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Quan, Lianfeng

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BANGOR BUSINESS SCHOOL

BANGOR UNIVERSITY

FUNDS TRANSFER PRICING AND PERFORMANCE EVALUATION

BY

LIANFENG QUAN

SUPERVISED BY

PROFESSOR LYNN HODGKINSON

A thesis submitted in partial fulfillment of requirements for the Degree of Doctor of Philosophy (PhD) in Banking

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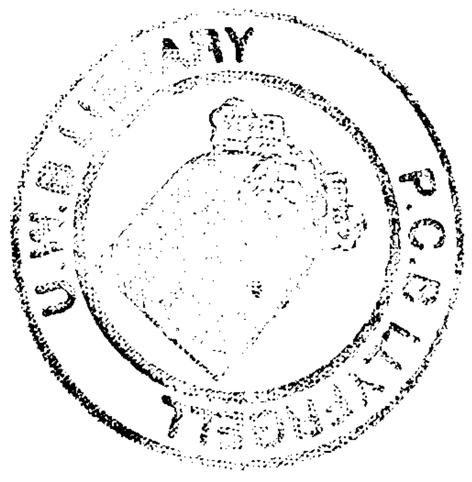

Dedication

I would like to dedicate this thesis to my beloved wife, Mrs. Ruhua Xianyu. None of this would be possible without your love and support.

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I am very indebted to my supervisor, Professor Lynn Hodgkinson, for her endless optimism, encouragement and support through my doctoral studies. The opportunity of working with her over the past three years has been a unique professional experience.

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Abstract

Funds transfer pricing (FTP) is a management accounting technique used to identify the source of profits contributions for business units and products, and is a strategic tool to integrate risk management with decision-making. As very few studies have investigated the FTP model for commercial banks, this thesis attempts to identify the factors driving the bank FTP model and to develop the model.

To develop the bank FTP model, the bank FTP process, which consists of the WHY, the WHAT, the WHO, the WHERE, the WHEN and the HOW factors, is designed. The WHY factor determines that the FTP model should be developed to enhance effective bank risk management process, and properly assign profit contributions within a bank to help achieve accurate bank performance evaluation. The WHERE factor demands that the FTP model should be developed at the bank business unit and instrument levels, and the WHEN factor requires that both the original and remaining term FTP models should be developed. The FTP model is developed with the responsibility accounting principles and financial risk management techniques, which are applied for the WHO, the WHAT and HOW factor design.

The implications of the FTP model developed in this thesis are examined by applying the model in bank performance measurements. The FTP model is found to be able to properly assign bank risks to business unit managers who have control over the risks, and properly allocate profit contributions within a bank. The FTP model is also applied in the different types of banks, which have varying degrees of decentralization of risk management decision-making authority. It is found that the FTP model can achieves effective risk management and accurate business performance evaluation in the partially decentralized bank. The case study analysis of the FTP model in the Chinese bank shows that the bank FTP model developed in this thesis is more effective in risk management than the bank's FTP method.

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List of Abbreviations

ALCO	Asset and Liability Management Committee
ALM	Asset and Liability Management
AMIfs	Association for Management Information in Financial Services
BBA	British Bankers' Association
CAPM	Capital Asset Pricing Model
CDs	Certificates of Deposit
Con.	Controllable by the business unit managers
EC	Economic Capital
FTP	Funds Transfer Pricing
GFT	Gross Funds Transfer
LIBOR	London Interbank Offered Rate
MMFTP	Matched Maturity Funds Transfer Pricing
NFT	Net Funds Transfer
NI	Net Income
NII	Net Interest Income
NIM	Net Interest Margin
PBOC	The People's Bank of China
RAPM	Risk Adjusted Performance Measurement
RAROC	Risk Adjusted Return on Capital
RMB	Chinese Currency
RP	Risk premiums
SHIBOR	Shanghai Interbank Offered Rate
TCE	Transaction Cost Economics
TP	Transfer Pricing
Uncon.	Uncontrollable by the business unit managers
VaR	Value at Risk

Chapter One: Introduction and Research Questions

1.1 Significance of the Issues

Transfer pricing (TP) is one of the most important issues in the strategic and operational management practices of large business organizations. According to Seed (1970, p.10), "there is possibly no single accounting topic that consumes more management time and energy ... than the business of establishing acceptable transfer prices".

Due to the liberalization and the volatility of financial markets, increased competition and diversification, banks are exposed to new risks and challenges. According to Lawrence and Lorsch (1967), to cope with risks, an organization has to achieve requisite decentralization of organizational components while simultaneously integrating their collective efforts. Nowadays, banks tend to decentralize to create various business units, each of which is responsible for a specific product market under the direction of the business unit managers having speciality of controlling the risks associated with the products. In the decentralized banks, each manager is close to the product markets and has a smaller area of risk management responsibility to worry about. When the managers are motivated to effectively control their risks, the risks for the overall bank could be reduced.

A bank benefits from decentralization, but it needs the process of integration to ensure that efforts of the decentralized bank business units collectively attain the goals of the total bank. Lawrence and Lorsch (1967) in their research argue that most firms in the various industries can be successful (in terms of the traditional measures of profitability) only when they achieve the required decentralization and are then able to integrate the diverse units. Watson and Baumler (1975) points out

that TP mechanism can be used to enhance organizational decentralization and to facilitate organizational integration.

However, TP may result in inter-divisional conflicts. According to Mehafdi (1992), the conflicts may be incurred when the application of the TP system results in poor performance evaluation results, which are then taken into account to decide on the reward and punishment policies. Radebaugh and Gray (1997) argue that the source of the conflict may also be the opportunistic behaviour of some business unit managers to improve their individual performance at the expense of overall company profit.

To resolve the conflicts, FTP must facilitate the coordinate action of the decentralized bank business units, and the funds transfer prices generated by the FTP model must reflect the contribution of any bank individual operation adequately. The appropriate coordination among the business units would help reduce the opportunistic behaviour of the business unit managers. The adequate profit contribution measurement would facilitate bank top management properly evaluate the performances of business units, and help establish an appropriate managerial incentive system. To develop the bank FTP model, this thesis concentrates on two focuses, financial risk management focus and performance evaluation focus.

1.2 The Financial Risk Management Focus

As one of the primary goals of the bank decentralization is to manage bank risks, FTP must facilitate the decentralized bank business unit managers to effectively control risks. Bank top management must decompose risks imbedded in bank products so that the decomposed risks can be assigned to the decentralized business units that have control over the risks. However, due to the volatility of financial

markets and increased competition, banks have been increasing the types of financial risks taken on the balance sheet. In these circumstances, it is complicate to isolate the risks involved in the banking businesses.

This thesis focuses on studying how the bank FTP model can be developed to decompose the risks imbedded in bank products and business units, and then assign the profits from managing the risks to the unit that takes the responsibility and have the capability to control the risks. The bank FTP model aims to enhance effective bank risk management process. According to Culp (2001), the effectively functioning risk management process consists of five general activities: identify risks and determine tolerances; measure risks; monitor and report risks; control risks; and oversee, audit, tune, and re-align the risk management process. Therefore, the bank FTP model should be capable of being integrated with the effective risk management process and enhance the process. This study is confined to the domestic bank FTP and cross-border TP is not covered. Thus tax risks are outside the scope of this study.

1.3 The Performance Evaluation Focus

To solve the inter-divisional conflicts incurred by the poor performance measurement by TP, the funds transfer prices generated by the FTP model must be applied to accurately reflect the contributions that every business unit or product makes to the profitability of the whole bank. As previously discussed, the FTP model aims to help bank top management properly assign the responsibility of controlling risks to the business units' managers. To properly measure the profit contributions of the business unit, the cost of these risks should be explicitly charged to the units incurring the risks, and the profits from the risks should be assigned to the units managing the risks. The bank FTP model stresses the importance of understanding the returns associated with various business activities

and quantifying the risks related to the returns.

To evaluate the risk management contributions made by each bank business unit, this thesis attempts to develop the bank FTP model based on the principles of responsibility accounting. According to the generally accepted principle of responsibility accounting from Solomons (1965), cost should be charged to the department, which has the power to accept and reject the invoice or which pays for the labor required. Solomons points out that an appropriate allocation of assets and the authorities of managing the assets to organization units would help generate profits. Another responsibility accounting principle from Solomons is that costs should be borne by, and revenues should be credited to, business units responsible for them. The principle implies that business unit managers should only be made responsible for the activities under their control. Solomons warns that managers should not be made responsible for the items of cost, which they cannot control; neither should they be rewarded for revenues, which are not a result of their efforts.

Integrating the responsibility accounting principles with the bank FTP model development would make each bank business unit bear the costs of the risks it incurred and obtain revenues from managing the risks. This will enable bank top management to properly measure the risk-adjusted performances of the business units and products. The proper bank business performance measurement would help establish an appropriate bank managerial incentive system.

1.4 Research Questions

To ensure that banks benefit from decentralization and reduce the inter-divisional conflicts from poor performance measurement with TP, the research questions for this thesis are stated as follows:

How the FTP model is developed to be able to integrate with the effective bank risk management process and enhance the process?

How the FTP model is developed to properly allocate the profit contributions within a bank so that the performances of the bank unit or product can be accurately measured?

1.5 Structure of the Dissertation

The following chapter of this thesis covers the definitions of TP for manufactory and financial industries in order to highlight the link between TP and FTP. In addition, this chapter reviews the six-factor TP framework, TP in an organizational context, and the motives for FTP.

Chapter Three presents the literature review of the TP methods, and summarizes the advantages and limitations of each TP model.

Chapter Four focuses on the research design by stressing the methodologies for the six-factor bank FTP framework design and the bank FTP model development. This chapter provides a research map that depicts the relationships between the methodologies.

Chapter Five conducts empirical investigations on bank FTP process. The results from the investigations are used as the inputs to the six-factor bank FTP framework design.

Chapter Six designs the six-factor bank FTP framework using the data and information obtained from the previous chapters.

Chapter Seven develops the bank FTP model. According to the WHEN factor designed, both the original term and the remaining term FTP models are developed. According to the WHERE factor designed, the bank FTP model is developed at the bank business unit and instrument levels.

Chapter Eight examines the implications of the bank FTP model developed in this thesis. After integrating the FTP model with the bank performance evaluation metrics, net interest margin (NIM) and risk adjusted return on capital (RAROC), some important functions of the model are found. The implications of the remaining term FTP model are also examined in this chapter.

Chapter Nine discusses the organizational application of the bank FTP model. The FTP model is applied in different types of the banks. This chapter aims at examining whether the bank FTP model is effective in each type of the banks.

Chapter Ten conducts a case study analysis of applying the FTP model in a Chinese commercial bank and presents the findings from the case study.

Finally, Chapter Eleven summarizes the possible areas of future research, as well as discusses the limitations and the implications of this study.

Chapter Two: Transfer Pricing Theory

2.1 Introduction

TP exists because an internal market exists for the exchange of goods and services between segments or divisions of the same organization. This chapter outlines the basic general ideas in relation to TP. The definitions of TP for manufacturing industry are discussed to examine why organizations apply it as part of their management control process. The studies on the definitions of FTP discuss the TP issue from the perspective of management of funds transactions within financial organizations. To provide a further understanding of the TP definitions, this chapter also reviews the TP framework, which determines the administrative process used for implementing an organization's TP policy.

This chapter also reviews the motives for FTP and discusses TP in an organizational context. Watson and Baumler (1975) suggest that, to set up an appropriate TP system, one should go beyond a simple description of the buying and selling units to a full study of the structure of the organization that encompasses the degree of decentralisation and integration. Thus, in order to understand the nature of TP, it is necessary to understand how TP is integrated with organization structure.

The first section of this chapter discusses the definitions of TP followed by the second section, the TP framework review. The third section examines TP in an organizational context, and the fourth section discusses TP process in terms of transaction cost economics. The fifth section studies the motives for TP, and the sixth section compares transfer price derivation in the manufactory and financial industries. The final section is the summary.

2.2 The Transfer Pricing Definitions

2.2.1 Definitions of Transfer Pricing for Manufactory Industry

Dean (1955) advocates that any company wishing to measure divisional profitability will need to develop transfer prices. Dean declares that the TP issue is actually about pricing in general, modified slightly to take into account factors that are unique to internal transactions.

Wells (1968) defines that a transfer price is the monetary expression of a movement of goods and services between organizational units of the same enterprise. Along a similar vein, Wojdak (1968), Fantl (1974), Mainlandt (1975), Flavell (1977), Dagher (1977), Lamber (1979), Thomas (1980), Venu (1983), Cats-Baril et Al. (1988), and McAulay and Tomkins (1992) define TP as the monetary values assigned to goods and services transferred. These definitions show that a transfer price is a monetary valuation placed on the physical goods or services transferring from supplying division to the purchasing division.

Kaplan and Atkinson (1989) point out that the transfer price represents revenue for the supplying division, and cost of an equal amount for the purchasing division, unless a dual pricing scheme is used. According to Smullen (2001, p.123), "where one unit within an organization supplies another unit with goods or services, the payment or receipt made in relation to that supply is a transfer price". Smullen illustrates that the term "transfer price" refers to the dollar amount of the interdivisional exchange; the phenomenon of pricing intrafirm transactions is called TP. Smullen points out that the term "unit" within the definition does not necessarily mean a unit of managerial control. The unit is not necessary to be a department or budgetary unit, and there are many other types of unit, which may be the subject of transfer prices. Thus, TP may be used in relation to projects, products, distributional units, processes and decisions. Smullen believes that

whether there is a matching "payment or receipt" will depend on the way in which the TP system is established and the payment may not involve any transfer of resources but be entirely notional.

Thomas (1980) points out that TP can be viewed as a part of the common cost allocation problem. However, according to Mehafdi (1992, p.3), "transfer prices are the monetary values attached to internalised market transactions between units of an organisational set-up, which are separated by management responsibility." Mehafdi argues that it is incomplete to look at TP as a mere cost-revenue exercise and that this view fails to place the TP problem in the context of the decentralised responsibility center structure.

2.2.2 Definitions of Funds Transfer Pricing for Financial Industry

The manufactory TP situation involves one organization unit transferring physical goods to the second unit. However, in the financial industry, the situation is rather different: the materials transferred among organization units are funds, instead of physical goods. There are only notional transfers and have no relation with the actual movement of funds. Thus the objective of TP within the financial industry is quite different from that within the manufactory industry.

The FTP issue is about pricing for internal funds transaction within a financial institution. A FTP system provides an internal source of revenue to funds providers and an internal source of expense for funds users. Kawano (1990) states that a FTP system handles the problem of charging net funds users and crediting net funds providers at the profit center, product and customer levels. The Association for Management Information in Financial Services (AMIfs) research committee (2001) defines that a FTP process assigns a market-based contribution value to each source and use of funds based on the underlying account or transaction attributes at

the time of origin. The research committee argue that this is the most comprehensive method for inclusion in an overall profitability measurement process.

Cole and Woody (1995) advocate that FTP is a management accounting technique used to calculate the true NIM component of profitability for business units, products, and customers. According to AMIfs research committee (2001), the FTP plays an important role in the financial management accounting system and is a critical component of the profitability measurement process, as it allocates the major contributor to profitability, NIM, among business units. Along a similar vein to Cole and Woody, Bowers (2006) argues that FTP is a management information system that establishes the value of funds gathered or deployed for the purpose of measuring the NIM contribution of the funds transactions.

To give a further understanding of the TP definitions, the following section discusses the TP process.

2.3 The Transfer Pricing Process

The TP process represents an important and pervasive problem in designing and implementing management information and control system. Eccles (1985) points out that there are two principal determinants of TP practices: strategy and administrative process. Eccles argues that both corporate strategy and unit strategies, such as strategies for groups, divisions, or even individual products, affect TP practices. The strategy referred to by Eccles determines what a company does. Eccles states that the second determinant is the TP administrative process, which has five major components: (1) how the transfer price is set, (2) the individuals involved, (3) what information is used, (4) when transfer prices are set, and (5) how conflict is managed.

Mehafdi (1992, p.4) gives an illustration of the TP process: "a transfer implies a movement in time and space of something quantifiable and pricing indicates the placement of a monetary value or a price." The TP process is further illustrated by the survey of large decentralised companies in the UK made by Mehafdi. The survey summarizes that a six-factor framework can be applied in designing a TP process, which involves (1) a reason (WHY), (2) an object (WHAT), (3) a subject or agent (WHO), (4) a place (WHERE), (5) a time (WHEN) and (6) a procedure (HOW). This six-factor framework is similar with that proposed by Eccles (1985). The following discusses the six-factor TP framework.

The WHY Factor

Mehafdi (1992) states that the WHY factor concerns the underlying reasons for the transaction to take place internally, especially when there is an external market for the transferred commodity. The WHY factor stated by Mehafdi concerns the corporate strategy, which is proposed by Eccles (1985) as the first determinant of the TP practice. Some transactions are required to be made internally in some organizations. As will be evidenced in Chapter Five, funds users are required to borrow funds from funds providers within the same bank. The funds users can go for funds from the external money market only when there are no excess funds from the providers within the bank.

The WHAT Factor

According to Eccles (1985), the WHAT factor concerns the different types of information used by managers to set transfer prices. Eccles points out that the information can include data on costs, on market prices of the selling profit centre, and on market prices of competitors of the selling profit centres. For the WHAT factor, Eccles concerns more on pricing issues. However, Mehafdi (1992) defines that the WHAT factor concerns the thing transferred, be it goods (raw material and

products) or services, and its importance to the company, the transferor and the transferee. In the manufacturing industry, transfer prices are normally set for intermediate products, which are goods and services that are supplied by the selling division to the buying division. The goods are further processed and then sold to other internal divisions or the external buyers.

The WHO Factor

According to Eccles (1985) and Mehafdi (1992), the WHO factor concerns the individuals involved in, responsible for and affected by the transaction. Eccles thinks that this factor should concern who is involved in setting the transfer price. Eccles states that this factor can be characterized in terms of centralized versus decentralized. Mehafdi argues that clearly identifying the individuals helps the top management of the organization delegate the authorities to the managers of the segments of the organization and accurately assign the responsibility for managing the transactions.

The WHERE Factor

Mehafdi (1992) points out that the WHERE factor concerns the origin and the destination of the transfer, which may be the transferor or the transferee. The WHERE factor should be clearly defined so that the responsibility of managing business transactions can be properly assigned. This is crucial as the proper assignments of the responsibility help an organization hold its managers responsible for those activities under their control.

The WHEN Factor

Eccles (1985) thinks that the WHEN factor is one of the major components of TP administration process. Eccles points out that the WHEN factor needs to concern how frequently and under what conditions the transfer prices are changed. Along a

similar vein to Eccles, Mehafdi (1992) states that the WHEN factor concerns the point of the time when the transaction takes place.

Mehafdi (1992) argues that the WHEN factor is important for cost and revenue allocation across time periods and performance evaluation and reward, as performance reports and feedback to divisional managers should be timely. To enable TP to properly measure the performance of divisional managers, the changes of the cost or market prices used to determine the transfer prices should be considered. Eccles (1985) warns that conflict will exist when transfer prices are not adjusted for these changes.

The HOW Factor

According to Eccles (1985), the HOW factor should concern how the transfer price is set, and how conflict is managed. Eccles illustrates that this factor should concern the types of conflict resolution process that is used. Similarly, Mehafdi (1992) defines that the HOW factor concerns the internal procedures and regulations that control both the physical transfer and its costing. The procedures and regulations can be designed to solve any conflicts in the TP process. Mehafdi states that the HOW factor also concerns the techniques and quantitative methods that can be used for producing transfer prices.

The discussions on the six-factor framework provide a good understanding of the definition of TP. Mehafdi (1992) points out that this six-factor TP framework can be used as a starting point for empirical research on TP process. To have a further understanding of TP, Mehafdi suggests that TP problem should be placed in the context of the decentralised responsibility center structure. The following section examines TP in an organizational context.

2.4 Transfer Pricing in an Organization Context

According to Benke and Edwards (1980), the trend toward large decentralized organizations increases the importance of the internal exchange of goods and services among various operations organized as responsibility centers, such as departments and subsidiaries. Therefore, it is necessary to examine how TP is integrated with the decentralized organizational structure.

According to Luthans (1973), there are at least three views of decentralization, and in order to be clear about the view used in this thesis, all three views are briefly discussed. One view is decentralization in a geographical sense. A second view of decentralization refers to functions within an organization. For example, if there is one business planning department, the planning function is said to be centralized. If each business unit or division has its own business planning department, the planning function can be said to be decentralized. The third view, and the view used in this thesis, refers to the delegation of authority. The more authority the managers of the business units of the organization have, the greater is the degree of decentralization. Benke and Edwards (1980) state that decentralization, however, is a relative term. They argue that there is never complete decentralization or complete centralization.

2.4.1 The Benefits and Costs of Decentralization

Decentralization is an approach to the organizational design. Riahi-Belkaoui (2001) points out that in this approach an organization is segmented into various specialities, each of which is responsible for a specific product market under the direction of a manager having strategic and operating responsiveness. Numerous benefits for decentralization are provided in the TP literature as discussed below:

(1) According to Lawrence and Lorsch (1967), decentralization helps an

organization reduce risk and uncertainty. They state that as organizations deal with their external environments, the organizations become segmented into units, each of which has as its major task of dealing with a part of the conditions outside the firm. Lawrence and Lorsch point out that each unit manager has a limited span of surveillance, and that each one has the capacity to deal with only a portion of the total environment. Under these circumstances, Lawrence and Lorsch think that organizations can be decentralized to deal effectively with the uncertainties in their external environment.

According to Watson and Baumler (1975), the central problem facing complex organizations is one of coping with risks or uncertainties. They advocate that an organization's design represents a response to the sources of uncertainty and that decentralization enables an organization to create some units to deal with the uncertainty and thereby leave other units to operate under the conditions of near certainty. Watson and Baumler argue that, when the units dealing with uncertainty consist of risk management specialists who are motivated to effectively manage the uncertainty, the risks or uncertainties for the overall organization could be reduced.

(2) Solomons (1965) argues that an organization seeks diversification through decentralization. In an organization, various business activities may require various business units, which have special skills that can be applied to mange the activities. For example, a commercial bank may be decentralized to form a commercial loan unit, which may be organized to specially mange the loan customer relationships. Solomons argues that a decentralized structure makes it relatively easy for a company to combine diversity with unity.

(3) Emmanuel and Mehafdi (1994) think that decentralization increases managerial

effectiveness. The decentralization of the organizational structure makes the delegation of authority for decision-making possible. As organizations grow in size and complexity it is impossible for a single decision-maker or a small group of decision-makers to possess all the information necessary to manage the organization. For example, a bank may deal with deposit taking, loan and a range of other diversified activities. It may operate in 10 countries spread across four continents with highly diversified product markets. It would be extremely difficult for a central management team to manage such a diversified organization without delegating decision-making authority to local managers who possess more information about circumstances affecting the production and marketing of any particular product or service on offer. In these circumstances, according to Emmanuel and Mehafdi, the locus of operating decision-making power can be shifted further down the hierarchy. This enables the top management to place the decision close to the realities of the market place. Therefore, decentralized decision-making is likely to result in better decisions because the people who make them are closer to the scene of action and have a smaller area of responsibility to worry about.

(4) Burlingame (1961) argues that delegating decision-making authority to divisional managers can lead to higher levels of motivation. Burlingame thinks that a great improvement is believed to result in any firm when the creative talents of responsible individuals are encouraged to develop in a climate of individual responsibility, authority and dignity, a climate that is made possible by the decentralization of decision-making.

Burlingame (1961) states that greater efficiency results from the sense the divisional managers have that they are running their business. Wilson and Chua (1993) argue that good managers are usually people with a high need for

achievement. If they are only allowed to act on instructions from the top management, they may be demotivated and feel frustrated at not being able to exercise any authority. Thus, allowing decision-making at a local level may encourage managers to be more entrepreneurial in their actions.

On the other hand, decentralization may incur some unfavourable costs. Riahi-Belkaoui (2001) points out that decentralization may result in incongruence between the business unit's goal and the corporate goal. Riahi-Belkaou argues that decentralization can lead to dysfunctional decision-making and, consequently, to suboptimization. For example, a decision may increase business units' profit but limits the organization profit as a whole. According to Hirst (1981), organization decentralization increases interdependence among business units. This makes organization management more difficult. The following section discusses the types of interdependence and how interdependence affects organization management.

2.4.2 Interdependence among Organization Units

Macintosh (1994) defines interdependency as the extent to which departments depend on each other and exchange information and resources to accomplish their respective tasks. This thesis uses the term "interdependence" in the Thompson (1967) sense. Thompson identifies three patterns of interdependency: pooled, sequential and reciprocal interdependence.

(1) According to Thompson (1967), in the pattern of the pooled interdependence, it is not necessary to say that each organization unit is dependent on, and supports, every other unit in any direct way. Thompson argues that each unit renders a discrete contribution to the whole and each is supported by the whole. (2) Thompson states that in the serial interdependence each unit performs its part of the task and passes the job on to the next unit. Thompson argues that each unit in

the serial interdependence line is highly dependent on all the others and each can only perform its part of the task after work has been successfully complete in the previous component. Macintosh (1994) points out that serial interdependence puts great demands on the organization for coordination and close control. (3) Thompson refers the reciprocal interdependence as the situation in which the outputs of each unit become inputs for the others. In the reciprocal interdependence, the outputs of two units become input for each other.

There are strong relationships among pooled, sequential and reciprocal Interdependence. Thompson (1967) summarizes that all organizations have pooled interdependence; more complicated organizations have sequential as well as pooled interdependence; and the most complex organizations have reciprocal, sequential and pooled. Thompson points out that an organization that contains reciprocal interdependence contains sequential and pooled interdependence; an organization that contains sequential interdependence contains the pooled type; however, an organization that contains pooled interdependence cannot determine whether it has the others. Thompson thinks that, in the order introduced, the three types of interdependence are increasingly difficult to coordinate because they contain increasing degrees of contingency.

Hirst (1981) argues that the higher the degree of interdependence, the higher the degree of task uncertainty, and consequently, the more confused the responsibility boundaries. Macintosh (1994) confirms Hirst's view that interdependence makes it difficult to delimit the responsibilities of each organization unit. Macintosh argues that inappropriate delimitation of the organization unit responsibilities would result in incorrect performance evaluation of the unit since the performance of the unit may be measured by the cost or revenue beyond its control. Along a similar vein Emmanuel and Mehafdi (1994) indicate that in the case of internal trade,

uncertainty is accentuated by the varying degrees of interdependence between and sometimes within organization units. They argue that the increased uncertainty may make the degree of task uncertainty higher and consequently makes the responsibility boundaries more confused. Riahi-Belkaoui (2001) thinks that higher interdependence between the business units may make every decision beneficial to one unit and harmful to another and thereby harms the whole organization. However, Riahi-Belkaoui points out that organizational decentralization is likely to be most beneficial and least costly when the organizational units are fairly independent.

To achieve the benefits and minimize the costs from the organizational decentralization, and delimit the responsibility of organization units, a TP system can be established as will be discussed in the following section.

2.4.3 Integrating Transfer Pricing with Organization Design

As previously discussed one way of coping with risks and uncertainty is for an organization to decentralize to create special units for the purpose of centrally managing the risks so that other units operate under certainty. Once the organization is decentralized and various responsibility centres are established, goods and services transferred among these units. Organizational decentralization expects unit managers to operate their units as an autonomous business. However, organizational units tend to be interdependent in most decentralized organizations. As previously discussed higher organizational interdependence may lead to the more confused responsibility boundaries. Therefore, TP should be designed to delimit the responsibility of organization units so that organization resources and the associated responsibilities can be properly assigned.

To account for the transfer of goods and services from one unit to another unit,

Smullen (2001) states that TP can be established to provide links between different organization units and defines in a quantitative way the nature of the relationship between different units. Smullen points out that when the linkages have been established among business units by a TP system, corporate goals, motivations and decision-making authorities are embedded in the system, through which these goals, motivations and authorities are assigned to various business units.

To examine whether each unit works towards the objectives of the whole organization, the performance of the units should be evaluated. As will be discussed in the following section, TP can be applied to evaluate the performance of business units. Solomons (1965) points out that business units are very much concerned with the allocation of costs and revenues to the functions and persons responsible for them in the business. This is because the profit contribution figures are often used as inputs to the organization incentive system. As TP is applied to derive the profit contribution, the TP model needs to be developed in a way that achieves the objective of correct allocation of the costs and revenues among the business units. The TP system must motivate business unit managers to pursue their own self-interest in a manner, which is conducive to the success of the company as a whole. This is one of the primary aims of the FTP model development in this thesis.

Once the TP system ensures its function of performance evaluation and goal congruence, an organization tends to be decentralized to cope with uncertainty and risks and to increase managerial efficiency. According to Ronen and McKinney (1970), a TP system becomes a necessary requirement for an organization to be decentralized. Smullen (2001) addresses the similar view that TP plays an important role in allowing the breaking up of the organization into units and activities.

The previous section discusses the role of TP in a decentralized organization, whereas the following section explores the transaction costs incurred in the TP process.

2.5 Transaction Costs Economics to the Transfer Pricing Process

Williamson (1985, p.1) argues that the appropriate level of economic analysis is the transaction, which he defines as the transfer of goods or services across a technologically separable interface. Colbert and Spicer (1995) state that transaction costs economics (TCE) focuses attention on the relative costs and hazards of conducting transactions within alternative governance structures. They argue that as the costs of conducting transactions within markets increase it becomes increasingly likely that firms will resort to alternative arrangements such as internalizing the transaction.

Van der Meer-Kooistra, and Vosselman (2000) point out that transaction costs are interpreted economically as opportunity costs. They illustrate that the opportunity costs are the gains missed due to not choosing the best among the non-chosen alternatives. The transaction costs may include suboptimal decision making, opportunistic behaviour by subunit managers, and internal friction and disharmony incurred from the TP process.

Williamson (1985) makes two assumptions, (1) bounded rationality and (2) opportunism, to underpin the TCE theory.

(1) According to Williamson (1985), bounded rationality refers to limited observational, language and computation abilities of individuals. The organizational failure framework from Williamson shows that when there is environmental uncertainty, bounded rationality precludes individuals from

foreseeing or anticipating all possible courses of action and their contract implications. Williamson identifies that the economization of bounded rationality takes the forms of decision processes and the involvement of governance structure. He states that when organizations are confronted with bounded rationality, the costs of planning, adapting and monitoring transactions need to be explicitly considered.

Noteboom (1992) explains that bounded rationality is caused by the scarcity or cost of information and limited capacity for information processing, beyond cognitive competency. Noteboom states that all possible contingencies could have been foreseen and incorporated into the contract prior to commitment if rationality were unbounded. Van der Meer-Kooistra, and Vosselman, (2000) argue that, due to bounded rationality, management accountants and other decision makers cannot possess all the information required for making an optimal decision at the initial decision moment.

(2) Williamson (1985) points out that opportunism is self-interest seeking behavior, which implies a lack of complete honesty in negotiating and enforcing contracts. He argues that because of opportunism, individuals enjoined in small numbers exchange may make false or self-serving claims about contract terms.

Williamson (1985) asserts that opportunism is a troublesome source of behavioral uncertainty. He illustrates that people may not be totally honest and truthful about their intentions, or they might attempt to make use of unforeseen circumstances that gives them the chance to exploit another party. Noteboom (1992) argues that if there were no opportunism, contracts could be left incomplete in the trust that unforeseen contingencies would be met in a spirit of

cooperation and mutual benefit.

After making the assumptions, Williamson (1985) puts forward three variables, which consist of (1) frequency, (2) uncertainty and (3) asset specificity, to determine whether the transfers made inside or outside have the lower transaction costs in various circumstances. Williamson argues that these variables of the TCE could be used to determine the organization's alternate mode of governing structure, economizing transaction costs. The three variables are discussed as follows:

(1) Frequency. According to Williamson (1985), frequency of trade refers to the frequency with which a particular transaction occurs in the market. Williamson argues that the cost of hierarchical governance structures will be easier to recover for large transactions of a recurring kind.

(2) Uncertainty. According to Williamson (1985), uncertainty is related to the issue on how hard it is to foresee the eventualities that might occur during the course of the transaction. Williamson thinks that governance structures differ in their capacities to respond effectively to disturbances (i.e. uncertainty). He contends that uncertainty is caused directly by the behavioral natures of opportunism and bounded rationality.

(3) Asset specificity. Williamson (1985) states that asset specificity is of special importance because without it TCE would lose much of its significance. Colbert and Spicer (1995) explain that asset specificity arises when durable investments are made in relation to a particular transaction and the value of the investment in its next best use is considerably lower. They argue that as the level of transaction-specific investment increases, it becomes increasingly

important for the firm to protect its economic interests in the transfer relationship by ensuring that conflict and opportunistic actions by subunits are controlled.

These three variables will, according to the theory, determine whether transaction costs will be lowest in an internal transaction or in an external transaction. According to Colbert and Spicer (1995), dimensions of the transactions, which involve asset specificity, uncertainty and extent, are thought to be positively related to the decision to make internal transactions. Colbert and Spicer argue that the greater the extent (frequency and volume) of the transactions the more likely the transactions are made internal. As the level of asset specificity increases, the transaction costs associated with firms conducting transactions within markets rise. In this circumstance, Colbert and Spicer advocate that internal transactions will be likely to have transaction costs advantages.

