative combination of finance and engineering; wherein, the former comprises financial instrument elements (basic financial instruments and derivative financial instruments) and modern financial theoretical elements (such as asset pricing theory, asset liability theory, interest rate and exchange rate pricing theory, option pricing theory, hedging theory, etc.); the latter includes the comprehensive application of mathematical analysis, information technology, computer technology, engineering technology, especially the comprehensive application of systematic engineering, etc.).

The future development of financial engineering and FE subject will be closely combined with the mainstream of finance research, in other words, FE itself will represent an aspect of the mainstream of finance research. The main research content will be directed to a series of problems resulting from the discrepancy between basic premise hypotheses of capital market and finance and practical situations in classical companies. The main research method is empirical study, relying on real data from enterprises. FE pays more attention on creation of financial products and is oriented in a more direct way to the finance decision-making and investment, ranging from the design, development and application of new financial instruments to the financial design for enterprise merging, purchase and recombination. In this sense, the formation of FE ideology and application of FE methods are instrumental in promoting the development of national finance in a technical direction.

Secondly, equip finance with more modern spirits. If we track the development history of finance subject, we can find the following several stages generally: descriptive finance (qualitative analysis); analytical finance (qualitative analysis and quantitative analysis); FE subject (creativity and engineering-oriented). We can see that FE subject is the result when finance develops to the phase with high-tech content and is also the product of high integration of finance theory and practice.

Thirdly, equip finance with more practicality. FE is the natural result with the ever-continuing financial innovation and efficiency improvement of finance industry; the reason is that the application scope of financial instrument comes from financial practice and entirely applies in financial practice.

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