However, Colbert and Spicer (1995) warn that intemalizatlon of the transaction within the firm does not fully remove the potential transaction costs. They argue that firms may arrange their organization structures and control systems so as to encourage more cooperative, interdependent behaviour between subunits. According to Benke and Edwards (1980), TP is a system within the management control process. Thus a TP system can be established to minimize transaction costs. As previously discussed, six factors involve in the TP process. Therefore, the six factors need to be design so that the TP system can be established to minimize transaction costs.

To minimize transaction costs, and control the conflict and opportunistic actions by subunits, a TP system should achieve several important motives as discussed in the following section.

2.6 The Motives for Transfer Pricing

The discussions on the motives for TP help an organization determine the reasons why TP system should be established. Emmanuel (1976) states that the purpose of the TP system and the objectives of the individual firm should be compatible. He argues that companies having different overall objectives will not employ TP for the same purposes. Literature shows that the dominance of a particular TP motivation is dictated by the following four aspects, achievement of corporate goals, pinpointing divisional responsibility, evaluation of divisional performance and maximizing divisional autonomy.

2.6.1 Achievement of Corporate Goals

Benke and Edwards (1980) argue that TP has two major objectives, which are to guide the members of the company toward the company's goals (goal congruence) and to evaluate the progress of the company's segments toward these goals (performance evaluation). According to Benke and Edwards, as TP is a system within the management control process, the TP technique selected by a company must facilitate the objectives of goal congruence and performance evaluation.

Drury (1994) states that a sound TP system should motivate actions that increase the profits of the organization as a whole. This will happen when actions that managers take to improve their branch or departmental profits also improve the profit of the whole organization. According to Drury, where the organization objective is to measure managerial performance, the TP system should be designed as a behavioral tool and motivate managers to concentrate on the products that maximize the profits of the bank as a whole. Drury points out that if the objective is to measure economic performance, the TP method should be designed to best reflect the contributions that business units make to the profitability of the whole organization.

Smullen (2001) argues that funds transfer prices are indicative of the relationships between a bank's subunits and the bank as a whole. These prices should be set to enable a harmonization of goals of a bank and its subunits. Smullen states that appropriate funds transfer prices should be generated to ensure that the managers of a bank's business units act in a way, which is congruent with the total interest of the bank. On the other hand, Smullen points out that these managers may have opportunistic behaviour, they may pursue their own self-interest in a way that contravenes the culture and practice of the bank. Smullen argues that this may lead to a possibility of dysfunctional behavior if the appropriate funds transfer prices are not generated. Therefore, a poorly designed FTP system can lead to actions that maximize the profit of bank business units, but which are detrimental to the bank as a whole.

2.6.2 Pinpointing Divisional Responsibility

Risk management is increasingly a vital activity for all financial organizations and banks are faced with the challenge of assigning the costs of the risks to the appropriate units, while simultaneously isolating responsibility for managing and controlling the risks. Uyemura and Deventer (1993) point out that bank business units' managers may have some discretion of asset and liability product pricing, but they may have no control over market yield curve shifts or unusual behavior of index rates, such as the prime rate. Therefore, the responsibility of managing the risks should be clearly identified and isolated.

Both Chorafts (1997) and Bessis (1998) advocate that a FTP system should serve to properly allocate risks within a bank so that the performance of business units is independent of market movements beyond their control. They argue that the purpose of FTP process is to let business units not be responsible for managing the risks beyond their control. To assign the responsibility of managing the risks, each

risk involved in the funds transactions should be identified and isolated. However, both Chorafts and Bessis do not concern how bank risks can be decomposed with FTP.

Ersoz (2000) addresses that FTP methodologies are critical to the understanding of bank risks and risk management. To clearly identify the responsibility of managing financial risks that are embedded in different departments within the bank, the risks must be isolated and assigned to the appropriate units. Smullen (2001) confirms the view of Ersoz that one key principle of FTP is to ensure that the risk management responsibility is clearly identified and isolated.

2.6.3 Evaluation of Divisional Performance

As previously discussed TP is a system within the management control process, thus TP must facilitate the objective of performance evaluation. Smullen (2001) argues that if a bank breaks up its business into its components and to establish sensible transfer prices, the bank can calculate the performance margins of a transaction or any sub portfolio of transaction and its contributions to the overall margin of the bank. Similarly, other researchers present their views on how FTP is used for the performance evaluation of bank business units. Drury (1994) declaims that FTP enables a bank to allocate bank internal revenues to the fund providers and internal expenses to net fund users. In this circumstance, Drury states that the application of FTP can result in a report of branch/product profits that represents a reasonable measure of the contribution of the branch/product to the profits of the society as a whole.

Cole and Woody (1995), Ernst & Young (1995), Bessis (1998) and Greuning and Bratanovic (2003) argue that FTP can facilitate the profitability measurement of various components (branches, products, customer, and accounts) of the institution

by relating appropriate costs to revenues. By charging funds users and crediting funds providers, bank top management can monitor and evaluate whether business units perform in a way that add values to the bank. Thus, FTP enables bank managers understand the impact of individual unit in the generation of profits.

Under the TP system, the information on the performance evaluation of each unit is reported on the basis of where the results were incurred and who has responsibilities for them. This requires that business units' performance measurement can only be made on the factors under their control. It is critical to separate controllable costs from noncontrollable costs. Mehafdi (1992) argues that performance evaluation cannot be expected to achieve the desired motivational impact on divisional managers if the managers are judged on the basis of non-controllable factors, especially if the effect of these factors on performance results is not taken into account when deciding on the reward and punishment policies. Along a similar vein Riahi-Belkaoui (2001) states that the inclusion of noncontrollable items in performance reports was found to produce unfavourable ratings for the performance measurement reports.

Eccles (1985) states that TP practices affect performance measurement, evaluation, and reward, which in turn affect perceptions of fairness by individual managers. Shih, Crandon and Wofford (2004) state that the profit contribution figures derived from the FTP system are often used to measure and evaluate performance as well as to support the decision-making process. They point out that these results are also used to determine provisions of the incentive system. Under these circumstances TP directly affects employee behavior, and thus has real impact on all the operations of the institution.

2.6.4 Maximizing Divisional Autonomy

Ronen and McKinney (1970) states that a TP system must serve as a stimulus to managers to increase their efficiency without losing the autonomy of divisions as profit centers. Along a similar vein Antić and Jablanović (2000) state that business unit managers in an organization should be free to satisfy their own needs either internally or externally at the best possible price.

FTP should not interfere with the process wherein the funds using unit rationally strive to minimize its costs and the funds providing unit rationally strive to maximize its revenues. In a financial organization, funds providers try to maximize its revenue from the funds transferred, and the funds users try to minimize the transfer prices on the funds transferred to them. This situation may be more complicated when there are restrictions imposed on the subunits by the top management. For example, a bank may put forth a rule, which prevents one subunit from using funds from the external market until internal funds are used up, or a policy which states that only some particular funds may be purchased externally without central management approval. Under this circumstance, according to Emmanuel and Mehafdi (1994), given the implicit value judgments and behavioral norms inherent in the performance evaluation and reward system, it is normal to expect divisional managers to engage in what may be perceived by central management as dysfunctional behavior. Emmanuel and Mehafdi believe that this may take the form of private information withholding and misrepresentation, which may result in sub-optimization. Emmanuel and Mehafdi point out that to reduce sub-optimization, an optimal TP system should be set up to ensure that the organization's as well as the subunits' profit maximization can coexist with the operating autonomy of the subunit managers.

However, Yunker (1982) states that the greater the subsidiary autonomy, the

tighter performance evaluation must be in order to maintain the necessary level of control. Given the important function of TP in coordinating action of the interdependent business units, the greater the subsidiary autonomy, the stronger the TP must be designed to monitor and control the business units.

As discussed above, TP aims to achieve several important objectives for an organization, it is difficult to establish a TP system that accomplishes all the objectives, but it is critical to consider the most important objectives simultaneously. Different organizations may have different organizational structure and face different external environment. Therefore, they may focus on different objectives and the TP system established must seek to achieve the objectives set by the organization. The subsequent section discusses the comparisons of the transfer price derivation in different industries, whereas the following chapter details the TP methods applied in the different industries.

2.7 Comparisons of Transfer Price Derivation in the Manufactory and Financial Industries

There are numerous methods that can be used to generate transfer prices. It is easier for financial institutions to produce transfer prices than that for manufactory companies since financial institution managers have a good understanding of the cost structures in terms of the inputs of financial obligations into their production process. For example, if a bank raises funds and then invests those funds, the cost structure of the funds can easily be estimated from the competitive and efficient money market. The managers can also show how their costs relate to revenues because revenues are derived from financial obligations, which are based on their costs, and thus have a good understanding of their cost structure. However, the TP method is more complex for financial institutions than for manufactory industries due to the following three reasons.

First, the cost structure is more volatile for financial industry than manufactory industry. Manufacture's systems have developed over a long period of time because manufacturers generally do repetitive tasks over consistent time frames. Thus, the factors for the manufactory industries' TP model are relatively stable. In the financial industry, the product mix and demands for resources vary considerably from month to month depending on interest rates, the general economic condition, and customers' demand for loans, certificates of deposit (CDs), and other financial products. The variability of the number of the product inputs and outputs makes the FTP model complex since it must incorporate the variability to reflect the changing financial situations.

Second, the uncertainty of the future costs makes the TP model more complex for financial institutions than manufactory industries. Once a manufacturer has produced a product, its expense essentially stops. However, a financial institution that makes a three-year fixed loan, which is supported by one-year CDs, must face the risk incurred from rising levels of interest rates. The payment from customers for the loan is fixed, but the payment for the CDs may increase due to increasing levels of interest rates. This may mean the financial institution suffers from a narrowing loan yield. Thus the FTP for the CDs and the loan must include the future costs incurred from changing levels of interest rates.

Third, a distinguishing feature of financial institutions is that they operate in a competitive financial market. Thus their profitability is highly sensitive to their cost of capital, especially to their cost of risk capital. As will be discussed in Chapter Seven, risk capital is one of the main inputs for the FTP model.

2.8 Summary

This chapter outlines the TP definitions for manufacturing and financial industry.

The definitions show that TP plays an important role in the management accounting system and it is a critical component of the profitability measurement process. For the further understanding of the TP definition, a six-factor TP framework is reviewed.

This chapter also reviews TP in a relevant organization context. The aim of the organization decentralization and integration is to reduce business uncertainty, to enable efficient decision making, to measure the impacts of managerial decisions and to increase motivation congruent with the organisation's objectives. Reviews of the transaction cost economics reveal that internal transactions and an appropriate TP system can be used to solve the conflicts between business units.

This chapter also examines the four motives for FTP. Achievement of corporate goals is considered to be a motive to let business units act in a way that achieves corporate goal congruence. Accurately pinpointing divisional responsibilities would ensure that the responsibilities of managing the risks are clearly identified and isolated, and correctly evaluate the economic performance of business units. Evaluation of divisional performance is an important motive for FTP. FTP enables bank managers properly evaluate the provision or use of funds by the business units or products, and understand the sources of profits. This chapter also reviews that business units' autonomy should be maximized by FTP.

Chapter Three: Transfer Pricing Methods

3.1 Introduction

There are a number of methods for generating transfer prices and this section provides a review of the techniques. The key perspectives are derived from economics literature, which focuses on the conditions making central planning efficient, and from accounting literature, which is concerned with the practical application of TP within a commercial environment. The FTP methods for financial institutions are reviewed for providing understandings on how funds transfer prices are generated to achieve the motives of FTP, especially for corporate goal congruence and performance evaluation.

The first section of this chapter reviews the economist's perception of optimal transfer prices. The second section reviews the TP methods from the accountant's perception of transfer prices followed by the third section, which discusses FTP methods for the financial institutions. The final section is the summary.

3.2 The Economist's Perception of Optimal Transfer Prices

Smullen (2001) points out that the economic theory of TP was initially developed to understand how optimal planning might take place in a socialist economy. The model outlined in this section tries to explore the main theoretical insights of the economics literature in relation to TP. The following example on how to derive optimal transfer prices is from Smullen. It considers a firm with two departments: a basic production department and a finishing and sales department. The production department manufactures the output, which it can sell to an outside market or provide to the sales department. The sales department can buy the product from the outside suppliers and sell the final output on the market.

Smullen (2001) thinks that this situation can be set up as a standard maximization

problem. The situation where both departments are run as a single profit-maximizing unit is compared with that where both departments are run separately. The production department has a choice of selling the product direct to the market or to the selling department for a transfer price. The model discussed by Smullen identifies the transfer price, which will lead both departments to maximize their joint profit.

3.2.1 The Initial Model

In the initial model of the firm, Smullen (2001) develops a joint profit maximization decision in terms of the levels of sales by the production department to the market, the level of purchases of the product from the market and the level of sales by the sales department. In this example, Smullen assumes that the firm has market power in all the markets in which it trades. In this circumstance, Smullen declares that the setting of sales and outputs can be seen as one solution, which implies a set of prices in each of the markets in which it trades. If the appropriate set of prices were established then the sales would be at the optimal levels. Smullen states that it is the standard idea that the firm with market power can either set prices or the quantity of trades. Smullen points out that if the firm were a price taker in any market then the revenue function would just be the market price times the quantity of sale and the result would be a special case of the general model, the marginal revenue being the price.

Smullen (2001) presents the following profit function for the firm. This model is set up for a single time period[1].

$$\Pi = R_s(Q_2 + Q_3) + R_p(Q_1) - C_s(Q_2 + Q_3) - C_p(Q_1 + Q_2) - C_{ss}(Q_3) \qquad (3.1)$$

Where:

Π = profit of the joint business.

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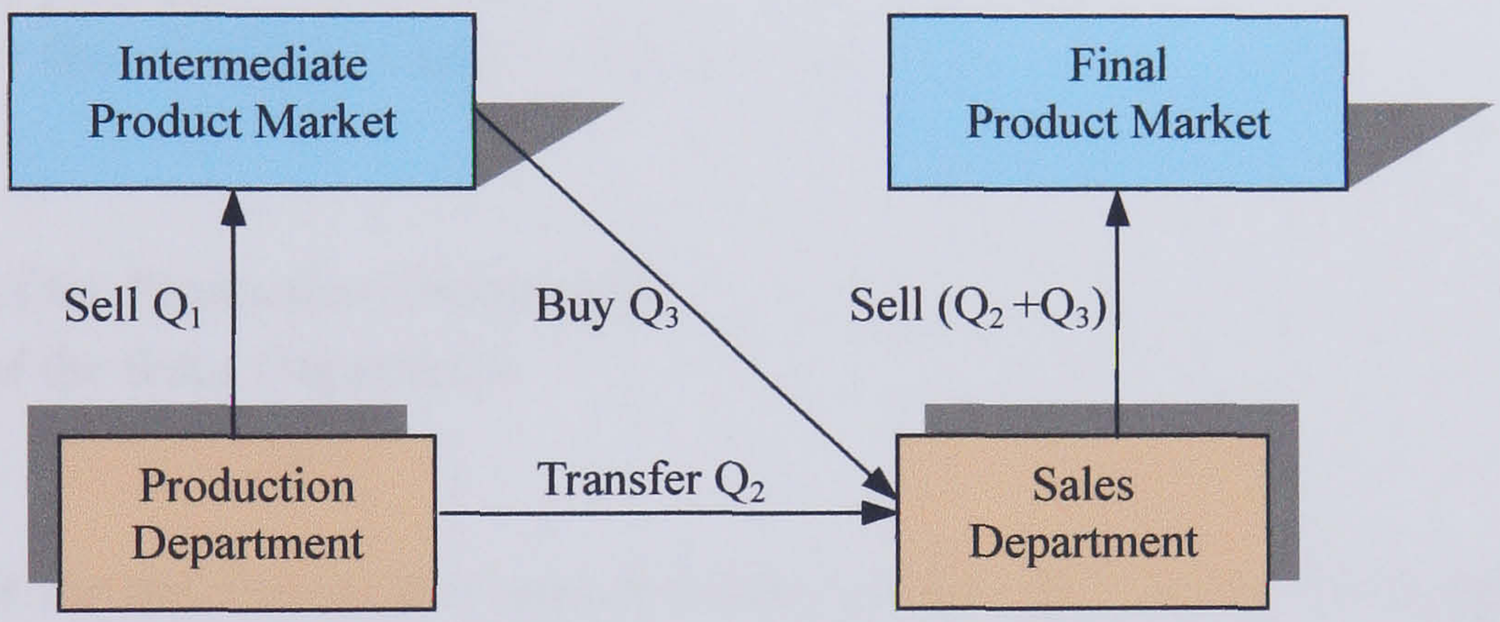
[1]Smullen (2001) states that this type of model can be established for a number of time periods. In general, however, the results will take the same form if there are no links between performances in the different time periods.

Q_1 = the amount of output of the production department sold outside the firm.
Q_2 = the amount of output of the production department sold inside the firm.
Q_3 = the amount of output bought outside the firm by the sales department.
R_s () = the revenue function of the sales department.
R_p () = the revenue function of the production department.
C_s () = the cost function for purchases by the sales department.
C_{ss} () = the cost function for purchases by the sales department outside the firm.
C_p () = the cost function of the production department.

To illustrate Smullen's (2001) initial model, the intermediate and final product sale route are depicted in Figure 3.1.

Figure 3.1: The Intermediate and Final Product Sale Route



In Figure 3.1, Q_1 is the amount of output of the production department sold to the outside intermediate product market and Q_2 is the amount sold to the sales department. The sales department buys the amount of Q_3 from the intermediate product market. The sales department produces the final products, which are further processed from the products bought from both the production department and the intermediate product market. Finally, the amounts of Q_2 plus Q_3 are sold to the outside market by the sales department.

According to Smullen (2001), the firm has three revenue functions $R_p(Q_1)$, $T_P(Q_2)$ and $R_s(Q_2+Q_3)$, the first being for the intermediate product sold by the production department outside the firm, the second for the intermediate product sold by the production department to the sales department, and the third for the final product sold by the sales department. Smullen breaks up the firm's cost function into four

components, C_p (Q_1+Q_2), which constitutes the costs of the production department, $T_P(Q_2)$, which is the cost of the sales department purchasing the intermediate products from the production department, C_{ss} (Q_3), which is the cost of the sales department purchasing the intermediate goods from outside market, and C_s (Q_2+Q_3), which is the cost of finishing and sales. According to Smullen, the form of C_{ss} (Q_3) indicates that the firm has market power in this market and is not faced by parametric prices.

Having determined the revenue and cost functions, the profit functions for the production department and the sales department are derived as:

$$\Pi_p = R_p(Q_1) + T_P(Q_2) - C_p(Q_1 + Q_2)$$
$$\Pi_s = R_s(Q_2 + Q_3) - T_P(Q_2) - C_{ss}(Q_3) - C_s(Q_2 + Q_3)$$

Where:

Π_p = profit of the Production Department.

Π_s = profit of the Sales Department.

The total profit for the firm is the sum of the profit from the production department and the sales department. The sum of Π_p and Π_s is as follows:

$$\begin{aligned}\Pi &= \Pi_p + \Pi_s \\ &= R_p(Q_1) + T_P(Q_2) - C_p(Q_1 + Q_2) \\ &+ R_s(Q_2 + Q_3) - T_P(Q_2) - C_{ss}(Q_3) - C_s(Q_2 + Q_3) - C_p(Q_1 + Q_2) \\ &= R_s(Q_2 + Q_3) + R_p(Q_1) - C_s(Q_2 + Q_3) - C_p(Q_1 + Q_2) - C_{ss}(Q_3)\end{aligned}$$

It can be seen that the profit function derived above is exactly the same as that from Equation 3.1. Smullen (2001) presents the joint first order profit maximizing conditions for the firm as follows.

$$\frac{\partial \Pi}{\partial Q_1} = \frac{\partial Rp}{\partial Q_1} - \frac{\partial Cp}{\partial Q_1} = 0 \qquad (3.2)$$

$$\frac{\partial \Pi}{\partial Q_2} = \frac{\partial Rs}{\partial Q_2} - \frac{\partial Cs}{\partial Q_2} - \frac{\partial Cp}{\partial Q_2} = 0 \qquad (3.3)$$

$$\frac{\partial \Pi}{\partial Q_3} = \frac{\partial Rs}{\partial Q_3} - \frac{\partial Cs}{\partial Q_3} - \frac{\partial Css}{\partial Q_3} = 0 \qquad (3.4)$$

Smullen (2001) illustrates that the optimal levels for the choice variables Q_1, Q_2 and Q_3 satisfy these conditions as is implied. The conditions are all variants of the normal marginal revenue, which equals marginal cost conditions. Smullen addresses that there are other sets of conditions implied by the functional form of the equations contained in the model. They are outlined in Equations 3.5 to 3.7.

$$\frac{\partial Rs}{\partial Q_2} = \frac{\partial Rs}{\partial Q_3} \tag{3.5}$$

$$\frac{\partial Cs}{\partial Q_2} = \frac{\partial Cs}{\partial Q_3} \tag{3.6}$$

$$\frac{\partial Cp}{\partial Q_1} = \frac{\partial Cp}{\partial Q_2} \tag{3.7}$$

Smullen (2001) explains the meanings of these marginal conditions as follows. Equation 3.2 shows that the marginal revenue from outside sales equals the marginal costs of production. Equation 3.3 suggests that the marginal cost in production added to the marginal costs in the sales department should equal the marginal revenue in sales. The marginal revenue in sales should also be equal to the sum of the marginal costs in sales and the marginal cost of buying the product from the outside market as indicated by Equation 3.4. Equation 3.5 indicates that the marginal revenues for the internally produced and bought in should be the same for the sales department. Equation 3.6 shows that the marginal costs in relation to the selling department should be the same for the product bought in as for the product manufactured by the production department. Equation 3.7 indicates that the marginal costs in the production department for the outside and inside sales should be same.

3.2.2 Profit Maximizing Model for Production Department

To develop the profit maximizing models, it is assumed that the production department and the sales department make their own decisions for their operations. The units Q_2, which are transferred from the production to the sales department, do

so at a transfer price of T_P. In these circumstances, Smullen (2001) provides the following profit maximizing models for the individual departments.

$$\Pi_p = R_p(Q_1) + T_p(Q_2) - C_p(Q_1 + Q_2) \tag{3.8}$$

The first order maximization conditions presented by Smullen (2001) are as follows:

$$\frac{\partial \Pi p}{\partial Q_1} = \frac{\partial Rp}{\partial Q_1} - \frac{\partial Cp}{\partial Q_1} = 0 \tag{3.9}$$

$$\frac{\partial \Pi p}{\partial Q_2} = Tp - \frac{\partial Cp}{\partial Q_2} = 0 \tag{3.10}$$

$$\frac{\partial Cp}{\partial Q_1} = \frac{\partial Cp}{\partial Q_2} \tag{3.11}$$

Smullen (2001) declaims that these conditions are those of profit maximization for the production department and again are standard marginal cost and revenue conditions.

3.2.3 Profit Maximizing Model for Sales Department

To facilitate the derivation of the first order conditions for profit maximizing for sales department, the profit function for the sales department is reiterated as follows:

$$\Pi_s = R_s(Q_2 + Q_3) - C_s(Q_2 + Q_3) - C_{ss}(Q_3) - T_p(Q_2)$$

According to Smullen (2001), the profit maximizing conditions for the sales department are as follows:

$$\frac{\partial \Pi s}{\partial Q_2} = \frac{\partial Rs}{\partial Q_2} - \frac{\partial Cs}{\partial Q_2} - Tp = 0 \tag{3.12}$$

$$\frac{\partial \Pi s}{\partial Q_3} = \frac{\partial Rs}{\partial Q_3} - \frac{\partial Cs}{\partial Q_3} - \frac{\partial Css}{\partial Q_3} = 0 \tag{3.13}$$

$$\frac{\partial Rs}{\partial Q_2} = \frac{\partial Rs}{\partial Q_3} \tag{3.14}$$

$$\frac{\partial Cs}{\partial Q_2} = \frac{\partial Cs}{\partial Q_3} \tag{3.15}$$

Smullen (2001) declares that if one considers the profit maximization conditions for the two as separate entities with the joint profit maximization solution equations, they are the same except for the equations in which T_p occurs. Therefore, if there are to be any problems in the separate management of the two departments they will be related to making equations 3.10 and 3.12 consistent with equation 3.3. Smullen points out that the degree of consistency depends on at what level the transfer price is set. Smullen illustrates that if one sets the transfer price so that the maximizing conditions are satisfied in the two departments and jointly for both combined, there is a single transfer price, which is both the receipt of the production department and the expenditure of the sales department.

3.2.4 Optimal Transfer Prices

Smullen (2001) derives the optimal transfer prices from both Equation 3.10 and 3.12.

$$Tp = \frac{\partial Cp}{\partial Q_2} = \frac{\partial Rs}{\partial Q_2} - \frac{\partial Cs}{\partial Q_2} \tag{3.16}$$

Equation 3.16 shows that the optimal transfer price is the one where the marginal costs of the production department are equal to the difference between the marginal revenue of the sales department and the marginal costs of the sales department on selling the output of the production department.

The previous section discusses the economist's view of transfer prices, whereas the following section explores the accountant's perception of transfer prices.

3.3 The Accountant's Perception of Transfer Prices

Smullen (2001) thinks that accountants have considered and used transfer prices that are optimal from the economist's perspective, but they have in general been more practical in their own views and related more to what has been used for transfer prices within the commercial world. The TP methods reviewed in this section includes cost based TP method, negotiated TP method, market based TP method and linear programming TP method.

3.3.1 Cost Based Transfer Pricing Methods

Cost-based TP method uses standard costs as a basis of pricing. Emmanuel and Mehafdi (1994) state that basing TP on standard costs has the benefit of making supplying divisions aware of costs and the need to be efficient. This section examines (1) marginal cost based TP method and (2) full cost based TP method.

Marginal Cost Based TP Method

The marginal cost is the incremental cost of producing additional units. Solomons (1965) argues that marginal cost has a real claim to form the basis of transfer prices. According to Hirsch (2000), most accountants and managers treat incremental variable costs as an approximation of marginal cost.

The marginal cost based TP method can be illustrated by an example adapted from Emmanuel and Mehafdi (1994). In this example, Division X transfers intermediate products to Division Y, which will further processes the products to the final products. The assumed cost and revenue function for both divisions are presented in Table 3.1. The calculation process of the transfer price is illustrated in Table 3.2.

Table 3.1: Assumption of the Cost and Revenue for Division X and Y

	Division X	Division Y
Average Cost	25+7.5Q	5Q
Average Revenue	---	200-2Q

Where Q represents the quantity of output.

Table 3.2: The Calculation of the Marginal Cost Transfer Price

	Division X	Division Y
Total Cost	$25Q+7.5Q^2$	$5Q^2$
Total Revenue	---	$200Q-2Q^2$
Marginal Cost	25+15Q	10Q
Marginal Revenue	---	200-4Q

Optimal Output Level: Marginal Cost=Marginal Revenue

$25+15Q+10Q=200-4Q \Longrightarrow Q = 175/29 \approx 6$ units

Optimal Transfer Price= Marginal Cost of Supplying Division at the Optimal Output Level

=25+15Q=25+15*6=115 per unit

Source: adapted from Emmanuel and Mehafdi (1994, p.17)

As previously discussed, the optimal transfer level of an intermediate product takes place when the transfer price for the intermediate product equals marginal cost of the division that buys the product. To calculate marginal cost and revenue, the continuous functions in Table 3.1 need to be converted to total costs and revenues, and then differentiated. Table 3.2 shows that the optimal output level is derived when the marginal cost equals marginal revenue. As shown in Table 3.2, the marginal cost transfer price for the supply division X is 115 per unit.

The marginal cost based TP method has some advantages. Smullen (2001) declaims that if the transfer price is set on this basis it prevents certain dysfunctional behaviors by the organizational units. Smullen explains that if the transfer price is set above the marginal cost then the supplying department has an incentive to sell as much as possible since it will make an extra profit on each unit sold. If the transfer price is set below the marginal cost then there is no incentive for the supplying department to provide an extra unit.

On the other hand, the marginal cost TP method has some limitations. (1) Kaplan and Atkinson (1998) advocate that marginal cost includes capacity-related costs, which are changing continuously. In this circumstance, Kaplan and Atkinson conclude that the marginal cost based TP needs to be adjusted continuously. The continuously changing TP makes the performance evaluation of business units difficult. (2) Another limitation is put forward by Riahi-Belkaoui (2001).

Riahi-Belkaoui advocates that although the marginal cost TP method is conceptually appealing, a transfer price based on this method requires available information on all production levels. Riahi-Belkaoui states that, because such figures are not always available, the variable cost may be used as an approximation. This is only an approximation because incremental cost can include costs other than strictly variable costs.

Full Cost Based TP Method

Antić and Jablanović (2000) state that this method includes all production costs as well as costs from other business functions. Therefore, the full cost TP method involves the allocation of all costs to whatever cost objective is being considered. Riahi-Belkaoui (2001) illustrates that TP based on full cost of the product is based on actual absorption cost. The full cost is then divided by the number of units to derive a price per unit, which is used as the transfer price.

The concept of the full cost TP method can be best illustrated with an example. It is assumed that a firm consists of two profit centers, Center A and Center B. Center B manufactures and sells the product Y to the outside markets. Center A sells Center B the component X, which is an integral part of product Y. The cost components of product X and Y are given in the Table 3.3.

Table 3.3: Cost Components of Product X and Y

Elements	Center A Component X (Unit Cost in $)	Center B Product Y (Unit Cost in $)
Cost of direct materials	2.40	0.60
Cost of direct labor	2.00	1.00
Factory overhead	4.50	1.60
Selling costs	2.60	0.30
Transfer Price	Not Applicable	Need to be solved
Total Costs	11.50	

With the full cost based TP method, the transfer price for the component X is the sum of the cost of all the elements listed in the second column of the Table 3.3, all

the elements in the "Profit Center A Component X".

Transfer Price = The Full Cost = $2.4 + $2 + $4.5 + $2.6 = $11.5

Riahi-Belkaoui (2001) advocates that the cost based TP method has the advantaged of being measurable, verifiable and readily available. This method could be applied for intermediate products with specific characteristics that cannot be found on the external market.

On the other hand, the full cost based TP method has some limitations. (1) One limitation is that the full cost based TP method may provide inaccurate cost information. Riahi-Belkaoui (2001) states that a transfer price based on full cost is actually based on absorption cost because it includes all direct and indirect expenses. As a result, Riahi-Belkaoui thinks that this type of transfer price may transfer the inefficiencies of the selling division to the buying division, making it unwise to use divisional profit for divisional performance evaluation. (2) Another limitation is that the full cost based TP is not costing system but cost recovery system that makes no attempt to reflect underlying cost behavior. Kaplan and Atkinson (1998) analyze that this limitation is due to the reason that the full cost method is often implemented by using a formula approach that takes variable cost and adds an arbitrary markup to cover capacity-related costs and perhaps a targeted profit margin.

3.3.2 Negotiated Transfer Pricing Method

Kaplan and Atkinson (1998) put forward that given the lack of a perfectly competitive market for the intermediate product and the limitations of cost based TP methods, perhaps the most practical method for establishing a transfer price is through negotiation between the managers of the two divisions. A negotiated transfer price is set by negotiations between the buying and selling profit centers. Riahi-Belkaoui (2001) states that a negotiated transfer price is the price set after bargaining between the buying and selling divisions. This system requires that

these divisions deal with one another in the same way that they deal with external suppliers and buyers.

To illustrate the negotiated TP methods, the following example assumes that the two profit center managers in the previous example negotiate a transfer price equal to full cost plus a markup of 30% of the full cost. As Table 3.3 shows that the full cost is $11.50 per unit. Adding a markup of 30% of the full cost, the negotiated transfer price is derived as follows:

Negotiated transfer price = 11.50*(1 + 30%) = $14.95 per unit

The negotiated TP has some advantages. Vaysman (1998) advocates that the negotiated TP method provides the firm's top management with significant decentralization benefits. Vaysman declaims that, under centralized decision-making structures, the firm's top management must learn divisional information to provide a transfer price. Top management must then spend scarce time learning and processing highly complex divisional information, possibly at the expense of long-run decisions. Under the negotiated TP, Vaysamn declares that top management does not have to understand divisional managers' private information and get involved in setting the transfer price. Other advantages put forward by Antić and Jablanović (2000) are that the negotiated TP method satisfies the motives of TP for goal congruence, performance evaluation and autonomy.

On the other hand, the negotiated TP method has some limitations. (1) The negotiated TP method may have the possibility that the firm's managers agree on suboptimal levels of output from the firm's point of view. Kaplan and Atkinson (1998) state that it may lead to a suboptimal level of output if the negotiated price is above the opportunity cost of supplying the transferred goods. (2) Vaysman (1998) indicates that the time required for negotiations is a big limitation for the negotiated TP. (3) Riahi-Belkaoui (2001) states that the negotiated TP system may have a negative behavioral impact when personality conflicts arise between the

bargainers; succeeding in the negotiation may become a more important goal than the company's profitability. This confirms Mautz (1968)'s view that the negotiated price implies an evaluation of the power to negotiate rather than evaluation of the performance itself. (4) Another drawback of this method discussed by Riahi-Belkaoui is that transfer prices should be set arbitrarily by a central decision of the top management when conflicts arise during the transfer price negotiations.

3.3.3 Market Price Based Transfer Pricing Method

Riahi-Belkaoui (2001) defines that a market price is the price, at which the producing and selling division would sell the product externally. In other words, the producing division charges the same price to its divisions as it would charge to outside customers in open market transactions. Riahi-Belkaoui states that, in practice, an organization will usually encourage internal rather than external transactions. The organization will usually benefit if the transaction occurs internally rather than having a producing division sell a certain amount externally while the purchasing division is acquiring the same amount from its own outside suppliers. Riahi-Belkaoui finds that internal rather than external transfers are encouraged by means of a discount from market price that is offered to reflect savings on selling and collection expenses and the delivery, service, or warranty terms associated with external sales. This discount may encourage an internal transfer, all other factors being held equal.

Wilson and Chua (1993) advocate that the market price based TP is applicable only under restrictive conditions. To effectively apply the prices for the transfers of the intermediate product, Wilson and Chua state that there should be perfect competition in the product market. Similarly, Riahi-Belkaoui (2001) states that a TP system based on market prices requires a competitive market, minimal interdependencies of the profit centers and the availability of dependable market quotations. If a highly competitive market for the intermediate product exists, then the market price less any adjustments discussed above can be the proper transfer

price. According to Riahi-Belkaoui, the conditions of a highly competitive market imply that the producing division is operating at full capacity and can sell as much of the product as it wishes to outside customers. The purchasing division can acquire as much as it wishes from outside suppliers. In the competitive market, either division should not affect the price of the product being transacted. Under these circumstances, Kaplan and Atkinson (1998) state that the market provides an objective valuation of the intermediate product, and that market price should be used to price transfers.

The comparison of the market price based TP method in competitive market and noncompetitive market is illustrated with an example. It is supposed that a company sells 1,000 units externally and 3,000 units internally. The assumed sale prices in competitive market and noncompetitive market are listed in Table 3.4.

Table 3.4: Market Sale Price (Competitive Market Vs. Noncompetitive Market)

Unit Sales	Sales Price Per Unit (Competitive Market)	Sales Price Per Unit (Noncompetitive Market)
1,000	16	16
2,000	16	14
3,000	16	12
4,000	16	10
5,000	16	8

In the competitive markets, it is assumed that the prevailing competitive market price is $16 per unit. If this price is used as the transfer price, and 3000 units are sold internally, the supplying division' revenue is as follows:

Total Revenue = $16*1,000 + $16*3,000 = $64,000

When the 3000 units are sold externally, the supplying division's revenue is the same as that when the units are sold internally. This is due to the reason that, in the competitive markets, the transfer price does not change with the demand on the intermediate products.

In the noncompetitive markets, if the transfer price is determined from the market price of $16, the total revenue is as follows:

Total Revenue = $16*1,000 + $16*3,000 = $64,000

However, the sales price changes as the demand for the intermediate products changes. When the 3000 units sold externally, the total units sold will be 4000 units, under this circumstance, Table 3.4 shows that the market price is $10 per unit and the total revenue will be changed as follows:

Total Revenue = $10*1,000 + $10*3,000 = $40,000

The calculation shows that when the 3,000 units previously sold internally are sold externally in the noncompetitive market, the price for each of the 4,000 units drops to $10 per unit, generating $40,000 in revenue, a decline of $24,000 compared with that of the competitive market. The transfer price of $16 per unit for the 3,000 units sold internally implicitly assumed that these units could be sold externally for $16 per unit, when, in fact, they could not. Therefore, assuming that the internal sales could be sold at external prices clearly is unrealistic in a noncompetitive market. This example confirms that market price based TP is only appropriate in competitive markets where the selling and buying divisions do not affect the price of the products being transacted.

The market price based TP has some advantages. (1) The market price has the advantage of providing an objective measure of value for goods or services exchanged. Wilson and Chua (1993) advocate that when competitive market conditions prevail, transfers that are made at market prices result in reported profits that are more representative of the economic contribution of the division to total organizational performance. Wilson and Chua explain that this is because, under competitive conditions, a market price is the opportunity cost of the goods. It represents the incremental cost to the buying division of buying the goods and further processing them. As previously discussed, incremental cost information are

useful in assessing the profit contributions made by business activities. (2) Another advantage is that the market price based TP ensures divisional autonomy. Riahi-Belkaoui (2001) argues that the market price is considered the most effective transfer price because it ensures divisional autonomy. With market price, a manager has the option of transacting either with another division or through an external party at the same market price. Therefore there is no need for a transfer price that is imposed by the top management.

The market price based TP also has some limitations. According to Riahi-Belkaoui (2001), there are serious limitations for using the market price based TP method due to the following three reasons: (1) In today's regulated economy, perfectly competitive markets are very rare. In an imperfect market, sellers or buyers can affect the market price. Therefore, market price is not appropriate for setting transfer price. (2) Even if the intermediate market is perfect, there is no guarantee that the market price is for a product strictly comparable in terms of grade and other relevant characteristics. Thus it is inappropriate to apply market price without any adjustments. (3) When the goods or services transferred do not have a ready market price, market price based TP cannot be derived.

3.3.4 Linear Programming TP Method

TP becomes complex when several divisions use one or more supplying divisions, when several goods and services are internally traded and when reciprocal interdependence[2] is present. Under these circumstances, Riahi-Belkaoui (2001) suggests that linear programming or shadow prices can be used for setting transfer prices. The value of mathematical programming of transfer prices lies mainly in the information extracted from the shadow prices produced by various models. Riahi-Belkaoui declares that the shadow prices provide a measure of opportunity costs internal to the organization and are believed to be the most realistic measure

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[2] Thompson (1967) defines that the reciprocal interdependence refers to the situation in which the outputs of each become inputs for the others.

of internal pricing for transactions between divisions. Emmanuel and Mehafdi (1994) think that these shadow prices, when combined with the relevant variable costs of constrained resources, can be used to develop transfer prices.

The linear programming TP method has some advantages. As Riahi-Belkaoui (2001, p.178) remarks, "because the calculations are explicit, the method may result in less conflict and be more acceptable to division managers. This is because the division managers have contributed to its calculation by proposing the various solutions from the programs they established." Riahi-Belkaoui states that the linear programming method has the advantage of being adaptable to a decentralized firm. The program can also be altered to encompass changing conditions.

According to Riahi-Belkaoui (2001), the linear programming method also has some limitations. Riahi-Belkaoui thinks that this method may be inappropriate if division managers provide inaccurate data to gain more control over the allocation of the scarce resource. Another limitation proposed by Riahi-Belkaoui is that the calculation process of the linear programming may be time consuming and costing.

3.3.5 A Comparison of the Transfer Pricing Methods

Kaplan and Atkinson (1998) state that it is true that no one TP system will work best in all organizations. Rather, the TP practice chosen in a particular firm must reflect the requirements and characteristics of that firm and must ultimately be judged by the decision-making behavior that it motivates. A summary of practice of using TP methods is outlined as follows.

(1) According to Kaplan and Atkinson (1998), where a competitive market exists for the intermediate product, an excellent transfer price can be obtained by adjusting the market prices with the selling, distribution, and collection expenses for outside customers.

(2) Where an outside market exists for the intermediate product but is not perfectly competitive and where a small number of different products are transferred, Kaplan and Atkinson (1998) suggest that a negotiated transfer price will probably work best, since the outside market price can serve as an approximation of the opportunity cost.

(3) When no external market exists for the intermediate product, Kaplan and Atkinson (1998) suggest that transfer should occur at the long-run marginal cost of production. Kaplan and Atkinson think that this cost will facilitate the decision making of the purchasing division by providing the stability needed for long-run planning but at the same time exposing the cost structure so that short-term improvements and adjustments can be made.

(4) Kaplan and Atkinson (1998) argue that a transfer price based on fully allocated costs per unit or full cost-plus markup has no discernible desirable properties.

(5) According to Riahi-Belkaoui (2001), linear programming TP method may not be used in producing transfer prices due to the complex, time consuming and costing process of the calculations.

The previous sections have discussed TP in a setting where physical goods are transferred within manufactory organizations, whereas the following section explores the transfer of funds within financial institutions.

3.4 Funds Transfer Pricing Methods for Financial Institutions

Kawano (1990) states that there are three methods available to perform FTP with variations thereon that provide the flexibility for use by all sizes of banks. The three methods that Kawano mentioned are single pool, multiple pools and matched maturity funds transfer pricing (MMFTP) methods.

3.4.1 Single Pool Funds Transfer Pricing Method

In the single pool FTP method, Kawano (1990) illustrates that funds are pooled together in a single pool, and there is only one pool buying and selling funds. Kimball (1997) finds that most banks began FTP using a single transfer price and a single funds pool, into which businesses sold funds and from which they purchased funds. Kimball states that the single transfer price often was a weighted blend of the various sources of funds available to the bank in the external capital markets.

The single pool FTP method can be best illustrated with an example. The data for the example are assumed and presented in Table 3.5. It is assumed that the hypothetical Bank XYZ has two branches. The profits from mortgage and deposit activities in each branch are calculated and presented in Table 3.6.

Table 3.5: Date Assumptions for the Single Pool FTP Method (In $ millions)

Item	Branch A	Branch B	Total
Accumulated mortgage balances	100	60	160
Accumulated savings balances	60	100	160
Average return on mortgages	10%		
Weighted average cost of savings	6%		
Funds transfer price	9%		

Table 3.6: The Single Pool FTP Method (In $ millions)

Item	Branch A		Branch B		Total
	Calculation	Value	Calculation	Value	
Interest Income from mortgage	100*10%	10.0	60*10%	6.0	16.0
Cost of funding at the transfer price of 9%	100*9%	9.0	60*9%	5.4	14.4
Profit contributions from mortgage		1.0		0.6	1.6
Credit for deposit at the transfer price of 9%	60*9%	5.4	100*9%	9.0	14.4
Interest expense on deposit	60*6%	3.6	100*6%	6.0	9.6
Profit contributions from deposit		1.8		3.0	4.8
Total contribution from mortgage and deposits		2.8		3.6	**6.4**

The total profit contribution for the Bank XYZ as a whole is $6.4 million, which is the product of $160 million mortgages and the mortgage profit margin 4% (4%=10%-6%). Table 3.6 shows that the total profit contribution ($6.4millions) is the same as that for the bank as a whole. This is due to the fact that the charges on funds used equal the credits for funds provided in the single pool FTP method. The

internal charges and credits exactly offset each other when evaluating bank performance as a whole. Therefore, the single pool FTP method does not change the profit contributions as a whole, but it allocates profit contributions to various business activities. This enables bank managers to examine how each business unit makes profit contributions to the bank as a whole.

The single pool FTP method has some advantages. Kawano (1990) states that this method is simple, easy to understand and implement. Uyemura and Van Deventer (1993) argue that the single pool FTP method is the simplest method for determining the net interest income (NII) for business units.

On the other hand, the single pool FTP method has three main disadvantages: (1) According to Kimball (1997), the single pool FTP method fails to take into account the existence of a sloped yield curve and often gives business managers incentives to operate in a way that is not optimal from a bank wide viewpoint. For example, the single pool FTP method encourages the acquisition of longer maturity loans since such loans would maximize the spread between the prices received on the loans and the transfer price. On the other hand, this method encourages the avoidance of long maturity deposits since the spread between the deposits and the transfer price is substantially less or even negative compared to that on short term deposits. These make bank asset and liability mismatch risk management difficult. (2) AMIfs Research Committee (2001) warns that the single pool FTP method cannot be used for product or customer profitability measurement since this method assumes all funds have equal importance within the financial institution. (3) Another limitation is that business units take the responsibility of controlling some unmanageable risks. Kawano (1990) points out that, with this method, there are no separation of interest rate risk and credit risk. When it is determined that business units managers are only able to control credit risk, with the single pool FTP method, the managers have to take the responsibility for controlling interest rate risk, such as the fluctuations in the level of prices or in the slope of the yield

curve. Under these circumstances, business managers' performance evaluation is based on the factors beyond their control. This would make the performance evaluation of the managers inaccurate.

3.4.2 Double Pool Funds Transfer Pricing Method

The double pool FTP method uses two pools and two transfer prices, one pool is for funds providers and carries an asset yield based transfer price, the other pool is for funds users and carries a cost of funds based transfer price. Kawano (1990) recommends that the credit provided to funds providers should be commensurate with the income earned from putting the funds to use. Similarly, funds users should be charged a price commensurate with the costs associated with raising the funds.

Table 3.7 and 3.8 are used to illustrate the double pool FTP method. It is assumed that there is only one branch, Branch A, in the bank and two transfer prices are used for funds transactions. The data presented in Table 3.7 are all assumed.

Table 3.7: Date Assumptions for the Double Pool FTP Method (In $ millions)

Item	Branch A
Accumulated mortgage balances	100
Accumulated savings balances	60
Average return on mortgages	10.00%
Weighted average cost of savings	6.00%
Transfer price for funds provider	7.80%
Transfer price for funds user	7.30%

Table 3.8: The Double Pool FTP Method

Item	Branch A	
	Calculation	**Value**
Interest Income from mortgage	100*10%	10.00
Cost of funding at 7.3% transfer price	100*7.3%	-7.30
Profit contributions from mortgage activities		**2.70**
Notional transfer price credit on deposit balances at 7.8% transfer price	100*7.8%	7.8
Interest expense on deposit	100*6%	-6
Profit contributions from deposit activities		**1.8**
Total contribution from mortgage and deposits		**4.5**

Table 3.8 presents the profits from mortgages and deposits. It shows that two

transfer prices are used in Branch A and the total profit contribution derived with the double pool FTP method is $4.5 millions, the sum of $2.7 millions from mortgages and $1.8millions from deposits. However, the total profit contribution should be $4 millions, the product of the total amount of mortgage ($100 millions) and mortgage profit margin (4%=10%-6%). The inconsistency of the profit calculation is due to the double counting problem of the double pool FTP method. The relationship between the transfer price (TP_{credit}) credits for funds provider and the transfer price (TP_{charge}) charges on funds users determines whether a double counting problem occurs:

- When TP_{credit} is larger than TP_{charge}, there is the double counting problem as described in this example. The results from setting TP_{credit} larger than TP_{charge} is presented in Table 2 of Appendix 1.

- When TP_{credit} equals TP_{charge}, the double counting problem is eliminated, and the double pool FTP method changes into single pool FTP method. The illustration of this case is presented in Table 3 of Appendix 1.

- When TP_{credit} is less than TP_{charge}, some profit margin is left after allocating the profit margin to both funds user and funds provider. As will be discussed in Chapter Eight, the contribution is allocated to the unit, which is specially designed for the purpose of managing risks. The illustration on this case is presented in Table 4 of Appendix 1.

The double pool FTP method has three main advantages. (1) AMIfs Research Committee (2001) belive that the double pool FTP method removes some of the contribution bias of the single pool FTP method, and provides a foundation for determining product profitability. The research committee think that this method makes the contribution value of sources and uses of funds more transparent. (2) Webb (1994) argues that if the aim of this profitability measurement system is to

rank contribution (not to allocate actual income), it is possible to arrive at a correct ranking even though the use of this method may inflate the financial statement due to the double counting problem. (3) Webb (1994) points out that this method is extremely popular since it avoids the political problem of favoring either funds providers or funds users by giving both a large spread.

On the other hand, the double pool FTP method also has some disadvantages. (1) AMIfs Research Committee (2001) states that there is no recognition that the tenor of the funds affects their contribution value. The committee illustrate that short-term funds carry the same transfer price of long-term funds. Neither single nor double pool FTP methods consider differentials based on the funds tenor. (2) Another disadvantage is that, similar to the single pool FTP method, the business units may take the responsibility of controlling some unmanageable risks such as interest rate risk. (3) The double pool FTP method applies one price for all the assets and another price for all the liabilities. It does not consider the different contributions made by the different assets or by the different liabilities. (4) AMIfs Research Committee (2001) warn that the double pool FTP method sometimes results in the double counting problem due to the dual allocation of the organization's overall NIM.

3.4.3 Multiple Pool Funds Transfer Pricing Method

AMIfs Research Committee (2001) define that, in the multiple pool FTP method, a distinct number of pools are created that span the entire maturity spectrum for the funds provided and used. The research committee argue that the assigned transfer price of each pool is based on its tenor and the prevailing term structure of prices and that long tenor pools receive a long-term price, while short-term pools receive a transfer price reflective of their shorter tenor. The committee state that the number and nature of the pools created should reflect the major tenor aspects of the balance sheet, which varies by institution.

To illustrate the multiple pool FTP method, some assumptions are made and summarized in Table 3.9.

Table 3.9: Data Assumptions for the Multiple Pool FTP Method (In $ millions)

Item	Branch A	Average Return/ Average Cost	Funds Transfer Prices
Mortgages	100.00	10.00%	7.00%
Auto loans	60.00	12.00%	7.80%
Savings	160.00	6.00%	7.20%

Table 3.10 illustrates the application of the multiple pool FTP method in deriving the profits from mortgages, auto loans and deposit activities in Branch A.

Table 3.10: The Multiple Pool FTP Method (In $ millions)

Item	Branch A	
	Calculation	**Value**
Interest Income from mortgage	100*10%	10.00
Cost of funding at 7% transfer price	100*7%	-7.00
Profit contributions from mortgage activities		**3.00**
Interest Income from auto loan	60*12%	7.20
Cost of funding at 7.8% transfer price	60*7.8%	-4.68
Profit contributions from auto loan activities		**2.52**
Notional transfer price credit on deposit balances	160*7.2%	11.52
Interest expense on deposit	160*6%	-9.6
Profit contributions from deposit activities		**1.92**
Total contribution		**7.44**

Table 3.10 shows that the total profit contributions from three business activities is $7.44 millions, the sum of $3millions from mortgages, $2.52 millions from auto loan, and $1.92 from deposits. The total profit derived for the bank is as follows.

Total Profits as a Whole= Total profits from mortgage + Total profits from auto loan

- Total actual interest expense on savings

= $100m*10 %+$60m*12 %-$160m*6%=$10.6m

The inequality results from the application of the multiple pool FTP method in allocating profit contributions among the bank business units. As will be discussed in Chapter Eight, the profit contribution differences are allocated to a special unit.

The multiple pool FTP method has three main advantages. (1) The multiple pool FTP method is a refinement to the single and double pool FTP method. Instruments are designated to a pool based on characteristics, such as type of product and maturity date. (2) Through the multiple pool FTP method, an individual business can eliminate interest rate risk by matching assets or liabilities with the appropriate maturity funding pools. For example, a business generating three-month CDs would sell the deposit to the designated three-month funding pool. The CDs would be assigned the three-month transfer price existing at the time of origination and would carry this price until maturity. In effect, the business would lock in a spread on the CDs that would not change even if market prices fluctuated. (3) According to Table 3.10, the multiple pool FTP method can be applied to measure the activities performed by each business unit and assign the profit contributions to these activities.

The multiple pool FTP method also has some disadvantages. (1) The multiple pool FTP method is more complex than the single or double pool FTP methods, and requires substantial expenditures to implement the method. (2) This method allows for limited profit contribution differentiation at product level because of limited pools.

3.4.4 Matched Maturity Funds Transfer Pricing Method

Altius Solutions, LLC (2003) found that the MMFTP method has been widely used in financial companies. According to the Banker's Glossary (2007), the MMFTP method assigns a cost of funds to assets and a credit for funds to liabilities that reflect the interest rate risk, especially the rate risk associated with the time remaining to maturity, in those assets or liabilities[3]. AMIfs Research Committee (2001) states that, because the transfer price represents a "market-based alternative", the net contribution value of all funds provided or used is determined

[3] This definition is obtained from http://www.americanbanker.com/glossary.html?alpha=M on July 10th 2007.

based on competitive prices at the time of transaction. The committee point out that the tenor based transfer prices are read from applicable alternative pricing curves, which are usually derived from treasury yield curves, inter-bank lending curves, inter-bank swap curves, or government agency advance curves. As will be discussed in Chapter Seven, the inter-bank lending curves plays an important role in derving the base funds transfer prices.

Similar to the multiple pool FTP method, the MMFTP method assigns unique transfer prices to each source and use of funds at the time of origination. Rather than use a discrete series of pools, the MMFTP method derives transfer prices from continuous term structure pricing curves. Uyemura and Van Deventer (1993) argue that the MMFTP method may be considered to be a much more detailed and refined version of the multiple pool FTP method. Its basic tenet is that every incremental customer transaction is matched with a corresponding hypothetical internal funds transfer. Uyemura and Van Deventer think that this matching concept should include the following two attributes. These attribtues will be applied for the base funds transfer prices developement in Chapter Seven.

(1) The transfer funds should mirror the expected cash flow pattern of the original transaction, including amortizations and/or prepayments.

(2) The interest rate assigned to the transfer funding should be consistent with the marginal cost of a large block of wholesale funding at the bank's current marginal funding prices for the cash flow pattern expected.

The concept of the MMFTP is best illustrated by an example. Consider an example of the commercial lending unit within a bank making a five-year, fixed-rate loan to a customer. The unit borrows at a fixed rate for five years from the ALCO. To offer the funds for the commercial lending unit, the ALCO buy CDs from the deposit-taking unit at a floating rate for three month London Interbank Offered

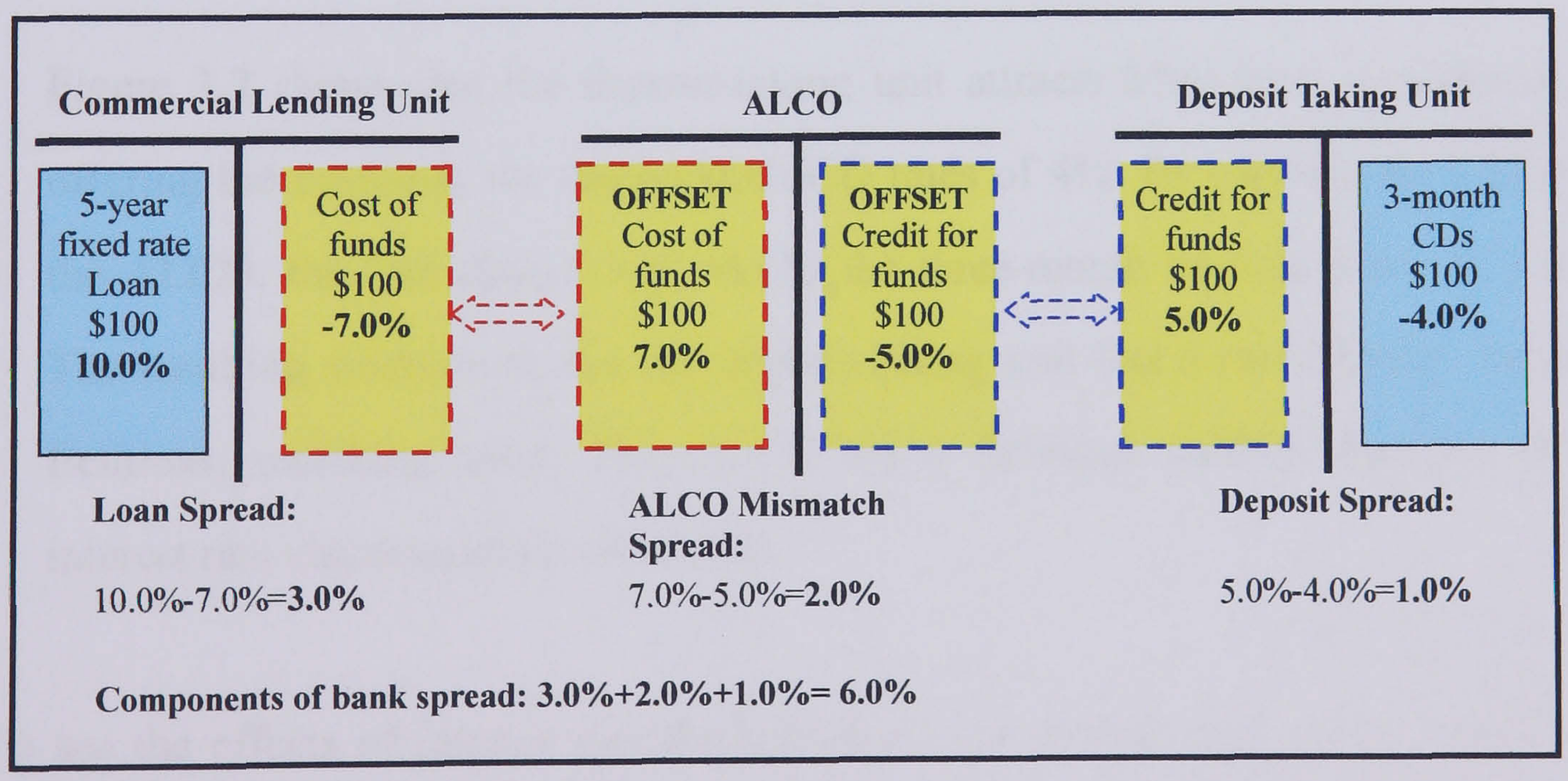
Rate (LIBOR). Therefore the fixed rate loan is funded by the three-month CDs. This paired transaction creates a duration mismatch. Both the commercial lending unit and the deposit-taking unit are assumed to have no capability to manage interest rate risk. Therefore, the interest rate risk associated with the paired transaction should be transferred to the ALCO. For the purpose of illustration, the assumptions for the MMFTP example are summarized in Table 3.11.

Table 3.11: The Assumptions for the MMFTP Example

	Interest Rate/Transfer Price	Types of Rate
Loan	5-year Loan Rate =10%	Fixed Rate
	Transfer prices for 5-year Loan =7%	Fixed Rate
Deposit	3-month CD Rate = 3-month LIBOR	Floating Rate
	Transfer prices for 3-month CD = LIBOR+1%	Floating Rate
Current 3-month LIBOR=4%		

To examine how the commercial lending unit and deposit-taking unit locked in their profit, the MMFTP method is applied. The MMFTP method creates a series of shadow asset or liability account as depicted in Figure 3.2.

Figure 3.2: Today's Balance Sheet



Source: Adapted from Chittenden (2000 p. 5).

The illustration of Figure 3.2 is presented as follows.

- Commercial Lending Unit. On the day of making the loan, the commercial lending unit knows that, for the next five years, it will receive fixed-interest

payments from its customer and make fixed interest payments to the ALCO. At the end of five years, the customer will repay the loan, and the lending unit will use the proceeds to repay the ALCO. The lending department therefore has locked-in its profit for this transaction and knows that the profit will not change if general market rates change.

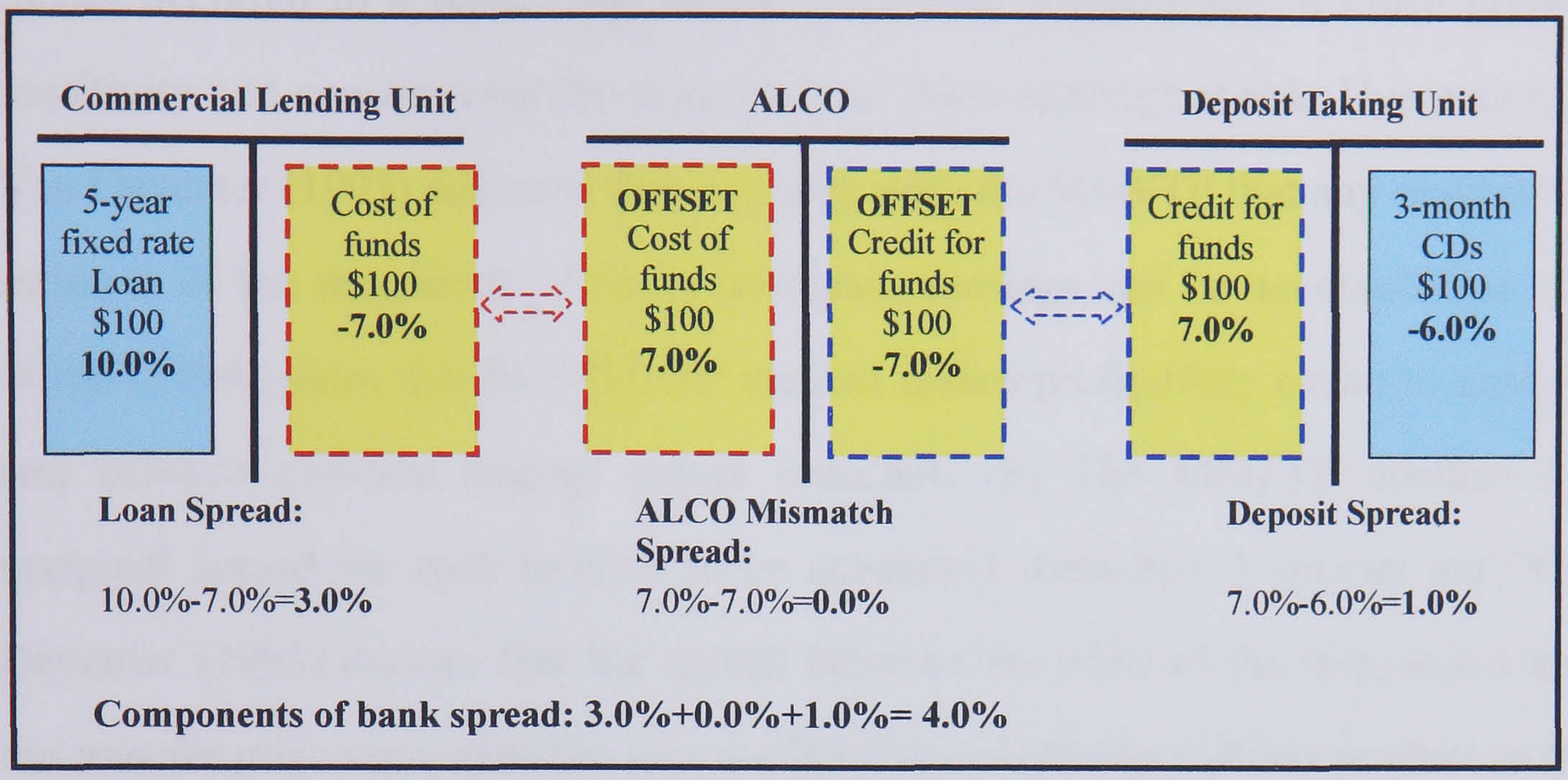
Figure 3.2 shows that the commercial lending unit lends the $100 funds to a customer, charging the customer the five-year transfer price of 7% offered by the ALCO, plus a spread of 3% to cover operating expenses. The resulting situation is that the lending unit has a real asset and a fictitious, matching liability. The ALCO has a fictitious asset that has the interest rate characteristics of the loan.

- The Deposit Taking Unit. The deposit-taking unit locked in its profit by consistently offering three-month floating rate funds to the ALCO and attracting the corresponding funds from customers.

Figure 3.2 shows that the deposit-taking unit attracts $100 from a customer, offering the customer the three-month CD rates of 4%. By offering the CD to the ALCO, the unit charges the ALCO the three-month transfer price of 5%. The resulting situation is that the deposit-taking unit had a real liability and a fictitious, matching asset. The ALCO has a fictitious liability that has the interest rate characteristics of the CDs.

To see the effects of interest rate fluctuation on the performance of the business units, the three-month LIBOR is assumed to move up 2% after three months. According to the assumptions made in Table 3.11, the changes for the balance sheet are shown in Figure 3.3.

Figure 3.3: Next Three-Month's Balance Sheet (Interest Rate Up 2%)



Source: Adapted from Chittenden (2000 p. 5).

Although the interest rate changes, the interest rate and cost of funds for loans does not change due to its fixed rate position. On the contrary, the interest rate and credit for deposits changes every three months because the bank uses three-month deposit as the source of funds for the fixed rate loan. If the interest rate moves up 2%, the bank's deposit rate and offset credit for funds increases 2% accordingly. This makes the ALCO spread drops to 0% from 2% and bank spread has declined from 6% to 4%, the full amount of which is reflected in the ALCO because it is caused by interest rates fluctuations.

This example shows that the MMFTP method pulls interest rate risk from the business units into the ALCO, and makes the ALCO the holder of the bank's interest rate risk position. The spread of business units' profit is locked at 4%, and it does not change as interest rate changes. On the other hand, the profit of the ALCO is based solely on the interest rates fluctuation and holds only the profit or losses from the interest rate risk fluctuation.

The MMFTP method has four main advantages. (1) As can be seen from the example presented in this section, the earnings attributable to interest rate

mismatching are correctly identified. The MMFTP can elucidate how the mismatch spread occurred to a bank. This would help bank mangers gain a much greater sensitivity and concern over the magnitude of these earnings at risk. Uyemura and Van Deventer (1993) advocate that it is only with the MMFTP that any reasonable estimate of the magnitude of these mismatch earnings can be accomplished. (2) Webb (1994) states that the MMFTP method makes profitability easier to analyse and achieve uniform pricing across branches. (3) The MMFTP enables the marginal spread for each product to be accurately measured. Uyemura and Van Deventer (1993) declare that the spread between the yield of the transaction and the transfer price represents the true profitability contribution of that product to the bank's overall NIM, and therefore, is the correct spread to incorporate in product or unit profitability analyses. (4) With the MMFTP, each product spread is independent of any other balance sheet element. Uyemura and Van Deventer (1993) emphsize that this is a critical point. They argue that many bankers mentally allocate certain deposit transactions to be the funding source for certain types of loans for the purpose of estimating their lending spreads. The example shows that the MMFTP method can be applied to separate the bank's NII for each product from any balance sheet mismatching. Any of those individual spreads are completely independent of the existence of any of the others and may be achieved on a stand-alone basis.

On the other hand, the MMFTP method has disadvantages. The main disadvantage is that the MMFTP method is much more complex than other pool based FTP methods, and requires more expenditure to implement the MMFTP method.

3.4.5 Comparisons of the Funds Transfer Pricing Methods

The comparisons of the single pool FTP method, the double pool FTP method, the multiple pool FTP method and the MMFTP method are summarized and presented in Table 3.12.

Table 3.12: Comparisons of Various FTP Methods

	Single Pool	Double Pools	Multiple Pools	MMFTP Method
Characteristics	(1) All funds are treated identically. (2) Simple to understand and to report results.	One pool for funds provided, another pool for funds used.	Segments funds into pools based on repricing term.	(1) Evaluate NII contribution at transaction level. (2) Uses repricing, amortization, maturity, and other cash flow attributes.
Setting Transfer Prices	All funds assigned an identical price.	Each pool has a price. One pool carries an asset yield based price; another pool carries a cost of funds based price.	(1) Each pool has a price commensurate with its term or other attributes. (2) Transfer prices often reflect term structure.	(1) Transfer prices are taken from alternative funds pricing curve usually benchmarked to term structure. (2) Price set at the time of origination based on term of cash flows.
Assessment	(1) Does not consider varying contribution of funds. (2) Used only for organizational profitability measurement. (3) Cannot be used for product or customer. (4) Does not consider risk in measurement.	Similar with single pool's assessment, but it makes the contribution value of sources and uses of funds more transparent.	(1) Allow for limited profit contribution differentiation at product level. (2) Crudely address some mismatch risk issues.	(1) Enables measure of product and customer profit contribution. (2) Insulate profit contribution from subsequent market price changes. (3) Mismatch reward given to funding center.

Source: Adapted from AMIfs Research Committee (2001, p.22)

Table 3.12 shows that the single pool FTP method is the simplest and the least effective of the four, the multiple pool FTP method is better in that it is more reflective of market reality, and the MMFTP method is the most effective and the most complex method. The MMFTP method can be applied to measure the profit contribution of products and can insulate the profit contribution of products from interest rate risk.

3.5 Summary

This chapter reviews TP methods from the perspectives of economists and accountants. Economists advocate that the optimal transfer price is the one where marginal revenue equals marginal cost. Whereas, the accountants' perception of TP methods includes cost based TP method, negotiated TP method, market price based TP method and linear programming TP method. Literature review shows that

market price based TP method should be used when a competitive market exists, negotiated TP method should be applied when the outside market is not competitive, and cost based TP method is appropriate when no outside intermediate product market exists. When several business divisions are seen to use one or more supplying divisions, when several goods and services are internally traded and when reciprocal interdependence is present, linear programming can be used for the development of transfer prices.

In the financial institutions, the single pool FTP, the double pool FTP, the multiple pool FTP and the MMFTP methods are applied for measuring the performance of the internal funds transactions. The comparisons of various pool based FTP methods show that the MMFTP method is most effective but also most complex. It can be applied to measure product profit contributions and insulate the profit contributions from financial risks.

Chapter Four: Research Methodology

4.1 Introduction

The research methodologies introduced in this chapter are applied to achieve the aims of this thesis. As discussed in Chapter one, the primary aim of this thesis is to develop the FTP model for commercial banks. To support the primary aim, a second aim of this thesis is to design the six-factor bank FTP framework, which consists of the WHY, the WHAT, the WHERE, the WHO, the WHEN and the HOW factors. Thus, two groups of the research methodologies are introduced. The first group consists of the methodologies used for the six-factor bank FTP framework design, whereas the second group introduces the methodologies that are used for the bank FTP model development. In the second group, the methodologies are mainly applied to solve quantitative issues related to bank financial risk management.

The first section of this chapter designs the research map to show the research process for the six-factor bank FTP framework design and the bank FTP model development. The second section introduces the methodologies applied for the empirical investigations on bank FTP process followed by the third section, the methodologies for the six-factor bank FTP framework design. The fourth section discusses the methodologies applied for the bank FTP model development. The final section is the summary.

4.2 Research Map

The methodologies addressed in this chapter seek to design the six factors involved in the bank FTP administration process and develop the bank FTP model. The research process and methodologies are depicted in Figure 4.1.

Figure 4.1: Research Map

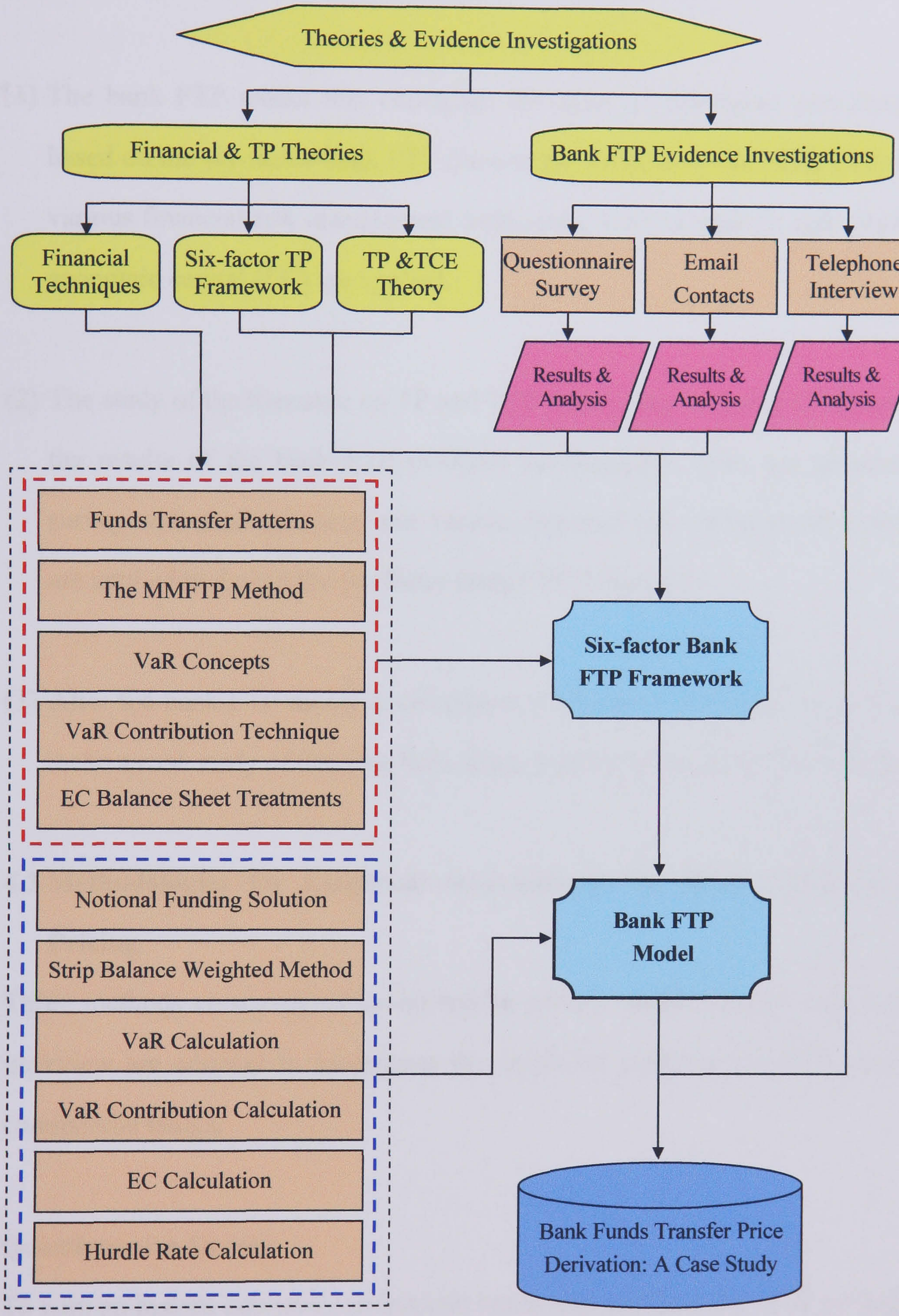


Figure 4.1 outlines the main research process, identifies the methodologies for the six-factor bank FTP framework design and the bank FTP model development, and presents the linkage between the steps in the research process. The research map

helps understand the aims of each methodology and the relationship between the methodologies. This is discussed below:

(1) The bank FTP model that comprises the heart of this thesis was developed based on the six-factor bank FTP framework. To develop the bank FTP model, various financial risk management techniques, such as value at risk (VaR) and economic capital (EC) are applied.

(2) The study of the literature on TP and TCE theory, the six-factor TP framework, the results of the bank FTP evidence investigations from the questionnaire survey and email contacts, and various financial risk management techniques are applied to design the six-factor bank FTP framework.

(3) After the bank FTP model development, a telephone interview is conducted to make a case study of deriving bank funds transfer prices with the FTP model.

4.3 Methodologies for Empirical Investigations on Bank Funds Transfer Pricing

Three methods consisting of questionnaire survey, email contacts and telephone interview are adopted to investigate the empirical evidences on FTP process in commercial banks.

Questionnaire Survey

To gain an insight into how commercial banks apply FTP in their risk management and business performance evaluation, a postal questionnaire survey is adopted. The questionnaire survey investigates the six factors, the WHY, the WHAT, the WHO, the WHERE, the WHEN and the HOW factors that are involved in the bank FTP administration process. The results from the survey are used to design the six

factors.

It is expected that the postal questionnaire survey may lead to poor responses because of the nature of the sensitive information requested on the bank FTP policy. There are several factors, which are considered to improve the response rate to postal questionnaires, and where appropriate they have been employed in this survey. The factors include (1) anonymity, (2) questionnaire size effects, (3) official sponsorship, (4) feedback of research results, (5) people filing the file and (6) cover letter.

(1) Anonymity. Collier and Wallace (1992) state that anonymity could become more important when a greater degree of sensitivity is involved in the subject matter. As the high level of sensitivity usually attached to the subject of FTP, the questionnaire form designed in this survey provides spaces for the name of the person filling out the form as well as the name and headquarters address of the bank. This makes it clear that filling in these spaces is optional, in case the bank wishes to participate anonymously.

(2) Questionnaire size effects. To determine whether questionnaire size affects the response rate to postal questionnaires, Sirken Pifer and Brown (1960) and Scott (1961) have conducted surveys which have involved sending two different short questionnaires to two samples of respondents and a third questionnaire, the other two compiled, to a third sample. There was no indication that the short questionnaires received higher response rates. Nevertheless, the questionnaire used in this survey covers 6 pages, of which 4 are used for questions thus allowing front and back cover pages for the questionnaire.

(3) Official sponsorship. Scott (1961) suggests that official sponsorship may

increase the response rate. This survey has been in part sponsored by the British Council, and this was indicated in the front sheet and covering letter. The supporting bodies may help demonstrate that the investigator of the project is affiliated with a government body, thereby reducing the suspicion with which business executives often regard requests for information from academics. This may help increase the response rate.

(4) Feedback of research results. FTP management is a confidential policy for a bank. It is expected that commercial banks would be anxious to know how other banks in the sample agree with or differ from them on various FTP issues. Thus promising to send a summary of the survey results may positively influence response rate. The questionnaire form requires the respondents to disclose her/his identity so that the summary report can be distributed to them if they request it. However, Collier and Wallace (1992) state that this raises the issue of whether nonanonymity resulting from feedback requirements may counteract the feedback inducement or may make subjects respond differently. Thus, this survey advises respondents to send their requests for the report separately and not along with the questionnaire. For example, they can request the report by sending an email or another letter separate from the questionnaire. This may eliminate the connection between the identity of the respondent and the questionnaire responses.

(5) People filing the file. As Collier and Wallace (1992) stated, it is necessary to identify and mail the questionnaire to named officers because it has been found that this substantially increases response rates. The information from The Bankers' Almanac (2005) gives the name and office address of the people contacted by this survey. Thus, the questionnaire is mailed to the named officers who are likely to be in charge of the FTP process in each of the

sampled banks. The named officers in this survey are considered to be the executive director, group finance director, group treasury, or group risk director.

(6) Cover letter. Collier and Wallace (1992) advocate that a covering letter is one of the main instruments in maximizing response rate. Emphasis has been placed on the importance of including a covering letter with the questionnaire, stating the importance of the questionnaire, and why the addressee's response is important. A covering letter was forwarded with the questionnaire.

Email Contacts

The questionnaire survey sought to obtain an unbiased and complete description of current practices on how banks deal with the six factors involved in their FTP process. According to Oyelere and Turner (2000), the questionnaire responses are estimated low due to the high level of sensitivity usually attached to the subject of FTP. Collier and Wallace (1992) warn that low response rate must cast doubt on findings. Therefore, the validity of the findings on the six factors from the questionnaire survey needs to be checked. According to Denzin (1970), multiple and independent methods, especially if investigating the same problem and reaching the same conclusion, have greater validity and reliability than a single methodological approach to a problem. Thus, to check the validity of the findings from the questionnaire survey, this thesis conducted emails contacts with bank FTP consultants. The FTP consultants are carefully selected among those who have good understandings of how commercial banks deal with the FTP issues.

The responses from the questionnaire survey may be incomplete. Therefore, another purpose of conducting email contacts is to obtain the answers for the questions uncompleted in the survey. The FTP consultants may have a wealth of information on bank FTP. Thus, the email contacts with the consultants can be

applied to explore bank FTP in-depth. The FTP information provided by the consultants could be helpful for the six-factor bank FTP framework design and the bank FTP model development.

Telephone Interview

To have a good understanding of the bank FTP model developed in this thesis, it would be helpful to make a case study analysis of applying the model in a bank. However, some of data for the FTP model are generally not available to the public due to banking business sensitivity issues. Therefore, a structured telephone interview is adopted to obtain the data unavailable from the public.

The structured telephone interview approach is taken in empircial evidence investigations, enabling information to be collected in a systematic way whilst allowing the participants to elaborate on issues requiring further discussion. As will be discussed in the FTP model development, the sensitivity vector is a complicate factor for the model. Through the discussions with the interviewee, the sensitivity vector can be explained and determined.

4.4 Methodologies for the Six-factor Bank Funds Transfer Pricing Framework Design

In this section, funds transfer patterns, the MMFTP method, the concept of VaR and VaR contribution, and business balance sheet treatments of EC are introduced.

4.4.1 Funds Transfer Patterns

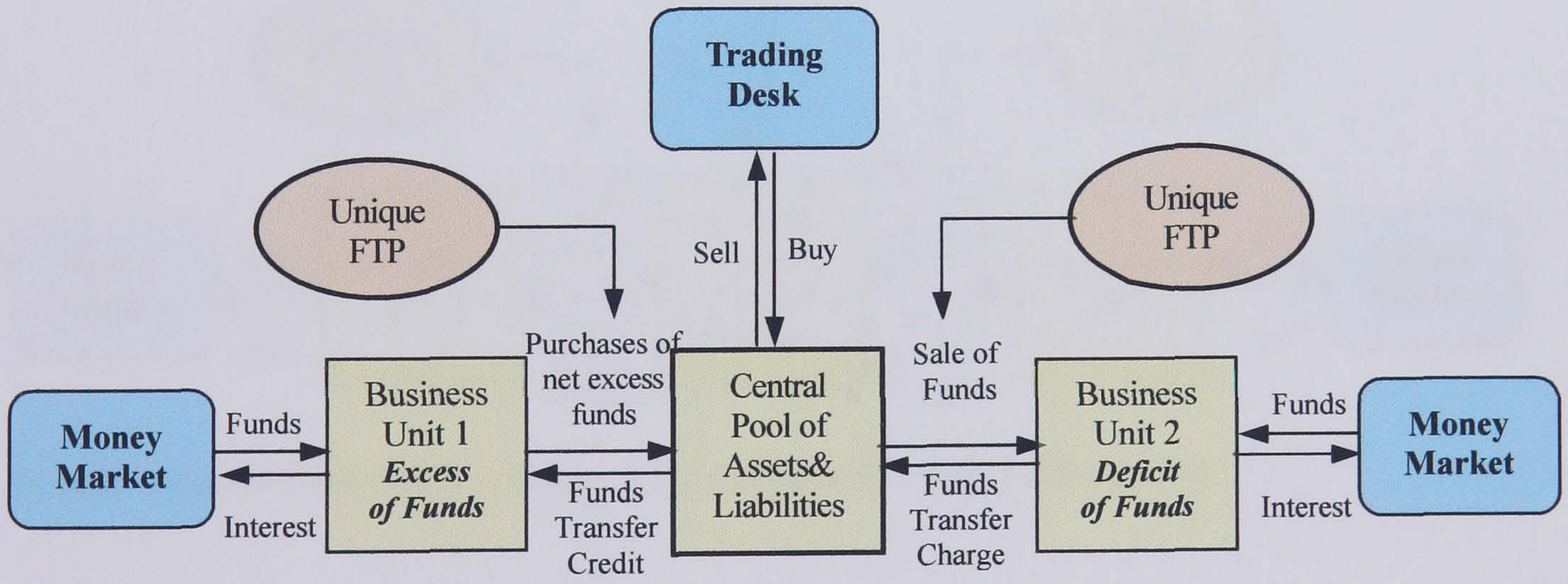
Funds transfer pattern is selected to design the HOW factor for the bank FTP framework. Banks act as the intermediaries across markets for funds gathered and invested. They routinely receive and invest funds from their customers. Deposits and other funds flow into the bank through its numerous collection channels. These

funds flow out through delivery channels for investment in loans and other financial assets. In this funds inflow and outflow system, uses and resources of funds are generally unbalanced. A bank funds transfer pattern decides where a bank puts or gets the unbalanced funds. This section introduces the net funds transfer (NFT) pattern and the gross funds transfer (GFT) pattern.

Net Funds Transfer

In the NFT system, a business unit groups the excesses and deficits of funds and then nets them. The NFT involves the theory that a given business unit funds itself, and then sells excess funds to the central pool or buy funds from the central pool to cover excess assets. The NFT system requires a unique transfer price for the net funds transferred. Transfers of net funds balances are depicted in Figure 4.2.

Figure 4.2: Transfers of the Net Funds Balances



Source: Adapted from Bessis (2002, p. 315) and Ernst & Young (1995, p.177).

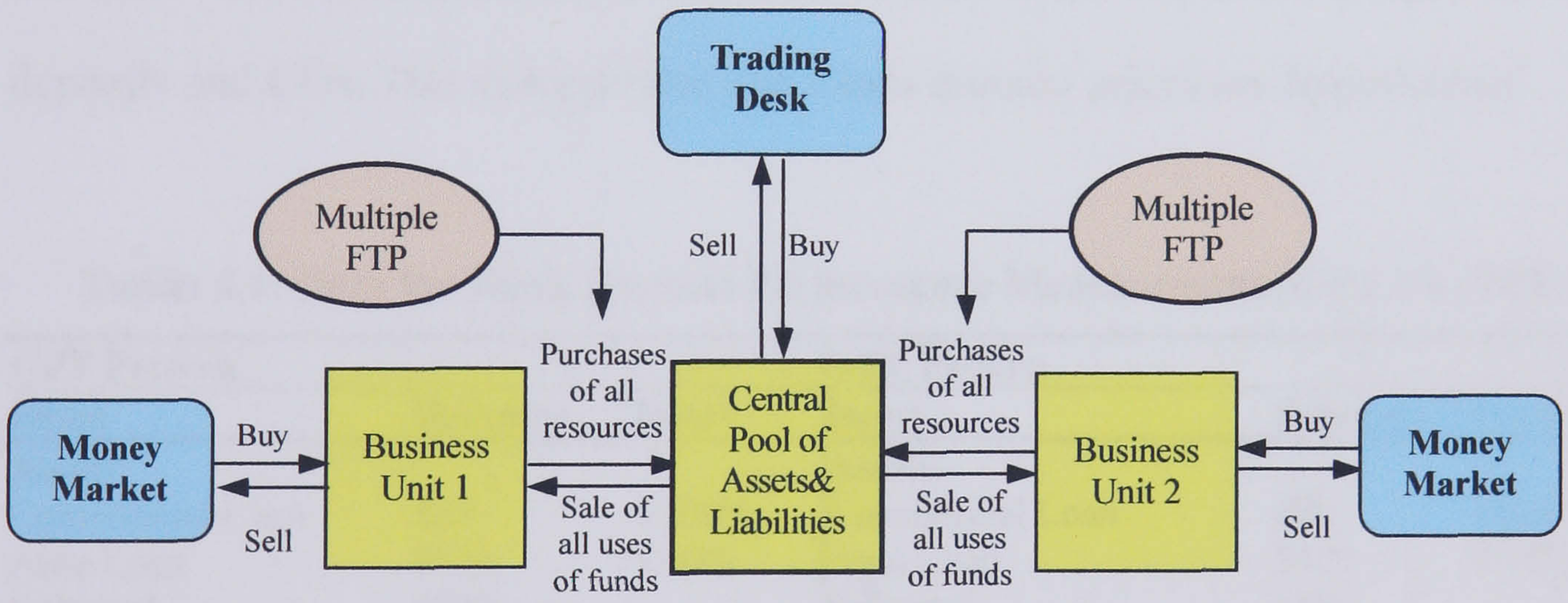
The NFT system is simple and easy to implement. However, with the NFT system all bank assets and liabilities generated by the operation of the subunit do not transit through the FTP system. Figure 4.2 shows that there is a unique funds transfer price, which applies only to net fund balances. The FTP policies impact is limited to netted fund balances. Therefore, it is difficult to make a detailed product

profitability analysis because of insufficient data provided by the NFT system.

Gross Funds Transfer

The GFT system requires that the central pool should purchase all the resources and sets prices for all uses of funds of business units, without prior local netting of assets and liabilities. The full amount of assets and liabilities transits through the central pool. The GFT system requires that all assets and liabilities be exchanged with the central pool in a full internal capital market with multiple funds transfer prices. With the multiple transfer prices, all funds provided are sold for credit to the pool and all funds needed are bought from the pool for a charge. Transfers of gross funds balances are illustrated in Figure 4.3.

Figure 4.3: Transfers of the Gross Funds Balances



Source: Adapted from Bessis (2002, p. 315) and Ernst& Young (1995, p.177).

The GFT system allows the full amount of assets and liabilities supported by funds transit through the central pool, thus makes transfer prices hit all the assets and liabilities of each business unit. This enables bank managers to calculate the margin of every asset and liability transaction. Therefore, transfer prices based on the GFT facilitates the reporting of every product's profit contributions. On the other hand, the GFT system has some disadvantages. The main disadvantage is that the GFT system is too complicated and it is time consuming to set up this system.

To properly choose a funds transfer pattern, the comparisons between the NFT and the GFT should be made. The NFT system is passive since it simply records excesses and deficits of funds and nets them. With the NFT, only the net balances are exchanged with the central pool and only a unique transfer price applies to the net balances. On the contrary, the GFT system is used as an active management tool. It records all assets and liabilities, and business units transfer all funds to the central pool without netting them. With the GFT, multiple funds transfer prices are used for the funds transferred. Therefore the GFT enables bank managers to make a detail performance evaluation of every business unit or bank product.

The comparisons of the roles of the NFT and the GFT for performance evaluation are illustrated with an example presented in Table 4.1 and Table 4.2. It is assumed that the bank has a commercial loan and an auto loan, which are funded by time deposits and CDs. The interest rates and funds transfer prices are hypothetical.

Table: 4.1: Data for Bank Product Performance Measurement (GFT Vs. NFT)

GFT Pattern			**NFT Pattern**		
Items	**Balances**	**Prices**	**Items**	**Balances**	**Prices**
Assets			**Assets**		
Commercial Loan	$80	10.00%	Commercial Loan	$80	10.00%
Auto Loan	$110	9.00%	Auto Loan	$110	9.00%
Subtotal	$190		**Subtotal**	$190	
Liabilities			**Liabilities**		
Time Deposits	$75	4.50%	Time Deposits	$75	4.50%
CDs	$230	4.00%	CDs	$230	4.00%
Subtotal	$305		**Subtotal**	$305	
			Excess liabilities	$115	
Funds Transfer Prices			**Funds Transfer Prices**		
Commercial Loan		5.00%	Excess liabilities		4.80%
Auto Loan		4.00%			
Time Deposits		4.80%			
CDs		4.49%			

Based on the data in Table 4.1, the NII of the commercial loan, auto loan, time deposits and CDs are derived with both the GFT and NFT pattern. The comparisons of the four businesses performance evaluation with the two funds

transfer patterns are summarized and presented in Table 4.2.

Table: 4.2: Bank Product Performance Measurement (GFT Vs. NFT)

GFT Pattern			**NFT Pattern**		
Items	**Calculations**	**Values**	**Items**	**Calculations**	**Values**
Commercial Loan			**Interest income**		
Interest income	\$80* 10.00%	\$8.00	Commercial Loan	\$80* 10.00%	\$8.00
Funding cost	\$80*5.00%	\$4.00	Auto Loan	\$110* 9.00%	\$9.90
NII		\$4.00	Earnings credits	\$115*4.80%	\$5.52
NII % of Total NII		36.86%	Total Interest Income		\$23.42
Auto Loan			**Interest expense**		
Interest income	\$110* 9.00%	\$9.90		\$75*4.50%	\$3.38
Funding cost	\$110* 4.00%	\$4.40		\$230*4.00%	\$9.20
NII		\$5.50			\$12.58
NII % of Total NII		50.68%			
Time Deposits					
Earnings credits	\$75*4.80%	\$3.60			
Interest expense	\$75*4.50%	\$3.38			
NII		\$0.23			
NII % of Total NII		2.07%			
CDs					
Earnings credits	\$230*4.49%	\$10.33			
Interest expense	\$230*4.00%	\$9.20			
NII		\$1.13			
NII % of Total NII		10.39%			
Total NII		**\$10.85**	**NII**		**\$10.85**

Table 4.2 shows that the GFT pattern gives more financial information than that of the NFT pattern. The GFT pattern enables bank managers to make a detailed analysis of the profitability of commercial loan, auto loan, demand deposits and CDs respectively. It can be seen from Table 4.2 that the auto loan NII is \$5.50, which is 50.68% of the total NII, and which ranks the first among those of the bank's business. On the contrary, the time deposit business makes least profit contribution to the bank. Table 4.2 also shows that the NFT pattern gives the overall result of the total NII and does not provide sufficient information for the performance evaluation of each business transaction.

4.4.2 The Concept of Value at Risk

The VaR contribution technique is applied to design the HOW factor for the bank FTP framework. This thesis attempts to apply the VaR contribution technique to

decompose the risks embedded in bank products and business units. Thus, this section introduces the VaR concept, whereas the following section presents the VaR contribution technique.

Marrison (2002) declaims that VaR is considered to be the best single risk measurement technique available. Marrison defines that VaR is a measure of market risk that tries objectively to combine the sensitivity of the portfolio to market changes and the probability of a given market change. VaR concepts are introduced for bank risk analysis due to the following three main advantages.

(1) A key feature of VaR is that it is forward looking and provides an estimate of the aggregate risk of the current bank asset and liability portfolio over the next measurement period. Marrison (2002) points out that the existence of a forward looking aggregate measure of risk allows bank managers to decompose the aggregate risk into its various sources.

(2) Neil (2002) argues that VaR is a measure of downside risk and can be used with skewed and asymmetric distributions of returns. According to Jorion (2007), many bank asset and liability returns are not normally distributed, and they may have some characteristics of skewed and asymmetric distributions. Thus, it is appropriate to apply VaR for measuring the fluctuations of those returns.

(3) Marrison (2002) states that VaR enables bank managers to measure and compare the market risks of different portfolio, compare the risk of the same portfolio at different times, and communicate these risks to colleagues, senior managers and sub unit managers. Neil (2002) confirms Marrison's view that the development of the concept of VaR, and even the name itself, has eased the

communication of information about risk.

The following section presents the VaR contribution technique that can be used to decompose the overall bank VaR by risk factors and by bank instruments.

4.4.3 Value at Risk Contribution

The VaR contribution technique enables bank top management to disaggregate the risks embedded in the bank instruments and business units. Proper decompositions of the risks facilitate the top management to assign the risks to the business unit managers who have control over the risks.

The aggregation of the stand-alone VaR for each risk does not, in general, equal to the total VaR required by a bank. Marrison (2002) explains that this is because the direct sum of stand-alone VaR ignores the correlation among the individual asset within a portfolio. The total VaR is calculated by including all of the bank's instruments. However, the stand-alone VaR for an instrument is the VaR that the bank would have if the rest of the bank's instruments were ignored. The VaR contribution technique measures the risk contributions made by each instrument by including the correlation effects. According to Marrison, the VaR contribution can be constructed to make the sum of VaR contribution for all the bank instruments equals the total VaR for the whole bank.

Marrison (2002) argues that VaR contribution identifies the magnitude and source of each risk for different bank instrument or for different risk factors. Thus VaR contribution defines meaningful keys for tracing back the overall risk to its sources. In this thesis, VaR contribution is applied at both (1) the business unit level and (2) the instrument level.

VaR Contribution at the Business Units Level

To develop funds transfer prices for the business units level, VaR contribution should be used to identify the magnitude and source of the risks for each business unit. For example, consider a bank that has two business units, A and B, and the total VaR is $100. The VaR contribution enables bank managers to calculate VaR for the business unit A and B. When it is assumed that VaR for the business unit A is $60, for the B is $40, the bank managers can make straightforward statements such as, "The VaR for the bank is $100, caused by contributions of $60 from the business unit A and $40 from the business unit B."

VaR Contribution at the Instruments Level

To produce funds transfer prices for bank instruments, VaR contribution technique enables bank managers to break down and aggregate risk contributions according to various risk factors that embedded in the instruments. For example, after deriving the VaR contribution for each risk factor, a bank manager can make a straightforward statement such as, "The total VaR for the bank instrument is $100, caused by contribution of $50 from taking interest rate risk, $20 from liquidity risk, $20 from credit risk and $10 from prepayment risk."

4.4.4 Treatments of Economic Capital in Balance Sheet

The treatments of EC in bank balance sheet are applied in the HOW factor design for the bank FTP framework. Jorion's (2007) declares that EC is used as the aggregate capital required as a cushion against unexpected losses. According to Marrison (2002), EC is one of the most important risk metrics because it is a unifying framework to translate all the risks into a single metric. EC can be applied to various forms of risk including interest rate risk, credit risk, other forms of market risks and operational risk. The benefit of using EC is that it can be used to quantify these risks and these risks can now be directly aggregated and compared

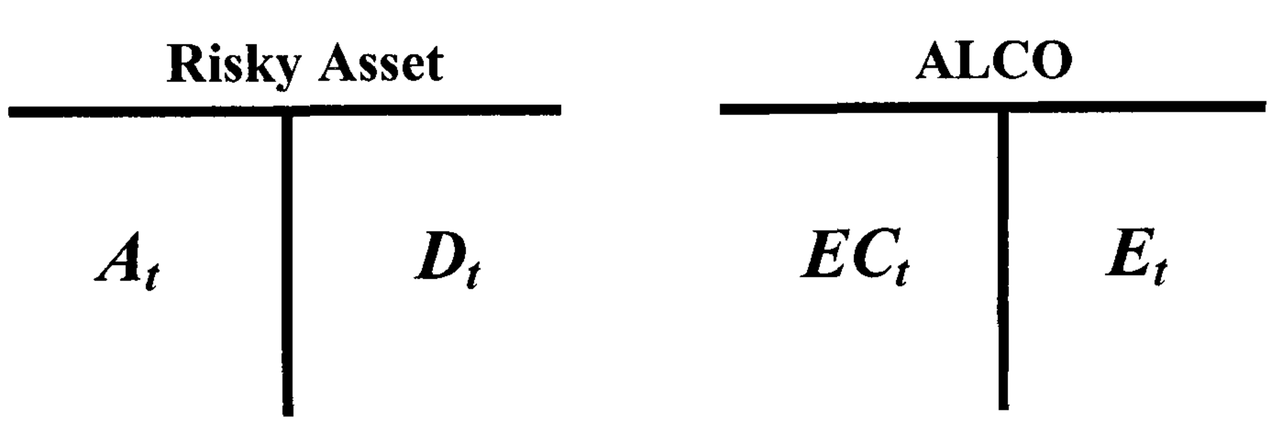
to each other. For example, one dollar of credit risk capital can equal to one dollar of interest rate risk capital.

EC must be allocated to the business units when the units are assigned the responsibility of managing the risks associated with the funds transactions. There are two common approaches to construct the balance sheet for the funds transactions.

The First Approach: Risky Assets Fully Funded with Debts

In this approach, the risky assets of the business are totally financed with debts. The equity within the business represents the EC as safety cushion for absorbing losses. The balance sheet for this approach is depicted in Figure 4.4.

Figure 4.4: Risky Assets Fully Funded with Debts



$$A_t + EC_t = D_t + E_t$$

In this approach, the risky assets (A_t) are charged their debt (D_t) rate for 100% of their funding requirement. The EC_t is hold by the ALCO in the form of additional assets that can be sold to cover any losses from the risky assets. The EC_t can be financed by equity (E_t) from the bank owner. EC_t financing price may be equal to the debt price, which is capital market price for the debt. However, the bank owner requires a high capital return equal to the hurdle rate (H). The difference is charged to the risky assets that create the risks requiring the capital to be held. The total charge to the assets is then the full amount of the assets multiplied by the debt cost, plus the amount of equity times the required excess return:

$$\text{The Total Cost Charged to the Assets} = D_t \times r_d + E_t \times (H - r_d)$$

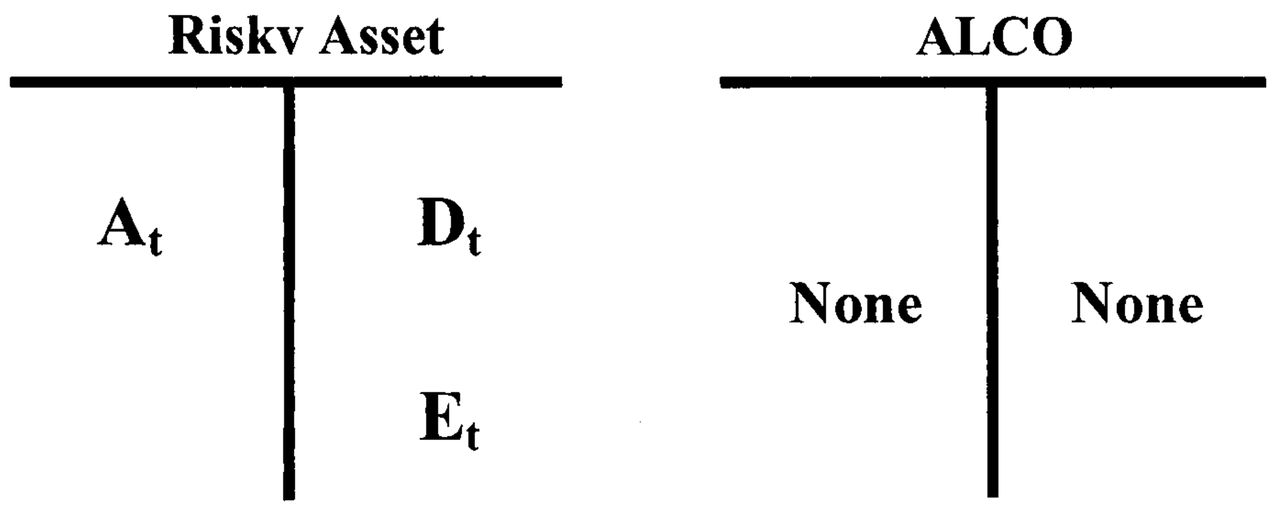
$$= A_t \times r_d + E_t \times (H - r_d) \qquad (4.1)$$

Where r_d is debt rate, and H is hurdle rate.

The Second Approach: Risky Assets Funded with Debts and Equity

In this approach, the EC is held by business unit to support the risky assets rather than by the ALCO. The balance sheet for this approach is depicted in Figure 4.5.

Figure 4.5: Risky Assets Funded with Debts and EC



$$A_t = D_t + E_t$$

In Figure 4.5, the risky assets (A_t) are funded with a mixture of debt (D_t) and equity (E_t). The amount of the required equity (E_t) equals the EC_t allocated for the risks associated with the asset transactions. The total cost charged to the assets is the amount of debts times the debt rate, plus the amount of equity times the hurdle rate.

$$\text{The Total Cost Charged to the Asset} = D_t \times r_d + E_t \times H \qquad (4.2)$$

The EC allocation by the two approaches produces the same costs charged to the assets. This can be examined by the rearrangement of Equation 4.2.

$$\text{The Total Cost Charged to the Assets} = D_t \times r_d + E_t \times H$$

$$= D_t \times r_d + E_t \times r_d - E_t \times r_d + E_t \times H$$

$$= (D_t + E_t) \times r_d + E_t \times (H - r_d)$$

$$= A_t \times r_d + E_t \times (H - r_d)$$

The result from the above rearrangement shows that the total cost of the second approach equals to that of the first approach. However, one of the approaches needs to be selected for the FTP framework design. This will be discussed in the following chapter.

4.5 Methodologies for the Bank Funds Transfer Pricing Model Development

The primary aim of this thesis is to develop the bank FTP model. This section introduces various financial models and methodologies that will be applied for the bank FTP model development.

4.5.1 Notional Funding Solution and Strip Balance Weighted Method

To derive the base funds transfer prices, this thesis applies the MMFTP concepts proposed by Uyemura and Van Deventer (1993). These concepts have been discussed in Chapter Three, but are reiterated as follows:

- The transfer funds should mirror the expected cash flow pattern of the original transaction, including amortizations and/or prepayments.

- The interest rate assigned to the transfer funding should be consistent with the marginal cost of a large block of wholesale funding at the bank's current marginal funding prices for the cash flow pattern expected.

The notional funding solution illustrated by Bessis (1998) and the strip balance weighted method demonstrated by Cole and Woody (1995) are applied to illustrate the above concepts.

Notional Funding Solution

According to Bessis (1998), the notional funding solution replicates the time profile of cash flows and interest rate type. For instance, with a fixed rate term loan,

the amortization profile is replicated. The funding which actually replicates the time profile of the loan is a combination of debts of various maturities. Such funding is more notional than real. It does not depend upon the existing resources. Bessis declares that the notional funding solution can be used as a benchmark for the purpose of determining the analytical cost of funds backing any given assets or liabilities.

Strip Balance Weighted Method

To determine the analytical cost of the funds for an asset instrument, the strip balance weighted method is used to disaggregate the instrument into its component principal cash flows or the strips and treat each strip as a separate bullet instrument. In this circumstance, Cole and Woody (1995) point out that each strip must be funded with the notional funds with the same maturity. The interest rate for the notional strip funds can be determined from the LIBOR index curve with the corresponding maturities. The strip balance weighted method is conceptually similar to the simple average, except that the various rates corresponding to each principal cash flow period are weighted by the notional funds that are matched for each principal cash flow. Thus the funding cost for the instrument depends upon the combinations of the volumes of the notional funds borrowed and maturities. It is derived as the average cost of funds of those notional debts that fund the bullet instruments. Its exact definition is that of the internal rate of return. It is the internal rate of return that makes the present value of the future cash flows generated by the debt equal to the amount borrowed. Thus the cost is not a single market rate but a combination of market rates from the LIBOR index curve.

4.5.2 Value at Risk Calculation

VaR calculation is applied to derive the risk adjustments for the bank FTP model. Marrison (2002) declares that there are three common approaches for calculating

VaR, the parametric VaR, historical simulation and Monte Carlo simulation[4]. Marrison declares that the parametric VaR is simple and convenient and produces more accurate measures of VaR.

The parametric VaR calculation needs to assume that the probability of loss distribution is normal and requires calculation of the variance and covariance parameters. Jorion (2007) thinks that the assumption of the normal distribution is not a concern in that at the highest level of a financial institution, the portfolio benefits from the central limit theorem, which states that the sum of independent random variables converges to a normal distribution. Jorion advocates that the distribution of aggregate bank portfolios disclosed in annual reports generally close to a normal distribution. In practice, there is not much difference in rankings provided by different risk measures.[5] Thus in this thesis, the parametric VaR method is chosen to calculate the potential losses incurred from funds transactions.

Jorion (2007) provides the equation for calculating the parametric VaR:

$$VaR = w_0 \alpha \delta \sqrt{\Delta t} \tag{4.3}$$

Where w_0 is the initial investment,

δ is the standard deviation of the return from the investment,

α is standard normal deviate, and

$\sqrt{\Delta t}$ is time interval in years.

Jorion (2007) points out that the standard normal deviate, α, is determined by

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[4] Marrsion (2002) summarizes the three methods in Chapter 6, page 104-135.

[5] Pfingsten et al. (2004) compare risk measures for actual trading portfolios and find that they are highly correlated.

finding the confidence level for the VaR calculation. One way to decide the confidence level is to use mathematical method based on the equation for calculating VaR. Jorion derives the standard normal deviate as follows:

$$-\alpha = \frac{-|R^*| - \mu}{\delta}$$

Where R^* is the expected return at worst-case outcome, and μ is the expected return.

After the derivation of the standard normal deviate, Jorion (2007) provides the following equation for calculating the confidence level.

$$1 - c = \int_{-\infty}^{w^*} f(w)dw = \int_{-\infty}^{-|R^*|} f(r)dr = \int_{-\infty}^{-\alpha} \Phi(\varepsilon)d\varepsilon$$

Where c is confidence level,

w^* is derived from

$$w^* = w_0(1+R^*)$$

Jorion (2007) transforms the general distribution $f(w)$ into a standard normal distribution, where $\Phi(\varepsilon)$ has mean zero and standard deviation of unity. Jorion concludes that the problem of finding VaR is equivalent to finding the deviate α such that the area to the left of it is equal to 1 - c. For a defined probability p, the deviate α can be found from tables of cumulative standard normal distribution function.

Another way to determine the confidence level is practical. Marrison (2002) points out that the VaR level of losses is the level that will be exceeded in α% of cases and α is determined by the desired default probability of the institution. Marrison states that this in turn is often decided on the basis of a desired credit rating and is the default probability associated with that rating. Marrison illustrates that the small probability of bank defaulting is the probability that corresponds to the bank's target credit rating. Thus the determination of the target credit rating can

decide the probability of the bank defaulting. Since the probability of defaulting decides the confidence level for the VaR calculation[6], the target credit rating determines the confidence level. The derivation of the confidence level can be illustrated with the following process:

Bank Credit Rating ↔ Bank Defaulting Rate → Confidence Level for VaR

4.5.3 Value at Risk Contribution Calculation

The VaR contribution is applied for deriving the risk adjustments for the bank FTP model. The mechanisms for calculating the VaR contribution are derived from the calculation of the portfolio standard deviation. Marrison (2002) presents how to derive the VaR contribution for a portfolio with two risk factors. To derive VaR contribution, Marrison considers a portfolio exposed to two source of risk, A and B. The variance of the value of the portfolio is equal to the sum of the variances caused by the two sources and the covariance between them:

$$\delta_P^2 = \delta_A^2 + 2\rho_{A,B}\delta_A\delta_B + \delta_B^2 \tag{4.4}$$

Marrison (2002) rearranges the terms in Equation 4.4 to make them a sum of a factor multiplied by δ_A and one multiplied by δ_B:

$$\delta_P^2 = \delta_A(\delta_A + \rho_{A,B}\delta_B) + \delta_B(\delta_B + \rho_{A,B}\delta_A) \tag{4.5}$$

If the both sides of Equation 4.5 are divided by δ_P, an additive equation for the standard deviation is derived:

$$\delta_P = \delta_A\left(\frac{\delta_A + \rho_{A,B}\delta_B}{\delta_P}\right) + \delta_B\left(\frac{\delta_B + \rho_{A,B}\delta_A}{\delta_P}\right) \tag{4.6}$$

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6 Jorion (2007) illustrates that the choice of the confidence level for VaR can be decided by the following rule: VaR can be set at a value such that the probability of losses exceeding VaR is equal to the probability of default for the risk.

Marrison (2002) points out that the terms within the brackets in Equation 4.6 can be seen as representing the average correlation between the given risk and the rest of the portfolio. Thus the risk contributions for A and B are derived as follows:

$$\text{Risk contribution for A} = \delta_A \left(\frac{\delta_A + \rho_{A,B}\delta_B}{\delta_P}\right)$$

$$\text{Risk contribution for B} = \delta_B \left(\frac{\delta_B + \rho_{A,B}\delta_A}{\delta_P}\right)$$

δ_P = Risk contribution for A+ Risk contribution for B

Based on Equation 4.3, the VaR contribution for each risk factor can be determined as follows:

$$\text{VaR} = w_0 \alpha \delta_P \sqrt{\Delta t} = w_0 \alpha \times \left[\delta_A \left(\frac{\delta_A + \rho_{A,B}\delta_B}{\delta_P}\right) + \delta_B \left(\frac{\delta_B + \rho_{A,B}\delta_A}{\delta_P}\right)\right] \times \sqrt{\Delta t}$$

$$= w_0 \alpha \times \left[\delta_A \left(\frac{\delta_A + \rho_{A,B}\delta_B}{\delta_P}\right)\right] \times \sqrt{\Delta t} + w_0 \alpha \times \left[\delta_B \left(\frac{\delta_B + \rho_{A,B}\delta_A}{\delta_P}\right)\right] \times \sqrt{\Delta t}$$

Thus, the VaR contribution for the two risks, risk A and B, can be defined such that they add up to the total VaR.

$$\text{VaR Contribution}_A = w_0 \alpha \left[\delta_A \left(\frac{\delta_A + \rho_{A,B}\delta_B}{\delta_P}\right)\right] \sqrt{\Delta t}$$

$$\text{VaR Contribution}_B = w_0 \alpha \left[\delta_B \left(\frac{\delta_B + \rho_{A,B}\delta_A}{\delta_P}\right)\right] \sqrt{\Delta t}$$

$$\text{VaR} = \text{VaR Contribution}_A + \text{VaR Contribution}_B$$

Marrison (2002) also presents how to derive VaR contribution for a portfolio with *N* risk factors. It is assumed that a bank has a number of instruments, *a* to *z*. The number of risk factors shared by the instruments are *N*. To derive VaR contribution, Marrison introduces the concept of the sensitivity vectors. The sensitivity vector for the bank as a whole has an element for each of the *N* risk factors:

$$D = [d_1 \; d_2 \quad d_k \quad d_N]$$

Where d_k is the derivative of the portfolio's value with respect to the *k*th risk factor:

$$d_k = \frac{\partial V}{\partial f_k}$$

Marrison (2002) explains that each sensitivity is the sum of the sensitivities of each of the instruments, *a* to *z*:

$$d_1 = d_{1,a} + \quad d_{1,m} \quad + d_{1,z}$$

$$d_k = d_{k,a} + \quad d_{k,m} \quad + d_{k,z}$$

$$d_N = d_{N,a} + \quad d_{N,m} \quad + d_{N,z}$$

Where $d_{k,m}$ is the derivative of the value of the instrument *m* with respect to risk factor *k*.

Marrison (2002) puts the sensitivity of each instrument into separate vectors as follows:

$$D_a = [\; d_{1,a} \quad d_{k,a} \quad d_{N,a} \;]$$

$$D_m = [\; d_{1,m} \quad d_{k,m} \quad d_{N,m}]$$

$$D_z = [\; d_{1,z} \quad d_{k,z} \quad d_{N,z} \;]$$

Marrison (2002) declares that the sensitivity vector for the whole bank will equal the sum of the sensitivity vectors for the instruments:

$$D = D_a + \quad D_m \quad + D_z \tag{4.7}$$

Having derived the sensitivity vector in Equation 4.7, Marrison (2002) calculates the portfolio variance in the following equation:

$$\begin{aligned} \delta_P^2 &= DCD^T \\ &= (D_a + D_b + \cdots D_z)CD^T = \sum_{i=a}^{z} D_i CD^T \end{aligned} \tag{4.8}$$

Where D^T is the transpose of D,

C is the covariance matrix calculated as follows:

$$C = \begin{bmatrix} \delta_1\delta_1 & \rho_{1,2}\delta_1\delta_2 & \rho_{1,N}\delta_1\delta_N \\ \rho_{k,1}\delta_2\delta_1 & \delta_k\delta_k & \rho_{k,N}\delta_k\delta_N \\ \rho_{N,1}\delta_N\delta_1 & \rho_{N,2}\delta_N\delta_2 & \delta_N\delta_N \end{bmatrix}$$

From this, Marrison (2002) defines the VaR contribution for the i instrument as follows:

$$\text{VaR Contribution}_{\,i} = \alpha \times \frac{D_i C D^T}{\sqrt{DCD^T}} \tag{4.9}$$

Where α is the standard normal deviate.

4.5.4 Economic Capital Calculation

EC is a very important input for the bank FTP model development. According to Marrison (2002), VaR can be applied to measure the EC required as a cushion against bank default. With the VaR defining EC, bank managers can decide, for a given business activity, how much capital is at risk in terms of a vision of worst-case outcome.

Marrison (2002) states that the EC is the amount that bank owners must pay into the bank at the beginning of the year so that the bank can carry out its planned investments and maintain its target credit rating with only a small probability of defaulting. Marrison points out that the EC to be held at the beginning of the year is the maximum probable loss, discounted back at the risk free rate to give the amount that must be put in reserve to maintain the required target debt rating. Marrison declaims that the discount rate can also be the return earned on high

credit quality and liquid portfolio. When it is determined that risk free rate is the actual return for the EC over a time period, Marrison provides the following equation:

$$EC = \frac{VaR_{\alpha}}{(1 + r_f)} \tag{4.10}$$

Where VaR_{α} is the maximum probable loss,

r_f is risk free rate, and

α is confidence level.

4.5.5 Hurdle Rate Calculation

The hurdle rate calculation is applied for deriving the risk premiums for the bank FTP model. The hurdle rate is the required rate of return of the EC. Since the EC is the capital borrowed from the bank owners who require that the return from the EC investment is not less than the hurdle rate. The hurdle rate can be derived from the capital asset pricing model (CAPM). Marrison (2002) advocates that the most theoretical pure approach to set the hurdle rate is based on the CAPM. The CAPM requires the following rate of return (r_i) for an investment:

$$r_i = r_f + \beta_i (r_f - r_m) \tag{4.11}$$

According to Marrison (2002), r_f is the risk free rate of return, r_m is the average return expected on the overall market, and β_i is the correlation between the return on the investment and the return on the market, weighted by the respective volatilities:

$$\beta_i = \rho_{i,m} \frac{\delta_i}{\delta_m}$$

Where δ_i is the volatility of the investment,

δ_m is the volatility of the market, and

$\rho_{i,m}$ is the correlation.

Marrison (2002) explains that when this equation is applied for the money invested in a bank, δ_i is the volatility of the bank's share price, $\rho_{i,m}$ is the correlation between the share price and the market, and the required return, r_i is the hurdle rate, *H*:

$$H = r_f + \beta_{bank}(r_f - r_m)$$

$$\beta_{bank} = \rho_{bank,m} \frac{\delta_{bank}}{\delta_m}$$

4.6 Summary

This chapter presents the methodologies that are applied for the six-factor bank FTP framework design and the bank FTP model development. The empirical investigations on the bank FTP practices are conducted through the questionnaire survey, email contacts and telephone interviews. The results from the questionnaire survey and email contacts are applied to design the six factors for the bank FTP framework. The data obtained through the telephone interviews are used for the purpose of illustrating the process of generating bank funds transfer prices.

This chapter also introduces various financial risk management concepts and methodologies that will be applied to design the six factors and develop the bank FTP model.

Chapter Five: Empirical Investigations on Bank Funds Transfer Pricing

5.1 Introduction

The objective of this chapter is to investigate the WHY, the WHAT, the WHO, the WHERE, the WHEN and the HOW factors involved in the FTP process within commercial banks. Using a postal questionnaire and email contacts, these investigations aim to address the following questions:

- WHY is the FTP system established in a commercial bank?
- WHAT objectives are transferred in the bank FTP process?
- WHO is involved in the bank FTP process?
- WHERE are the originations and destinations of the funds transfer?
- WHEN are the funds transfer prices determined?
- HOW are the funds transferred, and how are the transfer prices determined?

To demonstrate how funds transfer prices are generated with the bank FTP model developed in this thesis, all the data inputs to the model should be obtained. Some of the data can be found from the public resources. However, some data are generally not available to the public. Therefore, a telephone interview is conducted to obtain these data.

The first section of this chapter presents the process of conducting the empirical investigations. The second section concludes the results and findings from the empirical investigations. The final section is the summary.

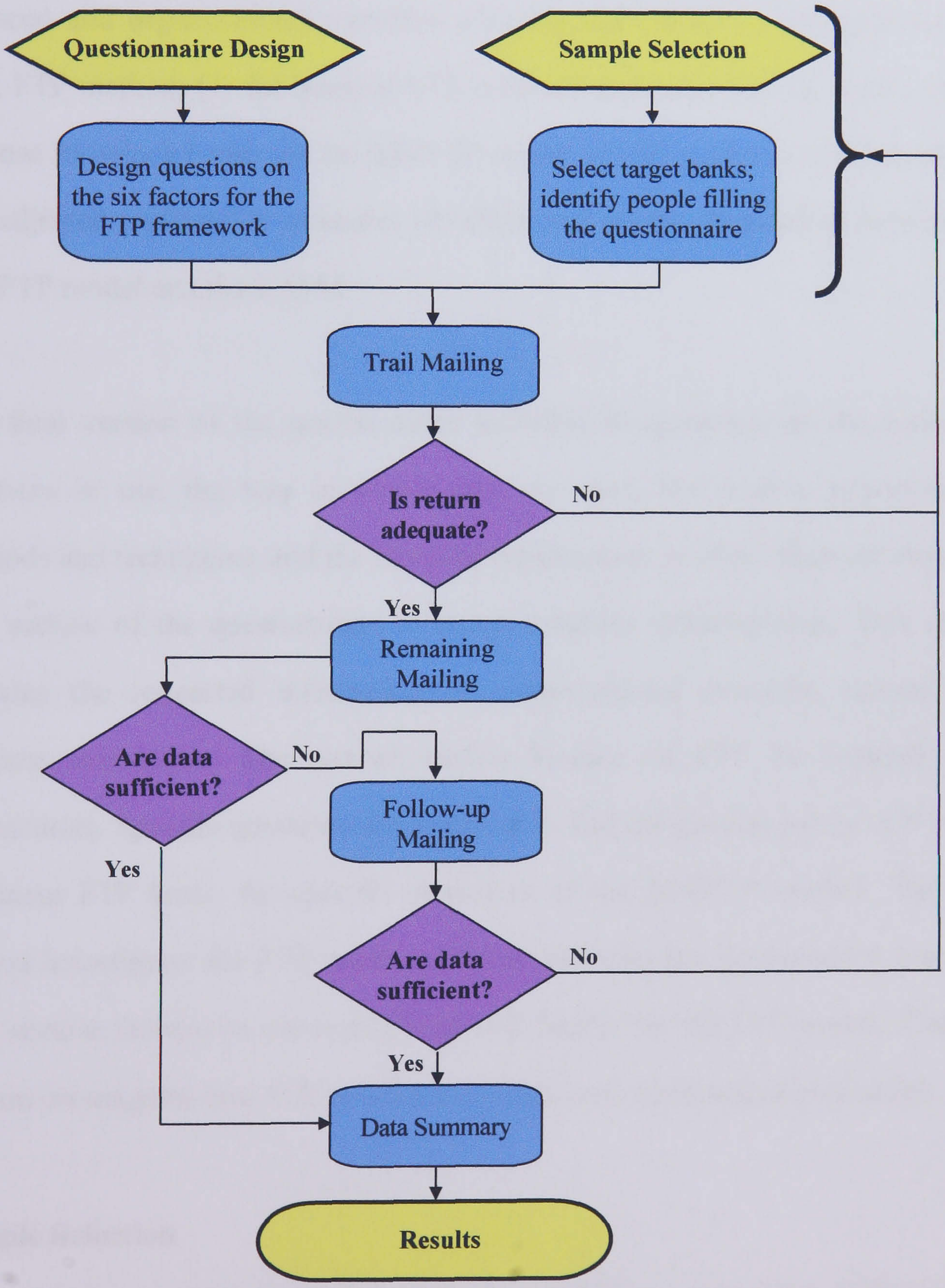
5.2 Empirical Investigations on Bank Funds Transfer Pricing

5.2.1 Questionnaire Survey

This section conducts a cohesive survey incorporating the three dimensions of

interest for this research, bank risk management, FTP, and performance evaluation. The aim of the survey is to ascertain empirical relationships within and among these three particular aspects of FTP policy in the context of UK domestic bank operations. The survey procedure is depicted in Figure 5.1.

Figure 5.1: Survey Procedure



Questionnaire Design

The questionnaire administered in this survey is designed after an extensive review

of the theoretical literature on TP both in manufactory and financial industries. The questions are designed in terms of the six factors presented in Chapter Two. Several drafts are necessary before an acceptable version is tested in trail mailings. The survey form is reproduced in Appendix 2 at the end of this thesis.

The survey establishes (1) the general objectives of using a bank FTP method, (2) financial and organizational variables affecting the choice by management of a bank FTP method, (3) the types of FTP methods applied in the UK banks, (4) the purpose for which banks use the MMFTP model, (5) the extent to which banks use risk adjusted profitability measures (RAPM), and (6) the relationship between the MMFTP model and the RAPM.

The final version of the questionnaire included 80 questions on the bank FTP practices in use, the way in which they are used, the relative importance of methods and techniques, and the financial environment in which they are used. The first section of the questionnaire is about company characteristics. This section includes the requested information on organisational structure, current bank business orientation. The second section focuses on FTP for internal funds transactions. Specific questions are designed to find the general policy of FTP, the dominant FTP basis, the specific objectives of the MMFTP method. The third section investigates the FTP model and bank financial risk management practices. This section focuses on surveying bank risk factors for the FTP model. The final section investigates how FTP is integrated with bank performance evaluation.

Sample Selection

This survey concentrates on large commercial banks because of the following two reasons:

(1) Large commercial banks are more likely to be organized on a divisional basis,

which means that these banks may have many branches[7]. This makes it possible that many interrelationships exist among branches and the head office.

(2) Large commercial banks are very active in deposit-taking business. This makes it possible that a great number of funds transactions may be made within the banks. Therefore, large commercial banks are likely to engage in significant FTP activities. The population for this survey consists of those 30 UK banks on the Times 1000 list of the year 1998[8].

Administration of Questionnaire

Stage one: trail mailing. On September 12, 2005, a trial mailing was sent out to the pre-test groups. As Collier and Wallace (1992) suggested, the groups may include (1) colleagues; fellow academics with an interest in the area or in questionnaire design, (2) users of data; the supporting bodies and others interested in the results, and (3) members of the population being surveyed. In this survey, colleagues and some professionals in the Bangor Business School, Bangor University, were invited to participate in the pilot survey. The remaining questionnaires would be sent out when the returns from the trail mailing seem adequate. The returns seemed adequate, thus the remaining questionnaires were sent out.

Stage two: remaining mailing. On October 15, 2005, the remaining questionnaires were sent out. A total of 30 commercial bank and building societies were contacted. The remaining mailing to each company consists of the following items, (1) a typed, personally signed covering letter, (2) the questionnaire and (3) a post-paid

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[7]Oyelere and Turner (2000) used the number of branches as the main characteristic in selecting the sample for the TP survey.

[8] Collier and Wallace (1992) stated that the "Time listing" is a common starting point for questionnaire populations in finance, auditing, accounting and management research.

return envelope.

Stage three: follow-up mailing. Collier and Wallace (1992) advocate that there are two main instruments in maximizing response rate: a covering letter and follow up mailings. Thus, a follow up mailing to those companies that had not yet responded was sent out on November 12, 2005. The follow-up mailing includes the same items as those in the previous mailing.

5.2.2 Email Contacts and Telephone Interviews

The previous chapter discusses that a combination of methodologies in the study of the same phenomenon has greater validity and reliability than a single methodological approach to a problem. On the other hand, it is expected that the responses from the postal questionnaire survey is low due to the sensitivity of the FTP issues faced by the banks. Thus this thesis conducts email contacts with the FTP professionals to inquire about the same questions of the questionnaire survey. The email contacts aim to obtain as much information as possible on the FTP issues and gain a full understanding of the FTP issues faced by commercial banks. Two FTP consultants, who are from non-bank financial service companies in the US and UK, have been located from a FTP issues discussion website[9]. In December 2005, several email contacts were made with the FTP consultants and the responses have been both timely and positive.

Finally, a telephone interview was conducted with bank FTP specialists. As discussed in the previous chapter, the aim of the telephone is to provide the data on the application of the FTP model. It was the intention of this research to use a sample of carefully selected interviews with the FTP experts in some commercial

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[9] The discussions on the FTP issues were hold with people whose names were obtained from http:// www.almprofessional.com on December 10th 2005.

banks in China. The telephone interview was conducted in January 2007. The interview was recorded and transcribed and lasted an hour. The interviewee was identified based on their employment, published works and, above all, his FTP experiences.

5.3 Summary of Results

5.3.1 Results from the Questionnaire Survey

The results of the questionnaire survey are examined from the sample characteristics and responses, position of person filling the questionnaire, profile of the participating companies, and participating companies' business and business orientation. This section also summaries the evidences on the six factors: the WHY, the WHAT, the WHO, the WHERE, the WHEN and the HOW factors.

Sample Characteristics and Responses

Four financial institutions, which include one bank and three building societies, responded to the first wave of mailing over a four-week period. No financial institutions were responded to the follow up mailing. This confirms that companies delaying in replying to questionnaires may be more alike the non-respondents, for example, see Scott (1961). One building society responded that it does not have a FTP system in use. Another building society stated that it had merged with a commercial bank in the UK. The remaining building society (Building Society XYZ) returned an uncompleted questionnaire form. However, the questionnaire from the responding bank (Bank XYZ) is complete. The respondents were asked to indicate if it would be possible to arrange an interview to discuss some of the issues relating to the questionnaire. No companies stated that they would be able to be interviewed.

The response rate was considered low due to the high level of sensitivity usually

attached to the subject of FTP. However, as the purpose of this survey is to find any evidences on the FTP practices, the statistical data analyses from the survey are not concerned.

Position of Person Filling the Questionnaire

As the questionnaire required, both of the questionnaires returned are completed and singed by the head of finance director, who is in charge of the FTP process. This increases the reliability of answers to the questions listed in the questionnaire form.

Profile of the Participating Companies

Bank XYZ and Building Society XYZ are UK's major financial services companies. The profiles of these two companies are described in Table 5.1.

Table 5.1: Company Characteristics: Bank XYZ & Building Society XYZ

	Bank XYZ	Building Society XYZ
Total Assets	£58.98 billions	£32.43 billions
Deposits	£56.77 billions	£30.27 billions
Loans	42.24 billions	£20.87 billions
Number of Branches	256	270

Table 5.1 shows that both companies have an asset base that is mainly supported by deposits. It also shows that the funds from customers are mainly lent out as bank loans. These indicate that many internal funds transactions are made within each company since the loan units have to obtain funds from the deposit-taking units. The large number of branches requires that a FTP system should be established for each of them to coordinate the business activities of their branches.

Participating Companies' Businesses and Business Orientation

The two companies' main businesses and business orientation are summarized and presented in Table 5.2 and Table 5.3.

Table 5.2: Current Main Businesses: Bank XYZ & Building Society XYZ

Type of Businesses	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Acceptance of short term deposits	Bank Building Society						
Acceptance of long term deposits	Bank Building Society						
Provision of short term loan	Bank Building Society						
Provision of long term loan	Bank Building Society						
Provision of mortgage loan	Bank Building Society						
Selling securities							Bank Building Society
Interbank funding transaction	Bank Building Society						

Table 5.3: Current Business Orientation: Bank XYZ & Building Society XYZ

Objective	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Short run profit		Bank	Building Society				
Long run profit	Building Society	Bank					
Increase in market share	Building Society		Bank				
Effective bank risk management	Bank Building Society						
New financial product development				Bank Building Society			
Maintain a strong liquidity position	Bank		Building Society				
Ensure a satisfactory funding mix	Bank Building Society						

Table 5.2 shows that the two main businesses conducted by both companies are deposits taking and commercial loans making. It is very uncommon that the amount of the deposits is exactly matched with that of the loans. Thus, it is understandable that both of the companies make interbank transactions to facilitate their liquidity positions. As will be discussed in Chapter Seven, the existence of

interbank loan business enables the derivation of the base funds transfer prices.

Table 5.3 shows that effective risk management is a vital activity for both companies. Ensuring a satisfactory funding mix is considered to be a critical issue for them. This is due to the reason that a satisfactory funding mix would enable financial institutions to reduce financial risk exposures. Both companies indicate that maintaining a strong liquidity positions is very important. With the moderate degree of importance in the development of new financial products, it is expected that more financial risks could be involved in their businesses.

Evidences on the Six Factors for the Bank FTP Framework

The aim of conducting the questionnaire survey is to provide information for designing the six factors for the bank FTP framework. The findings on the six factors from the questionnaire are summarized as follows:

The WHY Factor

The questionnaire surveys shows that bank business units are generally not allowed to borrow funds directly from the outside money markets or sell funds to the outside money markets without selling funds to the funding center. This requires that bank funds transactions must take place internally. The findings on the WHY factor are concluded from the results of the investigations on the general FTP objectives. The summary of the results on the general FTP objectives is presented in Table 5.4.

Table 5.4: The General Objectives of FTP: Bank XYZ & Building Society XYZ

General Objective	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Achievement of overall corporate goals	Building Society		Bank				
Identify and manage bank risks	Bank				Building Society		
Assign responsibilities to branch managers to mange resources		Bank			Building Society		
Motive branch managers desired behaviour			Building Society	Bank			
Determination of profit-related pay for branch managers			Bank Building Society				
Facilitate performance evaluation of products			Bank		Building Society		
Facilitate performance evaluation of managers				Bank	Building Society		
Facilitate performance evaluation of branches			Bank		Building Society		
Preserve branch autonomy					Bank Building Society		

Table 5.5 shows that both the bank and the building society think that FTP is applied to achieve the overall corporate goals. Bank XYZ concerns how to use FTP to identify and manage bank risks and to assign responsibilities of managing resources. The bank states that FTP is important for the performance evaluation of business units. It concerns less on how FTP can be used to motivate business unit managers. On the contrary, Building Society XYZ applies FTP mainly as a tool to motivate business units' managers. It does not concern how FTP can be used to identify and manage financial risks and to assign responsibilities of managing risks. Table 5.4 indicate that both companies do not concern much about the objective of FTP in preserving branch autonomy.

The evidences from Table 5.4 provide the information for the WHY factor design. The evidences emphasize that the WHY factor should concern the following two objectives, (a) effective bank risk management by properly assigning the

responsibilities of managing the risks among business units, and (b) accurate economic performance measurement of business units or products so that appropriate profit related pay system can be established.

The WHO Factor

The survey shows that both companies have a special unit take the charge of their FTP system. Both company state that there are only a few people, 1-5 people, working in the unit. Bank XYZ indicates that the unit is run by the people from various departments within the bank. The responses from both companies provide the evidences that the unit centrally manages the interest rate risk and liquidity risk; however, other bank risks are controlled and managed by business units themselves.

The WHAT Factor

The investigation evidences for the WHAT factor are summarized and presented in Table 5.5.

Table 5.5: The Objectives of the MMFTP: Bank XYZ

Specific objective	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Transfer bank risks to a special unit that effectively controls them							**Bank**
Assign responsibilities to unit managers to mange bank risks			**Bank**				
Manage the liquidity profile of bank assets and liabilities			**Bank**				
Reduce interest rate fluctuation losses		**Bank**					
Reduce market prices fluctuation losses			**Bank**				
Reduce asset and liability mismatch risks		**Bank**					
Reduce prepayment risks (option) risks			**Bank**				
Reduce credit risks					**Bank**		
Reduce basis risks		**Bank**					

Building Society XYZ replied that it does not have the MMFTP system, thus there

are no evidences on the WHAT factor from its response. However, there are some evidences on the WHAT factor from the response of the bank. Table 5.5 indicates that the bank does not use FTP to transfer risks. However, Table 5.5 shows that the FTP framework should concern the following risks, interest rate risk, liquidity risk, market price risk, mismatch risk, prepayment risk and basis risk. Table 5.5 also indicates that credit risk should not be much concerned by the FTP framework.

The WHERE Factor

Both companies indicate that FTP is applied at business units level. However, Bank XYZ emphasised that FTP is also applied at the instrument level. The bank states that the FTP method is used for the purpose of bank product pricing. This is understandable since products are key profit generators in any financial organization and an understanding of how they contribute to profitability provides basic organizational insights.

The WHEN Factor

Both companies responded that their companies' internal profitability analyses are prepared on a quarterly basis. This indicates that the funds transfer prices should be generated quarterly to measure the performance of their business transactions. Thus the bank FTP model should be developed to facilitate performance measurement at any point of time of the business transactions.

The HOW Factor

There are two evidences on the HOW factor from the survey. The first evidence is about flow of funds within the company. Both companies stated that no business units, apart from the funding centre, are allowed to borrow funds directly from the outside money markets or sell funds to the outside money markets without selling funds to the funding centre. The results from the investigations indicate that the

funds from the funds providers go directly to the central pool, from which the funds are transferred to the funds users. This means that there is a sequential interdependence between business units within the companies. These results are particularly used for the flow of funds design in the subsequent chapter.

The second evidence is that both companies have only one pool for their business units to buy funds from and sell funds to. The building society applies single funds transfer price for all their funds transactions. However, the bank states that multiple prices are applied for its funds transactions. The methods used by both companies to generate funds transfer prices are presented in Table 5.6.

Table 5.6: The Applications of the FTP Methods: Bank XYZ & Building Society XYZ

Method	Always used	Often used	Sometimes used	Rarely used	Never used
Average cost of raising funds	Bank, Building Society				
Average cost of funds plus fixed markup			Bank		Building Society
Marginal funding cost (incremental cost)		Building Society			Bank
Market price (for example, LIBOR)		Bank			Building Society
Adjusted market price					Bank, Building Society
Negotiated price					Bank, Building Society
Matched Maturity Funds Transfer Pricing Method			Bank		Building Society
Mathematical programming optimal price					Bank, Building Society
No transfer price (free transfers)					Bank, Building Society

Table 5.6 shows that both companies always use the average cost of raising funds for their funds transferred. The building society states that it does not apply the MMFTP method in its funds transactions. The bank claims that the MMFTP method is only used for the purpose of product pricing, and states that market price,

such as LIBOR, is often used for pricing its funds transactions.

5.3.2 Results from the Email Contacts

Several email contacts were conducted with two FTP consultants. The consultants provided a wealth of information on FTP in practice. The following is a summary of the comments of the email contacts related to the FTP practices.

Consultant 1

Consultant 1 is the director of an E-business financial software firm, a major FTP consultant company in the US. The mail contacts were conducted in December 2005. The consultant provided some evidences on the WHY, the WHAT, the WHERE and the HOW factors with the main points summarized in Table 5.7.

Table 5.7: FTP Evidences from the Consultant 1 (Every bank asset is over $15 billion)

	1994-1997	1997-2000	2000-2002	2002-2005
The WHY Factor	Product performance evaluation on a relative basis.	Performance evaluation. Examine treasury contributions.	Performance evaluation. Quantify risk.	Design performance driven compensation system.
The WHAT Factor	Interest rate risk	Basis risk and interest rate risk.	Basis risk, prepayment risk and interest rate risk.	Prepayment risk, liquidity risk, foreign exchange rate risk, and interest rate risk.
The WHERE Factor	Business unit, Instrument level.	Business unit, Instrument level	Instrument level	Instrument level
The HOW Factor	Multiple pool or single pool approach.	Incorporate risk variables in multiple pool approach.	MMFTP, Considering risk variables in the FTP model.	Struggling with how to effectively manage risks with the FTP.

The consultant provided the evidences on the FTP practices from 80 commercial banks in Europe. The FTP evidences are mainly for the years from 1994 to 2005. The consultant confirmed some observations from the previous questionnaire survey with the main points summarized as follows:

The WHY Factor

Accurate economic performance evaluation is important since banks tend to apply the FTP to accurately measure the performance of the bank business units so that a proper management compensation system can be established.

The WHAT Factor

Integrating FTP with bank risk management is critical since banks tend to increase the types of financial risks taken on the balance sheet.

The WHERE Factor

Banks apply the FTP at both business unit and instrument level. However, as the number of the products and services provided by banks are increasing, the banks tend to apply FTP at the instrument level.

The HOW Factor

The FTP model is becoming more sophisticated. The evidences shows that the FTP method evolves from single pool FTP method to the MMFTP method and that many commercial banks are still struggling with how to develop an appropriate FTP system to manage the increasing risks associated with asset and liability business activities.

Consultant 2

Consultant 2 is a senior FTP consultant at an international accounting firm in the UK. The email contacts were also conducted in December 2005 with the main points outlined as follows:

The WHY Factor

The second consultant stated that many banks attempt to design a FTP model to

separate each risk component embedded in bank product or business units and then quantify the risks. The consultant replied that the FTP model is closely linked with bank ALM model, the aim of which is to manage bank risks. This observation confirms the significance of this thesis that the FTP model is developed for the purpose of managing bank risks.

The WHERE Factor

The consultant confirmed the observations of the first consultant regarding the use of FTP at the instrument level. The consultant stated that FTP is used to calculate the FTP spread, which is the difference between the yield on asset/liability and the funds transfer price applied to the asset/liability. The results were used to compare product performance on a relative basis.

The WHAT Factor

The consultant stated that various types of bank risks should be incorporated in the FTP model. The types of the risks that should be incorporated in the FTP model include basis risk, interest rate risk, prepayment risk and liquidity risk. The risk factors suggested by the second consultant are similar with those suggested by the first consultant.

The WHO Factor

According to the consultant's experience, the ALCO is in charge of the bank's FTP system. The consultant pointed out that the ALCO could be the best candidate to administer the FTP system.

The WHEN Factor

The consultant stated that the FTP model should enable bank managers to examine the ALCO profit contributions to the whole bank over the whole life of the funds

transactions' time. As will be discussed in the following chapter, this requires that the FTP profit contributions should be examined based on the original term and remaining term FTP model.

The HOW Factor

The consultant stated that most of the banks apply a combination of the MMFTP method and the multiple pool method. The consultant pointed out that a changing money market and rates that are not completely controlled by a government agency or constant over long periods of time are factors that should be considered in the development of the FTP model.

The final suggestion made by the second consultant is that the model foundation to develop the FTP model is most important. The consultant stated that once the MMFTP model basic functionality is established, other variables for the FTP model should flow naturally in a module format. The consultant indicated that although this is a FTP software development issue, he has found it critical to the sound FTP modelling. The suggestion validates that designing the FTP framework, which is mentioned by the consultant as the model foundation, is fundamental for the development of the FTP model.

5.3.3 Results from the Telephone Interview

A telephone interview was conducted in January 2007. The interviewee is a senior ALM manager of the treasury department in a Chinese commercial bank. The bank's name is anonymous due to the confidential reasons. The main responsibility of the manager is to deal with the bank's FTP issues.

The interviewee confirmed the results from the email contacts and questionnaire survey regarding the important role of FTP in bank risk management and the use of

FTP in business units' performance evaluation. The interviewee stated that a FTP system is mainly used for the cost and revenue allocation among the bank's business units. The interviewee realized that FTP is a critical issue in managing bank risks. However, the interviewee stated that Chinese commercial banks are struggling with developing an appropriate FTP model to effectively manage bank risks. Finally, the interviewee indicated that a case study would be helpful in explaining how the FTP model is applied to derive funds transfer prices, and that some financial data from the commercial bank could be provided for the case study. The information gathered before, during and after the interviews is presented in the form of the case study in Chapter Ten.

5.4 Summary

This chapter investigates bank FTP issues by conducting a questionnaire survey, email contacts and telephone interviews. The results from the investigations provide crucial evidences for the six-factor bank FTP framework design. The questionnaire survey shows that commercial banks are concerned with how to use FTP to evaluate the economic performance of bank business units and products. A FTP system should be established to effectively manage bank risks and properly assign the responsibility of managing the risks among business units. The investigations indicate that it is necessary to set up a special unit to centrally manage bank risks. The survey shows that the FTP model should be developed at both the business unit and instrument levels. Both the original term and remaining term FTP model should also be developed.

The email contacts confirms the results from the questionnaire survey that the FTP framework should be designed to effectively manage bank risks and accurately measure the economic performance of bank business units and products. The email contacts also confirm that the FTP model should be developed at the business units

and instrument level. However, the findings from the email contacts emphasize that the FTP model development at the instrument level is crucial. The email contacts show that the ALCO not only centrally manages bank risks, but also administrates the FTP system. The email contacts suggest that the FTP framework is the foundation for the development of the FTP model.

The FTP issue investigations through the telephone interview show that a case study would be necessary to explain the process of the transfer prices derivation with the bank FTP model.

Chapter Six: The Six-factor Bank Funds Transfer Pricing Framework Design

6.1 Introduction

This chapter designs the six factors, the WHY, the WHAT, the WHO, the WHERE, the WHEN and the HOW factors, involved in the bank FTP process. As discussed in Chapter Two, a firm may arrange its organization structures and control systems to minimize transaction costs. Therefore, in this chapter, the six factors are designed to help establish bank structure and bank risk control system so that transaction costs in the bank FTP process are minimized. The results from the empirical investigations in the previous chapter help design each factor.

The six factors need to be designed before the bank FTP model development since these factors determine the bank FTP process, and the FTP model is a tool used to facilitate the administration of the bank FTP process. This thesis focuses on the HOW factor design with various financial risk management concepts and techniques. This is because the risk control procedures concerned by the HOW factor determine how bank risks are effectively managed. Some evidences found from the empirical investigations are also used in the HOW factor design. The allocation of the costs and profits from the risks will be discussed in the chapter of the bank FTP model development.

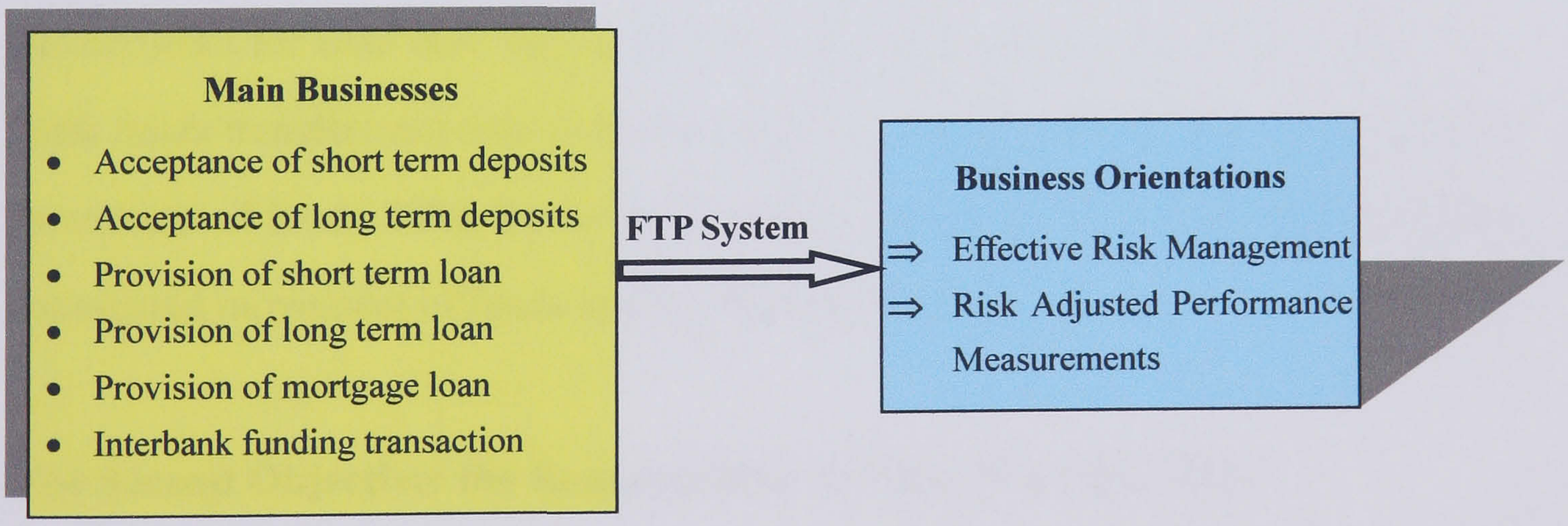
The first section of this chapter defines the objectives of the WHY factor followed by the second section, the WHAT factor design. The third section designs the WHO factor by identifying the responsibility of bank units' managers. The fourth section is the WHERE factor design. The fifth section designs the WHEN factor in terms of bank performance evaluation. The sixth section designs the bank funds transfer and risk management procedures that the HOW factor concerns. The seventh section generalizes the six-factor bank FTP framework. The final section is the summary.

6.2 The WHY Factor Design

As discussed in Chapter Two the WHY factor concerns the underlying reasons for the transaction to take place internally. The empirical investigations conducted in the previous chapter shows that bank business units are generally not allowed to borrow funds directly from the outside money markets or sell funds to the outside money markets without selling funds to the funding center. This requires that bank funds transactions must take place internally. This section attempts to find the reasons why FTP should be established in commercial banks.

The results from the empirical investigations show that the WHY factor should concern the objectives of (1) effective bank financial risk management and (2) accurate risk adjusted performance measurement. The investigation results indicate that FTP is applied to link the bank's main businesses with its business orientations. The uses of FTP in managing banking businesses are depicted in Figure 6.1.

Figure 6.1 Splitting up Bank Business Activities with a FTP System



Banks create values by taking the main business activities listed on the left side in Figure 6.1. A FTP system is established to make connections between the main businesses, which generate returns from various risk taking business activities, and the business orientations, which aim to effectively manage the risks associated with the activities and evaluate the risk-adjusted performance of the activities. Therefore, the bank FTP model should achieve the objectives of effective bank risk management and accurate business performance evaluation.

6.3 The WHAT Factor Design

As discussed in Chapter Two the WHAT factor concerns the things that transferred among business units. In commercial banks, the WHAT factor should concern (1) the funds transferred within a bank and (2) the responsibility of managing financial risks associated with the funds transferred.

The First Objective: the Bank Funds Transferred

In the manufactory industry, transfer prices are normally set for the intermediate products, which are goods and services that are supplied by the selling division to the buying division. The goods are further processed and then sold to the external buyers. Therefore, the thing that the WHAT factor concerns in the manufactory organizations changes as it transfers to the other business units. However, the thing that is being transferred within a bank is the funds, and the transfers may not involve any transfer of resources but may be entirely notional. For example, a bank may not have actual movement of funds from one business unit to the other unit. The payments between the business units are fictitious in that they are recorded in the accounts for each unit, but no money actually leaves the bank as a whole. Thus bank funds transfers are only notional transfers and have no relation with the actual movement of funds. With the notional funds transfer, the FTP model deals with the conceptual movement of funds among the business units.

The Second Objective: the Responsibility of Managing Bank Risks

According to the email contacts conducted in this thesis, bank funds transactions are getting involved in more and complicated risks, and there is an increasing requirement that bank risks should be effectively managed. However, due to the bounded rationality, business unit managers may not possess all the information required for making an optimal risk management decision. For example, business unit managers in the subsidiaries may not possess the information related to the overall risk positions of the bank. Thus business unit managers may not have the capability to deal with all the risks. Therefore, it is critical that the responsibility of

managing the risks is delimited and properly assigned to the unit managers who have the control of the risks. The process of delimitating the risk management responsibility is discussed in the HOW factor design.

6.4 The WHO Factor Design

Pinpointing the responsibility of bank risk management enables the top management to identify two groups of risks, risks under the control of the business units' managers and risks beyond the control of the managers. Thus, the WHO factor is designed to let (1) the business units' managers take the responsibility of managing the risks under their control, and (2) the ALCO managers centrally manage all the risks beyond the control of the units' managers.

The Responsibility of Bank Business Units' Managers

To assign the responsibility to the business units, the controllability of each business unit should be clearly defined. According to the empirical investigations in the previous chapter, in commercial banks, each individual or unit is responsible for a specific product market under the direction of a bank manager. With the area of controllability well defined, the bank top management can properly assign the responsibility of managing resources among these units.

The Reasonability of the ALCO

In this thesis, the ALCO is introduced to centrally manage the risks beyond the control of the business units. The ALCO is a responsibility centre, in which bank funds and the associated risks are accumulated. The centralization of bank risks makes the risks to be managed more efficiently since there is a dedicated responsibility for managing the risks. When various risks are concentrated in the ALCO, the ALCO is able to get benefit from any risk offsetting activities. Modern portfolio theory finds that, if one puts two sets of risky returns together, the risk embedded in combination diminishes due to the diversification effect.

Due to the introduction of the ALCO, bank business units' managers are no longer affected by the financial risks beyond their control and could focus their efforts on managing bank product volumes and operating expenses. Since the ALCO is responsible for managing the accumulated risks, sufficient economic capitals has to be assigned to the ALCO to protect it from the risk exposures. This will be discussed in the HOW factor design.

6.5 The WHERE Factor Design

Chapter Two discusses that the WHERE factor concerns the origin and destination of the physical goods transfer. According to the empirical investigations conducted in the previous chapter, the WHERE factor concerns that the bank FTP model should be developed to manage (1) the funds transferred between business units and (2) the funds supporting bank products.

Bank FTP Model Development at the Business Units Level

The empirical investigations indicate that bank funds are transferred between the business units and the funding pool, and there is a sequential interdependence between the business units and the central funding pool. Thus, a fund provider can be conceptually seen as originating funds to be sold to the pool; and a funds user is seen as buying funds from the pool, and then selling funds to the external markets. Hence, the funding pool can be seen as both funds transferor and funds transferee. In this circumstance, the FTP model needs to be developed to manage the funds transferred between the bank business units and the funding pool.

Bank FTP Model Development at the Bank Instruments Level

The funding pool provides funds for all the funds users who operate the products or instruments used for generating bank assets. On the other hand, the funding pool also accepts funds from funds providers who implement the products or instruments used for generating bank liabilities. As found from the empirical investigations, bank products are key profit generators in any financial organization and an

understanding of how they contribute to profitability provides fundamental organizational insights. Therefore, developing funds transfer prices at the bank instruments or products level is crucial for the profitability measurements of the funds transactions.

6.6 The WHEN Factor Design

According to Chapter Two, the WHEN factor defines the point of the time when the transactions take place. The empirical investigations show that banks tend to frequently prepare their profit statements for the internal profitability analysis purposes. As funds transfer prices are important inputs for the profit evaluation of the bank funds transactions, it is crucial that the FTP model can be applied to generate transfer prices at any point of the time over the life of the transactions.

If funds transfer prices are developed at the different point of the time of over the funds transactions period, a bank can more fully understand the dynamics of its profitability and can more securely appraise the performance of its risk management. Therefore, the WHEN factor is designed to make the FTP model concern not only the point of time when the funds transactions originated, but also the time over the life of the funds transactions. This thesis attempts to develop both the original and remaining term FTP models.

6.7 The HOW Factor Design

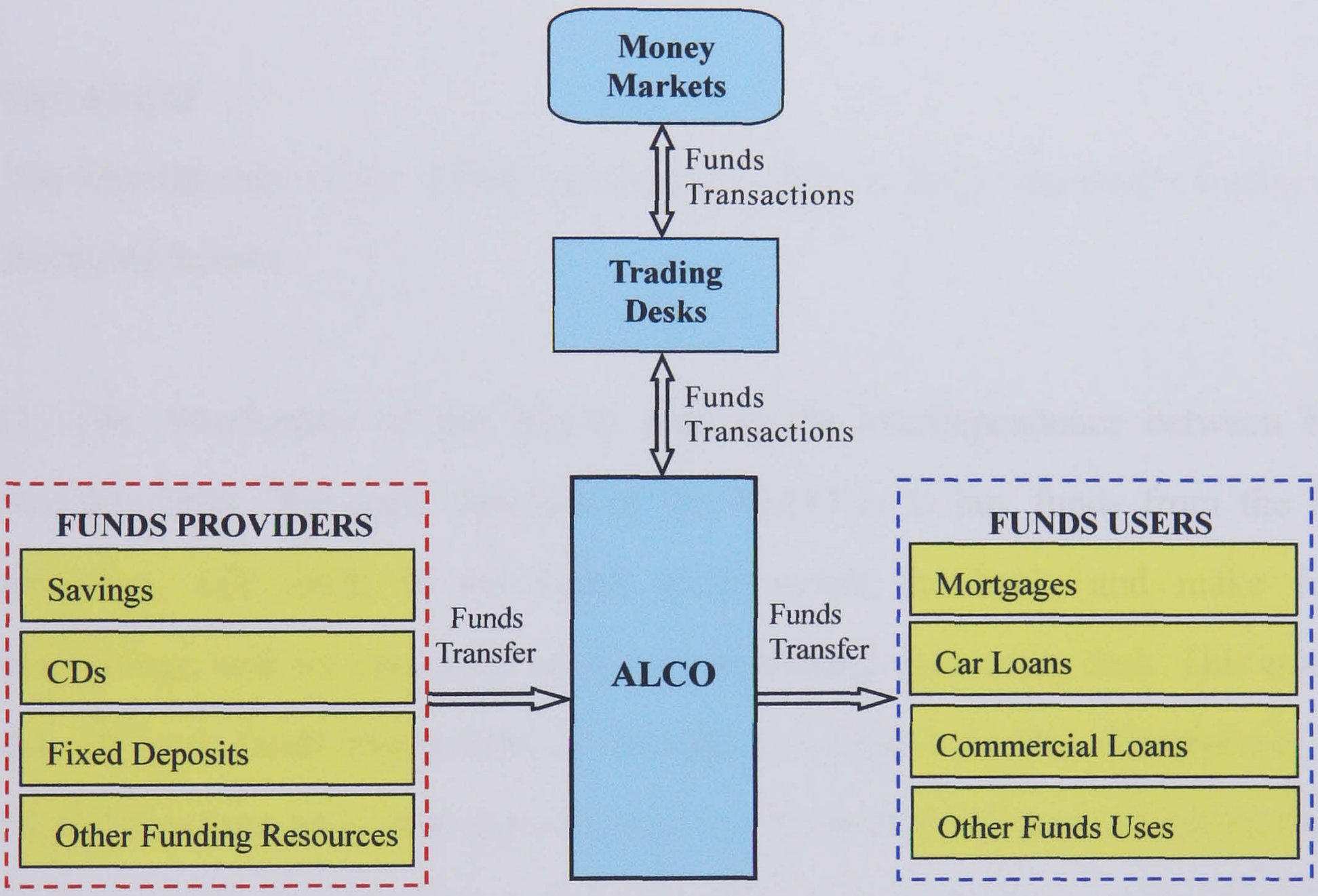
As discussed in Chapter Two, the HOW factor concerns the internal procedures and regulations that control both the physical transfer and its costing. In this section, funds transfer and risk control procedures are designed to manage bank funds transfer and the associated risks. The costing of the funds transferred will be discussed in the subsequent chapter.

6.7.1 Flow of Funds Design

To manage bank funds transactions, the flow of funds is designed. Clearly defining

the flow of funds can help bank top management determine the origination and destination of the funds transfer. According to the empirical investigations, four types of responsibility units, funds providers, funds users, the ALCO and the trading desk, are designed to manage funds transactions. The flow of bank funds is designed and depicted in Figure 6.2.

Figure 6.2: Bank Structure and Conceptual Transfer of Funds between Business Units



According to the questionnaire survey, there is a sequential interdependence between bank business units, thus funds providers are designed to transfer funds only to the ALCO, from which the funds are transferred to the fund users. Business units within the bank do not make any funds transactions with each other. Therefore, the funds within the bank flow in one direction. The funds flow design facilitates a bank FTP system to establish connections between business units, distribute the responsibility of managing risks, and allocate the costs and profits from the funds transactions within the bank. The illustration of the bank structure and conceptual transfer of funds between bank business units are presented as follows.

Funds Providers and Funds Users

In Figure 6.2, the funds providing unit consists of various business units that obtain funds from customers, such as savings and CDs, and the funds using center consists of the business units that make asset businesses, such as mortgages and car loans. As the sequential interdependence exists between funds providers and users, the funds users do not take the responsibility of obtaining funds from external customers, and the funds providers do not concern asset businesses.

The ALCO

The introduction of the ALCO attempts to achieve three important functions as discussed below:

(1) The introduction of the ALCO reduces the interdependence between bank business units. The main function of the ALCO is to buy funds from the fund providers, sell funds to the funds users within the bank, and make funds transactions with the external money markets through the trading desk. This ensures that all bank funds transactions go through the ALCO. In this circumstance, the ALCO functions as a clearinghouse, which is essentially the bank's internal capital market. In this internal market, business units are designed to go to the ALCO for their funding requirements. Each business unit gives all of its deposits to the ALCO and goes to the ALCO for all its funding requirements if it wishes to make loans. Therefore, the introduction of the ALCO reduces the interdependence between the funds providers and funds users. As discussed in Chapter Two, higher interdependence between business units may make every decision beneficial to one unit and harmful to another and thereby harms the whole organization, and decentralization is likely to be most beneficial and least costly when the organizational units are fairly independent. Therefore, the introduction of the ALCO benefits the bank as a whole.

(2) The introduction of the ALCO creates a highly competitive market since funds

providing division can sell as much of the funds as it wishes to the ALCO, and the funds using division can acquire as much funds as it wishes from the ALCO. In this market, neither division can affect the price of the funds being transacted since the ALCO is designed to determine the prices. The ALCO determines the prices based on the money market information it obtained through the trading desks. As will be discussed in the following chapter, this is a very important reason why market price based TP method is applied for the bank FTP model development.

(3) As all the funds are designed to flow through the ALCO, this facilitates all the risks associated with the funds transactions to be transferred to the ALCO. Accordingly, this makes the ALCO be the best candidate to function as a risk manager. The ALCO is designed to make funds transactions with the trading desks to hedge risks. This facilitates the ALCO take various hedging strategies to manage its risks. The ALCO may take three actions for managing the risks: do nothing with the risks, fully hedge the risks or partially hedge the risks. If the ALCO does nothing with the risks, it would receive the returns (profit/loss) from assuming the risks. Partially hedging strategy can be applied to alter the risk profile of the funds in the ALCO. This strategy would allow the ALCO to maintain some exposure to the bank risks. The ALCO can also fully hedge the risks by making long/short funds transactions through the trading desk with the interbank money markets.

Given the powerful functions achieved by the ALCO, it is possible that the ALCO can be the best candidate to administer the bank FTP system.

The Trading Desks

The trading desk is a unit that can access the internal capital market, the ALCO, and external capital markets, such as the interbank money market[10]. Through the

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[10]A term used to describe professional markets between banks. It can be used for funds traded overnight to satisfy reserve requirements at the central bank. The definition is accessible at http://glossary.reuters.com and accessed on January 20, 2007.

trading desks, the ALCO can make funds transactions with the interbank money markets.

The previous section designs the flow of the funds, whereas the subsequent section discusses how the risks associated with the funds are transferred within the bank.

6.7.2 Risk Centralization with the Gross Funds Transfer Pattern

Chapter Four introduces that funds transfer patterns consist of the NFT and the GFT patterns. This section discusses which pattern is applied for the HOW factor design.

Bank Risk Management with the NFT Pattern

With the NFT pattern, a business unit funds itself first, and then sells excess funds to the ALCO or buys funds from the ALCO to cover excess assets. Since assets and liabilities are netted before they are transferred to the ALCO, the net balances funding assumes that the assets offsetting the liabilities have the same maturity. This makes business units manager take the responsibilities of managing mismatch risks, which is generally managed by the ALCO.

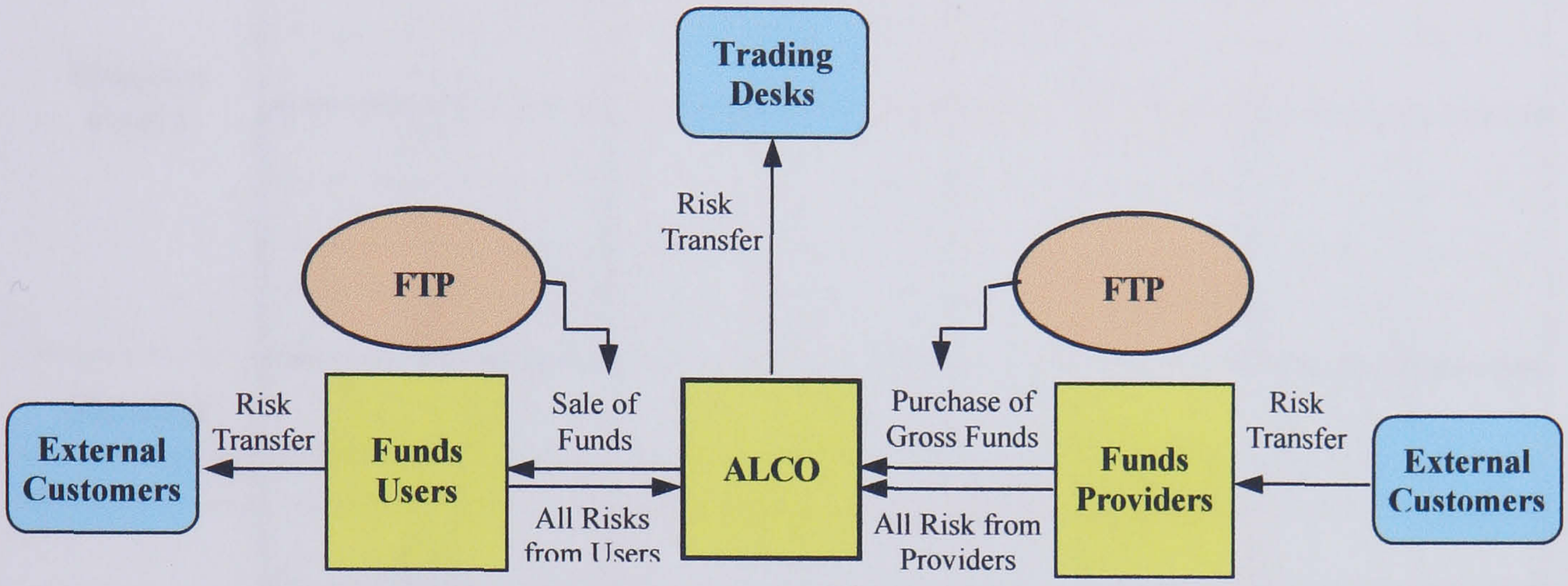
With the NFT pattern, all the risks associated with the funds transactions are accumulated in the business unit. Therefore, the business unit suffers from managing all the risks generated from their asset and liability activities. Due to the bounded rationality, it is unlikely that every business unit has full risk management skills to deal with all the risks. Therefore, the NFT pattern does not achieve the function of effective risk management.

Bank Risk Management with the GFT Pattern

With the GFT pattern, the ALCO purchases all the funds of business units, without prior local netting of assets and liabilities. Thus, the GFT requires the full amount of bank assets and liabilities to be transmitted through the ALCO unit, and this makes the transfer prices hit all the assets and liabilities of each business unit. With

the gross funds flowing through the ALCO, all the financial risks associated with funds transactions are accordingly transferred to the ALCO. The risk transfers with the GFT pattern is depicted in Figure 6.3.

Figure 6.3: Risk Transfers with the GFT Pattern



Source: Adapted from Bessis (2002, p. 315) and Ernst & Young (1995 p.177).

Figure 6.3 shows that the GFT pattern enables all the bank risks to be transferred to the ALCO. Therefore, the ALCO can access all the risks involved in the bank funds transactions. This makes the ALCO be the best candidate to manage bank risks. Given the powerful capabilities of the risk management function of the GFT pattern, this thesis applies the GFT in the HOW factor design. The application of the GFT pattern facilitates risk transfer. The following section discusses how the MMFTP method is used to transfer risks within a bank.

6.7.3 Risk Transfer with the MMFTP Method

Chapter Three discusses that the MMFTP method is the most effective FTP method in bank risk management. Therefore, this thesis attempts to integrate the MMFTP method with the HOW factor design. With the MMFTP method, a shadow asset or liability is created for each expected cash flow on the balance sheet. The balance sheet of matched assets and liabilities is presented in Table 6.1.

Table 6.1 Balance Sheet with the MMFTP Method

	Business Unit		ALCO	
	Asset/ Shadow Asset	**Liability/ Shadow Liability**	**Asset *(Offside to Shadow Liability)***	**Liability *(Offside to Shadow Asset)***
Business Unit 1	$A_{1,1}$	$\overline{L_{1,1}}$	$\overline{L_{1,1}}$	
	$A_{1,2}$	$\overline{L_{1,2}}$	$\overline{L_{1,2}}$	
	....	....	....	....
	$A_{1,M}$	$\overline{L_{1,M}}$	$\overline{L_{1,M}}$	
	$\overline{A_{1,1}}$	$L_{1,1}$		$\overline{A_{1,1}}$
	$\overline{A_{1,2}}$	$L_{1,2}$		$\overline{A_{1,2}}$
	....	...		....
	$\overline{A_{1,N}}$	$L_{1,N}$		$\overline{A_{1,N}}$
Subtotal	$\sum_{i=1}^{M} A_{1,i} + \sum_{i=1}^{N} \overline{A_{1,i}}$	$\sum_{i=1}^{N} L_{1,i} + \sum_{i=1}^{M} \overline{L_{1,i}}$	$\sum_{i=1}^{M} \overline{L_{1,i}}$	$\sum_{i=1}^{N} \overline{A_{1,i}}$
....	....	....	....	....
Business Unit N	$A_{N,1}$	$\overline{L_{N,1}}$	$\overline{L_{N,1}}$	
	$A_{N,2}$	$\overline{L_{N,2}}$	$\overline{L_{N,2}}$	
	....	....	....	
	$A_{N,M}$	$\overline{L_{N,M}}$	$\overline{L_{N,M}}$	
	$\overline{A_{N1,1}}$	$L_{N,1}$		$\overline{A_{N1,1}}$
	$\overline{A_{N,2}}$	$L_{N,2}$		$\overline{A_{N,2}}$
	....	....	....	....
	$\overline{A_{N,N}}$	$L_{N,N}$		$\overline{A_{N,N}}$
Subtotal	$\sum_{i=1}^{M} A_{N,i} + \sum_{i=1}^{N} \overline{A_{N,i}}$	$\sum_{i=1}^{N} L_{N,i} + \sum_{i=1}^{M} \overline{L_{N,i}}$	$\sum_{i=1}^{M} \overline{L_{N,i}}$	$\sum_{i=1}^{N} \overline{A_{N,i}}$
Total	$\Sigma(\sum_{i=1}^{M} A_{N,i} + \sum_{i=1}^{N} \overline{A_{N,i}})$	$\Sigma(\sum_{i=1}^{N} L_{N,i} + \sum_{i=1}^{M} \overline{L_{N,i}})$	$\Sigma(\sum_{i=1}^{M} \overline{L_{N,i}})$	$\Sigma(\sum_{i=1}^{N} \overline{A_{N,i}})$

In Table 6.1, the assets of the business units are exactly matched with the shadow liabilities with the same risk characteristics. By matching the assets with the shadow liabilities, the business units are hedged. In this circumstance, each asset funded by the shadow liability pays costs for the shadow liability, and will be able to lock in a match-funded spread at the time of origination of the asset. The offsets from the costs for the shadow liabilities are posted to the ALCO. On the other hand, the liabilities of the business units are matched with the shadow assets with the same risk characteristics. This would help business units hedge the risks associated with their liabilities. Each liability funded by shadow asset receives income from the shadow asset, and thus locks in its profit margin at the time of origination of the

liability transaction. The offsets from the credits for the shadow assets are also posted to the ALCO.

Table 6.1 shows that the offsetting mathced transfer liability and asset entries are made on the book of the ALCO. For each offestting transaction, there is an agreement between the business unit and the ALCO about the terms of the shadow asset or liability. These terms are the same as would be agreed between the bank and an external counter party and should mirror the risk characteristics of the business unit's transaction with the customer. In this circumstance, these offsetting entries have the same balance, maturity date, and interest rate as those of the matched liabilities and assets. Therefore, all the risks associated with funds transactions are transferred to the ALCO and the ALCO becomes the holder of the whole bank risks posistion. These risks only affect the profitability of the ALCO.

The matched pairs of transfer entries ensure that when the books of all units are consolidated, all internal funds transfers are eliminated. In this circumstance, bank funds transaction volumes are not changed. However, as all the funds transactions are assumulated in the ALCO, the total risks of the transactions may be reduced due to the diversification effects. This can be seen from the mordern portfolio theory, a bank can reduce portfolio risk simply by holding instruments, which are not perfectly correlated.

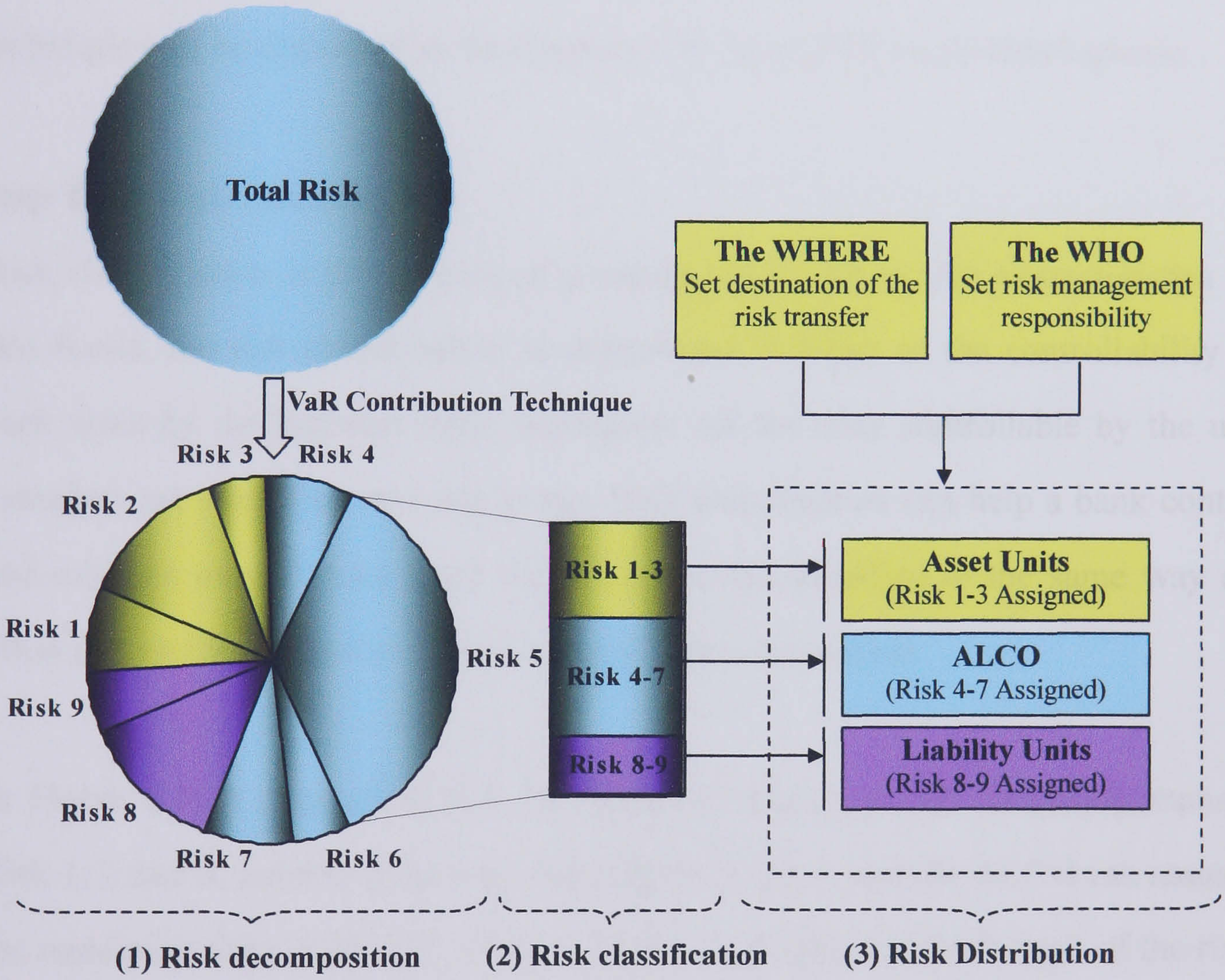
The previous section presents that how bank risks are centralized in the ALCO. The following section examines how the centralized risks are decomposed and distributed among the business units.

6.1.1 Risk Decomposition and Risk Distribution

Bank business units themselves can effectively manage some of the risks embedded in their funds transactions. However, due to the bounded rationality, the business unit managers may not be able to manage the remaining risks. In this circumstance,

the remaining risks need to be assigned to the ALCO. Therefore, the centralized risks in the ALCO need to be decomposed so that the risks under the control of the business units' managers are isolated from the overall risks and then assigned to the units that can effectively manage the risks. The process of bank risk decomposition, classification and distribution is depicted in Figure 6.4.

Figure 6.4: Bank Risk Decomposition, Classification and Distribution



As shown in Figure 6.4, three steps are designed to decompose risks, classify risks and distribute risks.

Step One: Risk Decomposition

As discussed in Chapter Four, the VaR contribution technique can be applied to identify the magnitude and source of each risk for different risk factors. Thus the VaR contribution technique defines meaningful keys for tracing back the overall risk to its sources. This thesis applies the VaR contribution to decompose the overall

risks centralized in the ALCO.

The risk decomposition with the VaR contribution can be better illustrated with Figure 6.4. All the risks associated with the funds transactions are centralized in the ALCO. If business units' managers cannot manage some risks, such as interest rate risk, these risks should be isolated from other risks and assigned to the ALCO. In Figure 6.4, the total risks are decomposed into 9 types of risks with the VaR contribution technique. The risk value decomposition with the VaR contribution technique will be discussed in the chapter of the bank FTP model development.

Step Two: Risk Classification

Risk classification is the process of grouping risks with similar characteristics. In this thesis, the risk classification is determined in terms of the controllability of bank risks by the business units' managers. All the risks controllable by the unit managers are classified into one group. Risk classification can help a bank control and mitigate overall risks since the risks that are classified in the same way are often susceptible to similar control and mitigation techniques.

In Figure 6.4, it is assumed that the asset unit managers can effectively manage Risk 1, 2 and 3, liability units can control Risk 8 and 9, and the ALCO can manage the remaining risks, Risk 4, 5, 6 and 7. In this circumstance, the 9 types of the risks are classified into 3 groups, for example, Group A, B and C. Group A consists of Risk 1, 2 and 3, which can only be managed by the asset unit. Group B includes Risk 4, 5, 6, and 7, which can only be controlled by the ALCO. Group C has Risk 8 and 9, which can only be managed by the liability unit.

Each unit in Figure 6.4 is assumed to only manage the risks in one category. For example, asset units can only manage the Group A risks and cannot manage Group B and C risks. After the risks are properly classified, the next step is to distribute the classified risks to the managers who have the capability to control them.

Step Three: Risk Distribution

Proper risk distributions need to identify the destination of risk transfer and to define the controllability and responsibility of each business unit. In Figure 6.4, the WHERE factor determines that the asset units, the ALCO and the liability unit have involved in implementing the funds transactions. Thus the grouped risks need to be allocated among these units. The WHO factor defines the controllability and responsibility of these units in bank risk management. This enables the bank top management to assign the risks to the appropriate units that can effectively manage the risks. For example, Group A risks are distributed to the asset units since the asset unit managers are defined to have full control over the risks and the managers have been delegated the authority of managing the risks. Similarly, Group B risks are allocated to the ALCO, and Group C risks are assigned to the liability units.

When risks are assigned to the business units, the risk capital or EC must be assigned to the business units to reserve as a cushion against the risks. The following section discusses how the EC is allocated for managing bank risks.

6.1.2 Economic Capital Allocation

As discussed in Chapter Four, EC is used as the aggregate capital required as a cushion against unexpected losses. When risks are assigned to the business units, the units must be allocated EC so that they can operate their businesses without default. Thus, EC allocation is a crucial component of the risk assignment process.

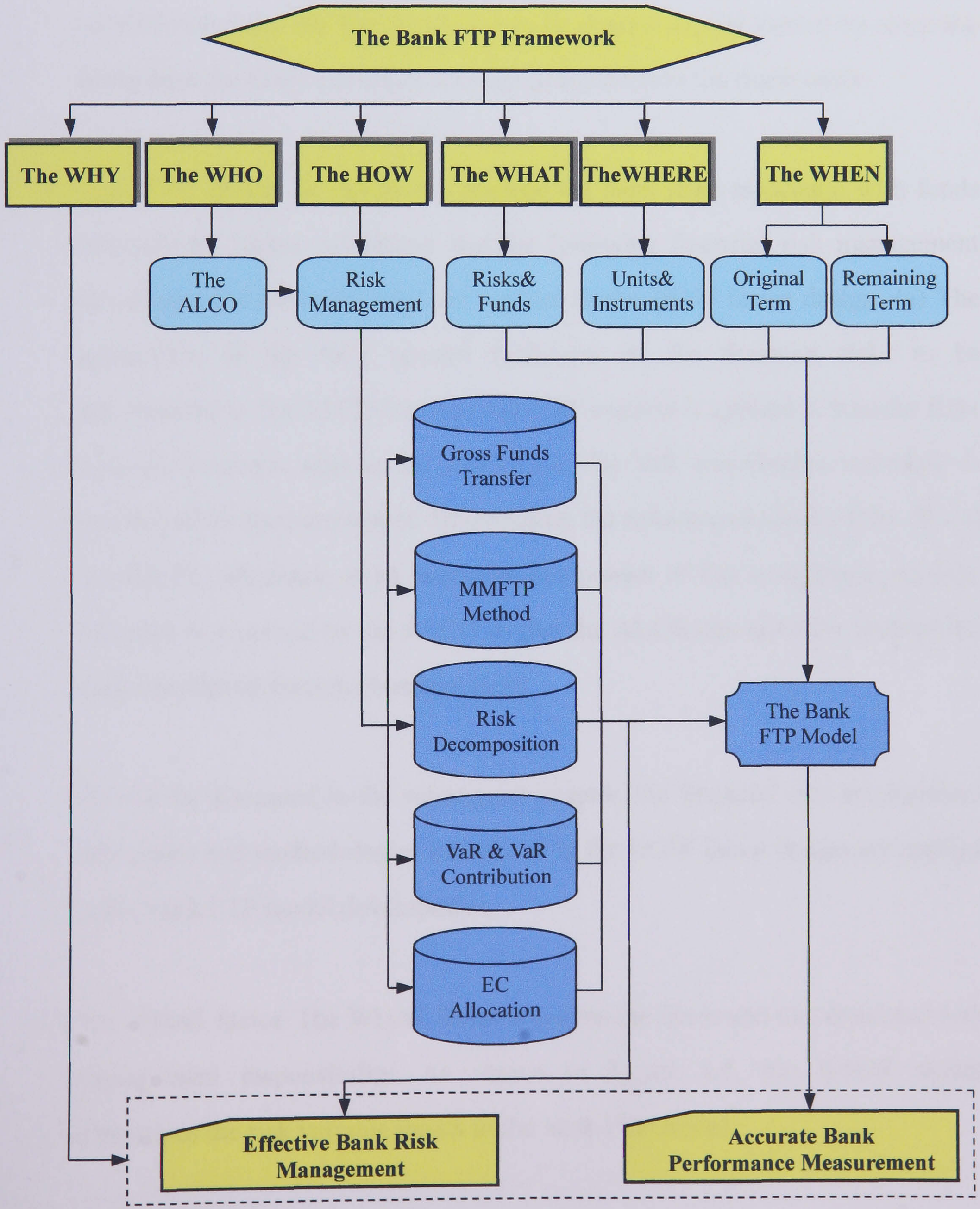
Two common approaches discussed in Chapter Four can be applied to construct the balance sheet of a funds transaction. Although, the second approach, risky asset funded with debt and equity, is equivalent to the first approach, risky asset fully funded with debt, this thesis applies the first approach in the HOW factor design. This is because FTP aims to centralize the risks in the ALCO. Hence, the EC for the risks also needs to be centralized in the ALCO. As reserving EC incurs opportunity costs for the ALCO, the costs need to be allocated to the business units that incur

the risks requiring the EC. The cost allocation process is achieved with the bank FTP model developed in the following chapter.

6.2 A Generalization of the Six-factor Funds Transfer Pricing Framework

It is necessary to make a generation of the six-factor designed so that the whole FTP framework is presented. The bank FTP framework is generalized in Figure 6.5.

Figure 6.5: The Six-Factor Bank FTP Framework Design



In Figure 6.5, the main objectives of FTP set by the WHY factor are to effectively manage bank risks and accurately measure bank performance. The objectives are achieved by designing the other five factors, (1) the WHAT, (2) the WHO, (3) the WHERE, (4) the HOW and (5) the WHEN factor.

(1) The WHO Factor. To manage the funds transferred and the associated risks defined by the WHAT factor, a specific unit, the ALCO, is introduced. The ALCO plays two important roles. (a) The ALCO act as a risk manager centrally control bank risks. (b) The ALCO act as an internal capital market by receiving funds from the funds providers and allocating funds to the funds users.

(2) The HOW factor. To effectively manage the bank risks associated with funds transactions, Figure 6.5 shows that the following financial risk management techniques and methodologies are applied in the HOW factor design. (a) The application of the GFT pattern facilitates all the financial risks to be accumulated in the ALCO. (b) The MMFTP method is applied to transfer risks from the business units to the ALCO. (c) The VaR contribution technique is introduced for the purposes of decomposing the risks accumulated in the ALCO. (d) The EC allocation is an important component of risk assignment process. EC must be reserved by the ALCO so that the ALCO can centrally manage the risks transferred from the business units.

As will be discussed in the subsequent chapter, the financial risk management techniques and methodologies introduced in the HOW factor design are applied in the bank FTP model development.

(3) The WHAT factor. The WHAT factor concerns the funds and the associated risk management responsibility. As shown in Figure 6.6, the WHAT factor determines the risk variable inputs to the bank FTP model.

(4) The WHERE factor. The WHERE factor determines that bank FTP model should be developed at the business unit and the instrument levels.

(5) The WHEN factor: the WHEN factor is mainly determined for the purpose of measuring bank performance measurement. The WHEN factor requires that both the original and remaining term bank FTP models should be developed.

6.3 Summary

This chapter designs the six-factor FTP framework for commercial banks. The objectives of effective bank risk management and accurate bank performance measurement are set by the WHY factor.

To achieve the objectives set by the WHY factor, the WHAT, the WHO, the WHERE, the HOW and the WHEN are designed. The ALCO unit is introduced to manage bank funds and the associated risks. The GFT and the MMFTP method are applied to centralize all the risks in the ALCO. The centralized risks are decomposed by the VaR contribution techniques. The WHERE identifies the origination and destination of the funds transactions, and the WHO factor defines the controllability and responsibility of each bank manager involved in the funds transactions. These enables the decomposed risks to be properly assigned to the managers who can effective control the risks.

The WHERE factor requires that the FTP model should be developed at the bank business unit and instrument levels, and the WHAT factor demands that risk factors involved in funds transactions should be incorporated in the FTP model. To measure the performance of bank business units and instruments, the WHEN factor requires that both original and remaining term bank FTP model should be developed. The final section of this chapter presents the six-factor bank FTP framework with a generalization.

Chapter Seven: Bank Funds Transfer Pricing Model Development

7.1 Introduction

In order to fulfill the primary aim of this thesis, this chapter develops the bank FTP model. The development of the FTP model aims to accurately measure the performance of bank business units and instruments. As discussed in the previous chapter, the costs of the EC must be allocated to the business units that incur the risks requiring the EC. The FTP model aims to allocate the costs and assign a profit contribution value to each source and use of funds within a bank.

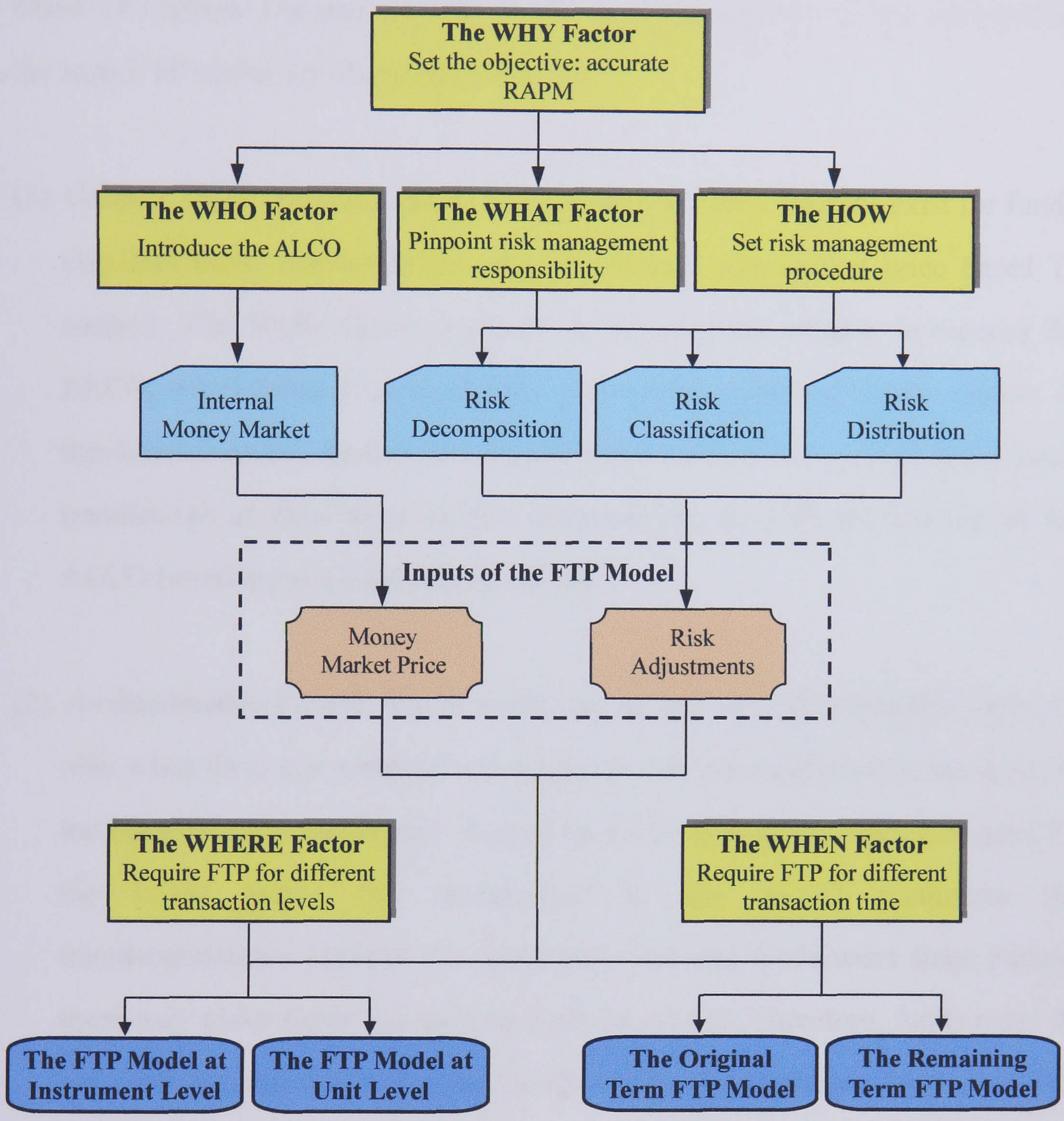
As the FTP model is a tool used to facilitate the administration of the bank FTP process, the model is developed in terms of the six-factor bank FTP framework designed in the previous chapter. The financial risk management methodologies and techniques, which are applied for the HOW factor design, are applied in the bank FTP model development.

The first section of this chapter outlines the FTP model format for deriving bank funds transfer prices. The second section develops the bank FTP model followed by the third section, the process of generating bank funds transfer prices. The fourth section develops the remaining term bank FTP model. The final section is the summary.

7.2 The Module Format for Bank Funds Transfer Price Derivation

The module format is used to illustrate the relationship between the bank FTP model to be developed in this thesis and the six-factor bank FTP framework designed in the previous chapter. Figure 7.1 describes how the bank FTP framework informs the development of the bank FTP model.

Figure 7.1: The Module Format for the Bank FTP Model Development



The FTP Model Objective Set by the WHY Factor

According to the WHY factor designed in the previous chapter, the bank FTP model developed in this thesis should achieve the objective of accurate bank performance measurement. The FTP model must properly allocate the cost of bank risks and the profits from managing the risks within a bank, and must reflect the contribution of any bank individual operation adequately. The adequate profit contribution measurement would facilitate bank top management properly evaluate the performances of business units and instruments, and help establish an appropriate bank managerial incentive system.

The FTP Model Inputs Set by the WHO, the WHAT and the HOW Factors

Figure 7.1 shows that the bank FTP model is developed based on the market price based TP method. The reasons why market prices are used as the basis to develop the bank FTP model are discussed as follows:

(1) Chapter Three discusses that when competitive money markets exist for funds, excellent funds transfer prices can be obtained with market price based TP method. The WHO factor designed in the previous chapter introduces the ALCO, which helps a bank establish a competitive internal money market. In this internal money market, funds users and providers can make as much funds transactions as they wish. In this circumstance, as discussed previously the ALCO functions as a funds clearinghouse.

(2) As discussed in Chapter Three, market prices can be used as transfer prices not only when there is a competitive market, but also minimal interdependencies of the business units are needed. According to the flow of the funds designed for the HOW factor, the introduction of the ALCO minimizes the interdependencies between the funds providers and funds users since both of them only make funds transactions with the ALCO. Therefore, funds users do not need concern the businesses conducted by the funds providers, and vice versus.

(3) Chapter Three also discusses that dependable market quotations are needed for applying the market prices as transfer prices. The HOW factor designed in the previous chapter shows that the ALCO can obtain money market information through the trading desks, which can easily access the external money markets.

Therefore, as shown in Figure 7.1, money market prices are applied in this thesis as the inputs to generate bank funds transfer prices. However, some modifications should be made to the market price to facilitate its use in practice. The WHAT

factor designed in the previous chapter determines the risk variables that should be incorporated in the bank FTP model. According to the WHAT factor, the bank risk management responsibility and controllability of business units and the ALCO managers are clearly defined. Based on the responsibility accounting principles, each bank business unit should bear the costs of the risks associated with its funds transactions. When any risks are transferred out of the business units, accordingly, the costs of the risks assigned to the business units should be reduced. Thus risk adjustments should be made to the market prices. These risk adjustments should be made to reflect the unique attributes of the particular financial institution or instrument. According to the HOW factor designed in the previous chapter, the risk adjustments can be produced through the risk decomposition, risk classification and risk distribution processes.

The above discussions show that the bank FTP model needs to have two components, (1) money market price and (2) the risk adjustments to the money market price.

(1) The money market price. The money market price is obtained from the external money markets, and reflects the source or use of funds in the money markets. The money market prices are used for the financial instruments that are actively traded in the money markets. This thesis defines the money market price as the base funds transfer price.

Oyelere and Turner (2000) points out that in the case of financial institutions, the market price would be the interbank rate. According to Rice (2004) and Kocakülâh and Egler (2006), bank asset and liability instruments priced based on LIBOR are actively traded in the money markets. The empirical investigations conducted in this thesis also shows that banks use LIBOR to price their funds transactions. Thus in this thesis the LIBOR index curve is used for deriving the base funds transfer prices.

(2) The risk adjustments to the base funds transfer price. According to the HOW factor designed in the previous chapter, putting EC in reserve can absorb losses from the risky activities. However, it incurs opportunity costs. The EC can be provided by the bank owners and is invested in the liquid financial instruments with minimal risks, hence the risk-free rate. However, bank owners require that the return from the EC investments is no less than their required return, the hurdle rate, which is introduced in Chapter Four. Therefore, the opportunity cost exists due to putting the EC in reserve. In this thesis, the opportunity cost is considered as the risk premium for compensating the potential losses from the risky activities.

The HOW factor designed in this thesis shows that opportunity costs incurred by reserving EC are initially centralized in the ALCO. This chapter attempts to develop the bank FTP model to assign the opportunity costs or the risk premiums to the business units. The funds transfer prices are produced with the following equation[11]:

$$\begin{aligned} \text{FTP} &= \text{Money Market Price} + \text{Opportunity Cost of EC} \\ &= \text{Base FTP} + \text{RP} \end{aligned} \tag{7.1}$$

A sophisticated FTP system also needs to cover the allocation of overhead costs to the business units, and include transfer prices for internal services such as accounting or legal services. A FTP model may also include the business mark-ups resulting from deliberate commercial policies of providing incentives and penalties. Thus Equation 7.1 needs to be adjusted to Equation 7.2 to reflect the fact that the overhead costs and business mark-up are taken into consideration.

$$\text{FTP} = \text{Base FTP} + \text{RP} + \text{Overhead Expenses} + \text{Business Mark-up} \tag{7.2}$$

As this thesis focuses on the development of the bank FTP model for the purpose

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[11] In this thesis, the "FTP" in all equations denotes funds transfer price and the "RP" stands for risk premiums.

of effective bank risk management, the determination of the overhead cost and business mark-up in Equation 7.2 are out of the scope of this thesis.

The Bank FTP Model Levels Set by the WHERE and the WHEN Factors

As shown in Figure 7.1, to achieve the bank objectives set by the WHY factor, the WHERE factor designed in the previous chapter requires that the bank FTP model should be developed at the bank business unit and instrument levels. With the both models, the performance of the bank business units and instruments can be measured respectively.

According to the WHEN factor designed in the previous chapter, both the original term and remaining term FTP models should be developed. With the both models, bank funds transaction performances can be evaluated at any point of time over the transaction period, and the dynamics of bank profitability can be fully understood.

Therefore, the following sections develop the bank FTP model at the business unit and instrument levels. Both the original term and remaining term bank FTP models are also developed.

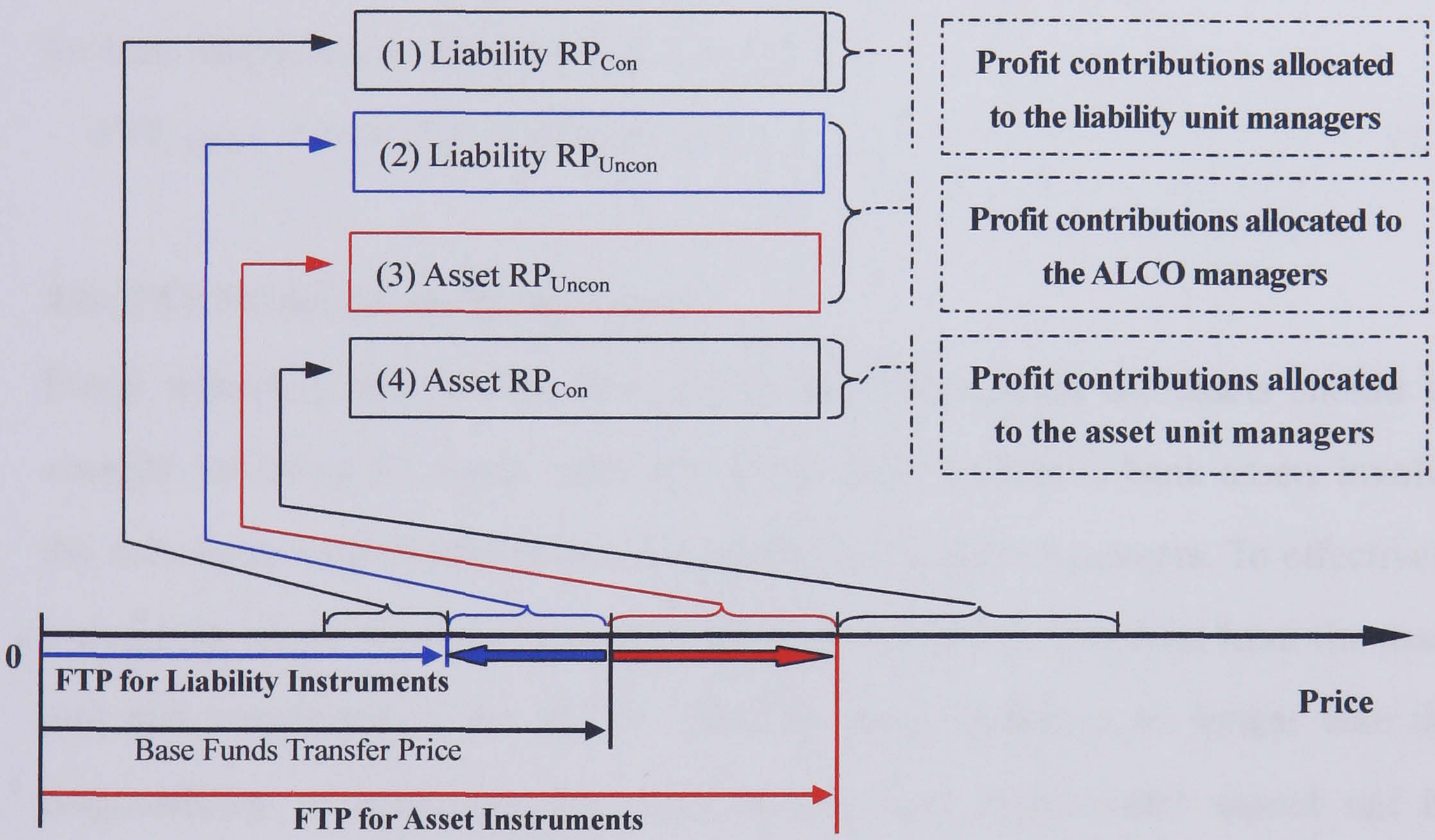
7.3 Bank Funds Transfer Pricing Model Development

The risk premiums in Equation 7.1 are the revenue components for the liability instruments since funds transfer prices are applied to credit liability units for offering the funds. When the liability units manage fewer risks incurred by the liabilities, the units accordingly earn less risk premiums. In this circumstance, the funds transfer prices for the liability units are decreased to reflect the fact that the liability units make fewer profit contributions due to managing fewer risks.

On the other hand, the risk premiums in Equation 7.1 are the cost components for the asset instruments since funds transfer prices are used to charge the asset units for using the funds. When the asset units manage fewer risks that incurred by the

assets, the profit contributions for the asset units need to be reduced. In this situation, the funds transfer prices for the asset instruments are accordingly increased to reflect that fact that the asset units earn fewer profit contributions due to managing the fewer risks incurred by the assets. Based on the Equation 7.1 and the above discussions, the components of the funds transfer prices for the bank assets and liabilities are depicted in Figure 7.2[12].

Figure 7.2: The Bank FTP Model Development



Risk premiums are the profit contributions generated from managing bank risks. In Figure 7.2, the total profit contributions from managing the risks incurred by the asset and liability instruments are the sum of (1) Liability RP_{Con}, (2) Liability RP_{Uncon}, (3) Asset RP_{Uncon}, and (4) Asset RP_{Con}. The FTP model is developed to ensure the proper allocation of the total profit contributions among the liability units, the asset units and the ALCO.

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[12]In this thesis, when the term "Uncontrollable by the business unit managers " needs to be shown in the subscript, the abbreviation "Uncon" is used. Similarly, the term "Controllable by the business unit mangers" is replaced by the abbreviation "Con".

The FTP Model for the Bank Liabilities

Funds transfer prices for the bank liabilities show how much the liability units should be credited for providing funds to the ALCO. Bank liabilities involve the risks both controllable and uncontrollable by the liability managers. To effectively manage the liability risks, the uncontrollable risks are transferred to the ALCO. Thus the liability managers no longer manage their uncontrollable risks and should not be credited for managing these risks. As depicted in Figure 7.2, the funds transfer prices for bank liabilities are decreased by the amount of the uncontrollable risk premiums, the Liability RP_{Uncon}. Thus the funds transfer prices for bank liabilities are developed as follows:

$$FTP_{Liability} = \text{Base FTP} - \text{Liability } RP_{Uncon,} \tag{7.3}$$

The FTP Model for the Bank Assets

Funds transfer prices for the bank assets show how much the assets should be charged for using the funds. Similarly to the bank liabilities, bank assets involve the risks both controllable and uncontrollable by the asset managers. To effectively manage the asset risks, the uncontrollable risks should be removed from the asset unit and transferred to the ALCO. Thus the asset managers no longer take the responsibility of managing the risks beyond their control and should not be credited for managing these risks, instead they should be charged for incurring their uncontrollable risks. Figure 7.2 depicts that the cost of the funds used by the asset managers is increased by the amount of the uncontrollable risk premiums, the Asset RP_{Uncon}, which is assigned to the ALCO. Thus, the funds transfer prices for bank assets are developed as:

$$FTP_{Asset} = \text{Base FTP} + \text{Asset } RP_{Uncon} \tag{7.4}$$

The previous section generalizes the bank FTP model, whereas the following section designs the procedure for deriving bank funds transfer prices.

7.4 The Process of Generating Bank Funds Transfer Prices

This section discusses the process of generating bank funds transfer prices. The process of generating bank funds transfer prices is presented in Figure 7.3.

Figure 7.3: The Process of Generating Bank Funds Transfer Prices

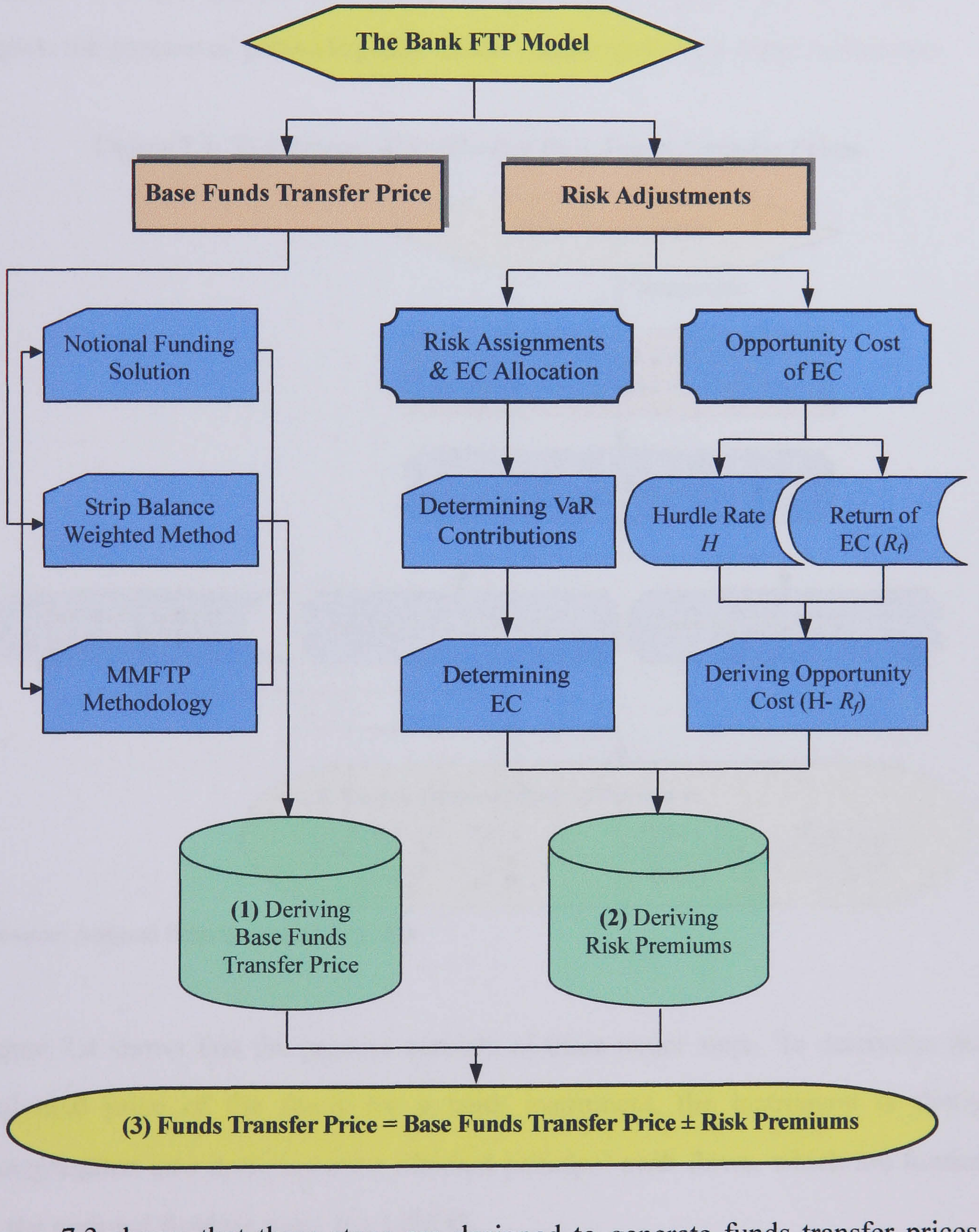


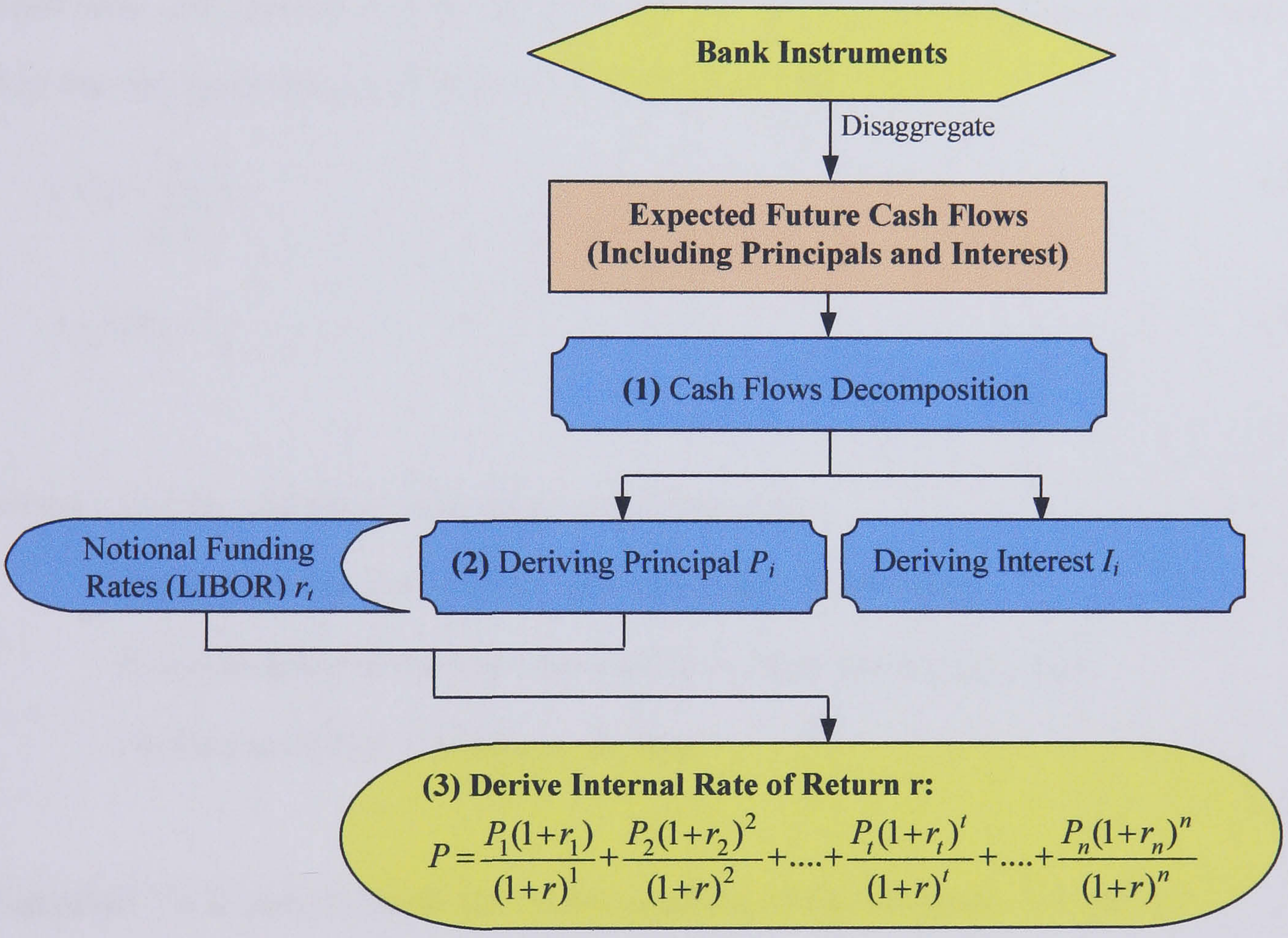
Figure 7.3 shows that three steps are designed to generate funds transfer prices. The three steps are (1) deriving base funds transfer price, (2) deriving risk premiums, and (3) adjusting the base funds transfer price derived in the first step. The following illustrates how the process is applied to derive bank funds transfer

prices.

7.4.1 Deriving the Base Funds Transfer Prices

The notional funding solution and the strip balance weighted method introduced in Chapter Four are applied to develop the base funds transfer prices. Figure 7.4 depicts the process of generating base funds transfer prices for bank instruments.

Figure 7.4: The Process of Producing Base Funds Transfer Prices



Source: Adapted from Quan (2003, p. 29).

Figure 7.4 shows that the process consists of three major steps. To determine the analytical price of the funds for a bank instrument, the instrument is firstly disaggregated into its component notional principal cash flows, which are funded by the notional funding rates, the LIBOR.

(1) Step one: deriving the future cash flows. In the first step, the instrument is disaggregated into its component cash flows that consist of principals and interest. This process finds the time profile of the instrument cash flows and interest rate

types. For example, Equation 7.5 is applied for deriving annual payment of a mortgage loan[13]:

$$A = \frac{P \times (1+r)^n \times r}{(1+r)^n - 1} \tag{7.5}$$

Where A is annuity, P is principal, n is the number of years and r is annual interest rate.

(2) Step two: determine the annual principal payment. With the amount of annual cash flow and interest rate of the principal, the annual interest paid can be derived. For the mortgage loan, the interest is derived as follows:

$$I_j = (P - \sum_{j=1}^{j-1} P_j) \times i \tag{7.6}$$

$$A_j = P_j + I_j \tag{7.7}$$

Where A_j is the amount of annual payment in the year j,

I_j is interest that the customer paid to the bank in the year j,

P_j is principal that the customer paid to the bank in the year j, and

i is the annual rate of return on the loan.

Equation 7.8 is derived with the rearrangement of the Equation 7.6 and 7.7.

$$P_j = A_j - (P - \sum_{j=1}^{j-1} P_j) \times i \tag{7.8}$$

Where P_j is component annual principal cash flow for the amortizing loan.

(3) Step three: deriving internal rate of return r. Given the time profile of the instrument, the base funds transfer price for the instrument is considered as the

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[13] This formula is obtained from http://www.moneychimp.com/articles/finworks/fmmortgage.htm on July 10th 2007

weighted average cost of the notional debts of various maturities that match the principal payments of the instrument. The notional debts are obtained from interbank money markets; therefore, the cost of notional debts is selected from interbank money market index curve, the LIBOR index curve. For the mortgage loan, the weighted average cost is obtained by calculating the internal rate of return in Equation 7.8. It is the rate that makes the present value of the future flows generated by the notional debt equal to the amount borrowed.

$$P = \sum_{j=1}^{N} \frac{P_j \times (1 + r_j)^j}{(1 + r)^j} \tag{7.9}$$

Where P_j is the principal that is paid by the customer in the year j,

r_j is the notional debt rate with the maturity j, and

r is the internal rate of return.

In this case, the internal rate of return r is the base funds transfer price. The rate r is the weighted average of the interbank market rates for the years from year 1 to the year n, using as weights a combination of the amount of each debt and of its maturity. The weights combine the effect of amounts with the length of time for which it is contracted. An example of deriving base funds transfer prices is presented in the Chapter Ten.

7.4.2 Deriving Risk Premiums

As Figure 7.4 depicted, deriving risk premiums is the second step in generating funds transfer prices. The risk premiums are used to compensate for the risks incurring the EC, thus the opportunity cost of the EC is considered to be the risk premiums. In this thesis, VaR, risk free return of the EC investment (R_f) and hurdle rate (H) are calculated for generating the opportunity cost of the EC. These concepts and calculations have been introduced in Chapter Four.

As discussed previously the EC is centrally managed by the ALCO. Thus, the

ALCO must determine the investment strategies of the EC. The actual return from the EC investment needs to reflect the risk tolerance of the ALCO. The ALCO may decide that EC is invested in risk free assets or in highly liquid financial instruments with minimal risk. For example, EC may be invested in interbank offered loans, which generally have high credit and are actively traded in the money markets. In this circumstance, LIBOR for the interbank loans is considered as the actual return from the EC investment. Having determined the actual return, the opportunity cost of the EC is derived as:

$$\text{Opportunity Cost of EC} = \text{Required return (H)- Actual return } (r_f) \tag{7.10}$$

Once the opportunity cost of one unit of EC is determined, the total amount of the opportunity cost is derived with the following equation:

$$\begin{aligned}\text{The Amount of the Opportunity Cost} &= \text{EC} \times \text{Opportunity Cost per Unit of EC} \\ &= \text{EC} \times (H - r_f) \end{aligned} \tag{7.11}$$

The total opportunity cost of the EC must be assigned to the initial investment w_0 since the suppliers of finance require the investment return of w_0 to be at least the hurdle rate, instead of the risk free rate of return. The opportunity cost assignment to the funds transactions with the market value of w_0 is shown in Equation 7.12:

$$\begin{aligned}\text{The Opportunity Cost of } w_0 &= \text{The Amount of the Opportunity Cost/ } w_0 \\ &= \text{EC} \times (H - r_f) / w_0 \end{aligned} \tag{7.12}$$

As discussed in Chapter Four, EC is derived from VaR calculation. Base on Equation 4.10, Equation 7.12 is adjusted as:

$$\text{The Opportunity Cost of } w_0 = \frac{\text{EC} \times (H - r_f)}{w_0}$$

$$= \frac{\text{VaR}_\alpha}{(1 + r_f) \times w_0} \times (H - r_f) \tag{7.13}$$

As the opportunity cost is the risk premiums, the cost derived with Equation 7.13 is

used to adjust the base funds transfer prices. The following section discusses the final step for deriving bank funds transfer prices.

7.4.3 Adjusting the Base Funds Transfer Prices

The final step depicted in Figure 7.3 is to apply the VaR contribution techniques and the results from the second step to adjust the base funds transfer price determined in the first step. VaR contribution calculation is introduced in Chapter Four.

Adjustments to the base FTP price index curve are often necessary to reflect unique attributes of the particular business units and instrument. Each financial instrument has unique function in a bank and has different risk characteristics from other instruments. This requires different amount of EC to be reserved for each instrument. As EC is scarce resource and limited for a bank, it needs to be properly allocated among business units and instruments. As discussed in Chapter Four, the VaR contribution can be applied to allocate the risk contributions among business units. The VaR contribution calculation from Equation 4.9 is reiterated as follows:

$$\text{VaR Contribution}_{i} = \alpha \times \frac{D_i C D^T}{\sqrt{DCD^T}} \tag{7.14}$$

Equation 7.14 shows that the VaR contribution by risk factors enable bank managers to determine how much EC should be reserved for the potential losses from the *i* instrument incurred by the risks. Based no Equation 7.13, the risk premiums are derived as:

$$RP_i = \frac{VaR_{\alpha}}{(1+r_f)\times w_0} \times (H - r_f)$$

$$= \frac{\text{VaR Contribution}_{i}}{(1+r_f)\times w_0} \times (H - r_f)$$

$$= \frac{\alpha \times \frac{D_i CD^T}{\sqrt{DCD^T}}}{(1+r_f) \times w_0} \times (H - r_f) \qquad (7.15)$$

As VaR contribution method enables the total amount of the VaR of the bank to be decomposed at business units and instruments level, this enables the bank FTP model to be developed at the corresponding level as discussed below.

Bank Funds Transfer Pricing Model Development at the Instrument Level

To derive the FTP model at the bank instrument level, it is assumed that a bank has a number of instruments, *a* to *z*. The number of risk factors shared by the instruments are *N*. When it is assumed that the business unit that implements the *m* instrument has no control over the risks from risk 1 to *k*, these risks should be transferred to the ALCO. In this case, with the VaR contribution technique, the EC reserved for the risk 1 to *k* can be determined. As discussed in Chapter Four, to derive the VaR contribution by each risk factor, the sensitivity vector for the D_m is broken down into a series of the vectors with all the elements equal to zero other than the element corresponding to the risk factor 1 to *k* of interest:

$$\begin{aligned}
\text{Overall Sensitivity Vector } D_m &= [d_{1,m} \;\; d_{2,m} \;\cdots d_{k,m} \;\; 0 \cdots 0] \\
D_{1,m} &= [d_{1,m} \;\; 0 \;\; \ldots 0 \;\; 0 \cdots 0] \\
D_{2,m} &= [0 \;\; d_{2,m} \;\ldots 0 \;\; 0 \cdots 0] \\
&\quad \ldots \\
D_{k,m} &= [0 \;\; 0 \;\; \ldots d_{k,m} \;\; 0 \cdots 0] \\
D_{k+1,m} &= [0 \;\; 0 \;\; \ldots 0 \;\; 0 \cdots 0] \\
&\quad \ldots \\
D_N &= [0 \;\; 0 \;\; \ldots 0 \;\; 0 \cdots 0]
\end{aligned}$$

Based on the Equation 7.14, the VaR contributions for the risk factor 1 to *k* for the instrument *m* are calculated as:

$$\text{VaR Contribution}_m = \alpha \times \frac{D_m CD^T}{\sqrt{DCD^T}} = \alpha \times \frac{\sum_{i=1}^{N} (D_{i,m}) \times CD^T}{\sqrt{DCD^T}} \qquad (7.16)$$

From Equation 7.16, VaR contribution for each risk factor is derived as follows:

$$\text{VaR Contribution}_{i,m} = \alpha \times \frac{D_{i,m} C D^T}{\sqrt{DCD^T}} \tag{7.17}$$

Since the sensitivity vector for the risks from factor *k+1* to *N* is set to be zero, the VaR contribution for these risks are zero. Having derived the VaR contribution for the *m* instrument, based on Equation 7.15, the risk premiums for the instrument *m* is derived as follows:

$$\begin{aligned} \text{Instrument RP}_{\text{Uncon}} &= \frac{\text{VaR Contribution}_m \times (H - r_f)}{w_0 \times (1 + r_f)} \\ &= \alpha \times \frac{\dfrac{\sum_{i=1}^{N} (D_{i,m}) \times CD^T}{\sqrt{DCD^T}} \times (H - r_f)}{w_0 \times (1 + r_f)} \end{aligned} \tag{7.18}$$

According to Equation 7.3, 7.4 and 7.18, the derivation of the funds transfer price for the instrument *m* is:

$$\begin{aligned} \text{FTP}_{\text{Instrument m}} &= \text{Base FTP} \pm \text{Instrument RP}_{\text{Uncon}} \\ &= \text{Base FTP} \pm \alpha \times \frac{\dfrac{\sum_{i=1}^{N} (D_{i,m}) \times CD^T}{\sqrt{DCD^T}} \times (H - r_f)}{w_0 \times (1 + r_f)} \end{aligned} \tag{7.19}$$

As previously discussed, when the instrument *m* is defined as a liability instrument, the risk premiums are reduced from the base funds transfer price; when the instrument is an asset instrument, risk premiums are added to the based funds transfer price.

Bank Funds Transfer Pricing Model Development at the Business Unit Level

Bank business units operate their banking businesses through various bank instruments. Bank funds providers raise funds with various liability instruments and that funds users apply funds through various asset instruments. Therefore, the

bank FTP model for the business unit level is derived based on the bank FTP model for the instrument level:

$$\text{FTP}_{\text{Business Unit}} = \text{Base FTP} \pm \Sigma\,(\text{Business Unit RP}_{\text{Uncon}}) \tag{7.20}$$

In Equation 7.20, the base funds transfer price for the business unit is the weighted average money market cost of the analytical funding for the instruments within the unit. With the bank FTP model for the liability generating business units, all the financial risks beyond the control of the liability unit are transferred to the ALCO. Thus the liability unit managers are not credited for incurring their uncontrollable risks. In this circumstance, the risk premiums in Equation 7.20 should be deducted from the base funds transfer price. On the other hand, with the FTP model for the asset generating business units, all the financial risks beyond the control of the asset units are transferred to the ALCO. Therefore, the asset units' managers should be charged for incurring the uncontrollable risks. In this circumstance, the risk premiums in Equation 7.20 are added to the base funds transfer price.

To transfer risks from the business units to the ALCO, the risks involved in business unit activities should be decomposed. As discussed in the previous section, the VaR contribution technique can be applied to achieve risk decomposition. To derive the VaR contribution, some assumptions are needed. It is assumed that the number of the bank instruments that Business Unit XYZ implements is *M*, and that *N* risk factors are involved in each instrument. The VaR contributions for the instruments in Business Unit XYZ are derived based on Equation 7.21:

$$\text{VaR Contribution}_{\text{Business Unit XYZ}} = \alpha \times \frac{\sum_{j=1}^{M} D_j C D^T}{\sqrt{DCD^T}} \tag{7.21}$$

When it is assumed that Business Unit XYZ has no control over the risks from risk 1 to risk *k*, the VaR contribution for these risk factors should be derived. The VaR contribution is calculated based on Equation 7.16 and 7.21.

$$\text{VaR Contribution}_{\text{Business Unit XYZ}} = \alpha \times \frac{\sum_{i=1}^{k}\sum_{j=1}^{M} D_{i,j} C D^{T}}{\sqrt{DCD^{T}}} \tag{7.22}$$

Therefore, based on Equation 7.15, the risk premiums for the business unit is:

$$\text{Business Unit RP}_{\text{Uncon}} = \frac{\text{VaR Contribution}_{\text{Business Unit XYZ}} \times (H - r_f)}{w_0 \times (1 + r_f)}$$

$$= \alpha \times \frac{\dfrac{\sum_{i=1}^{k}\sum_{j=1}^{M} D_{i,j} C D^{T}}{\sqrt{DCD^{T}}} \times (H - r_f)}{w_0 \times (1 + r_f)} \tag{7.23}$$

Based on Equation 7.20 and Equation 7.23, the funds transfer price for the business unit is derived as follows:

$$\text{FTP}_{\text{Business Unit XYZ}} = \text{Base FTP} \pm \Sigma \text{ Business Unit RP}_{\text{Uncon}}$$

$$= \text{Base FTP} \pm \alpha \times \frac{\dfrac{\sum_{i=1}^{k}\sum_{j=1}^{M} D_{i,j} C D^{T}}{\sqrt{DCD^{T}}} \times (H - r_f)}{w_0 \times (1 + r_f)} \tag{7.24}$$

As previously discussed, when Business Unit XYZ is defined as a liability generating unit, the risk premiums are reduced from the base funds transfer price; when it is an asset generating unit, risk premiums are added to the based price.

The previous sections discussed the origination term bank FTP model, which is applied for the funds transactions when they are originated, whereas the following section develops the remaining term bank FTP model, which is applied to derive funds transfer prices over the transactions' remaining term.

7.5 Remaining Term Funds Transfer Pricing Model Development

The remaining term FTP model is applied to generate funds transfer prices at the

later stage of business transactions so that their profit contributions can be measured over the transaction's remaining term. Remaining term FTP applies contemporaneous transfer prices to derive the contribution of the funds transactions predicted solely on their remaining principal cash flows. At origination, funds transactions' original term and remaining term transfer price are identical. The original term transfer price remains unchanged over a transaction's repricing life, however its remaining term transfer price changes. These changes are due to a combination of the transaction's life shortening, interim principal paydowns, and intervening market interest rate fluctuations, all which influence the prospective remaining principal payoff profile.

When the funds transactions' principal cash flow and money market rates change, the base funds transfer price will accordingly change. Both financial market and banks' situation are generally not identical at the different point of time. For example, over time, existing bank funds transactions run off the bank's balance sheet, and are replaced with newly originated business. This will change the risk profile of the whole bank. Thus both the number of bank risk variables and the correlation between these variables may change. All these will make the risk premiums that are applied to adjust the base funds transfer prices change.

However, the remaining term FTP model is similar in nature and calculation methodology to the original FTP model developed in the previous section. The only difference between these two models is the inputs for the model due to changing market and business situations. Based on Equation 7.19, the remaining term FTP model for the instrument level is:

$$\text{Remaining Term FTP}_{\text{Instrument}} = \text{Base FTP}_{\text{Remaining Term}} \pm \text{Instrument RP}_{\text{Uncon}}$$

$$= \text{Base FTP}_{\text{Remaining Term}} \pm \frac{\text{VaR Contribution}_{\text{RemainingTerm, Instrument}} \times (H - r_f)}{w_0 \times (1 + r_f)}$$

$$= \text{Base FTP}_{\text{Remaining Term}} \pm \alpha \times \frac{\frac{D_m CD^T}{\sqrt{DCD^T}} \times (H - r_f)}{w_0 \times (1 + r_f)} \tag{7.25}$$

In Equation 7.25, the sensitivity vector D_m and D, covariance matrix C, hurdle rate H, and risk free rate r_f are generally different from those when the funds transactions are originated. This is due to changing financial market and bank itself business situations. Interbank money market rates, LIBOR, generally changes over time, and funds transaction principal cash flow also changes, thus the base funds transfer price will be accordingly different from the base funds transfer price originally determined. This makes the funds transfer prices determined at the different stage of the funds transaction periods different.

Similarly, the remaining term FTP model for the business unit level is derived based on Equation 7.24:

$$\text{Remaining Term FTP}_{\text{Business Unit}}$$

$$= \text{Base FTP}_{\text{Remaining Term}} \pm \text{Business Unit RP}_{\text{Uncon}}$$

$$= \text{Base FTP}_{\text{Remaining Term}} \pm \frac{\text{VaR Contribution}_{\text{Remaining Term, Business Unit}} \times (H - r_f)}{w_0 \times (1 + r_f)}$$

$$= \text{Base FTP}_{\text{Remaining Term}} \pm \alpha \times \frac{\frac{\sum_{i=1}^{k}\sum_{j=1}^{M} D_{i,j} CD^T}{\sqrt{DCD^T}} \times (H - r_f)}{w_0 \times (1 + r_f)} \tag{7.26}$$

Similar with the variables explanations for Equation 7.25, in Equation 7.26, the sensitivity vector $D_{i,j}$ and D, covariance matrix C, hurdle rate H, risk free rate r_f, and base funds transfer price are also different from those of the originally determined. Thus, the funds transfer prices derived with the remaining FTP model are generally different from those from the original term FTP model.

7.6 Summary

This chapter develops the bank FTP model by applying the risk management concepts and techniques used for the six-factor bank FTP framework design. Market price based TP method is applied for the bank FTP model development.

Three steps are followed in generating bank funds transfer prices. Base funds transfer price development is the first step in constructing the bank FTP model. Base funds transfer price is developed with the methodologies, such as the MMFTP concept, notional funding solution and the strip balance weighted method. The second step of the FTP model development is crucial since it designs how the risks premiums are produced. The development of the opportunity cost of the EC is fundamental in deriving the risk premiums. The concepts of VaR, VaR contribution, EC, risk free rate and hurdle rate are applied for generating the opportunity cost of the EC. In the final step of the FTP model development, the base funds transfer price is adjusted with the risk premiums derived in the second step.

According to the definition of the WHERE factor, this chapter develops the FTP model at the bank instrument and business unit levels. According to the requirements set by the WHEN factor, both the original and remaining term FTP models are developed to measure the performance of a funds transaction over the whole transaction term.

Chapter Eight: The Implications of the Funds Transfer Pricing Model in Bank Performance Measurement

8.1 Introduction

This chapter discusses the implications of the original term and remaining term FTP models in bank performance measurement. Kiplalov (2004) advocates that financial institutions use two main categories of performance metrics. One is based on the ratio of modified return to the level of risk, such as RAROC, another one is based on earnings over and above the shareholder's required return allocated for the level of risk, such as NIM. Therefore, the bank FTP model is integrated with these two performance metrics to find the implications of the model.

The first section of this chapter applies the original term FTP model in the bank NIM measurement followed by the second section, the application of the remaining term FTP model in the NIM measurement. The third section summarizes the implications of the bank FTP model from the NIM measurement. This section presents five important functions achieved by the bank FTP model. The fourth section compares the bank FTP model with the pool based FTP methods and the MMFTP method. The final section is the summary.

8.2 Net Interest Margin Measurement with the Original Term Bank Funds Transfer Pricing Model

As the bank FTP model is developed at the business unit and instrument levels, this section examines the implications of the bank FTP model at the both levels.

8.2.1 Net Interest Margin Measurement at the Business Unit Level

To apply the FTP model in the NIM measurement, it is assumed that a bank has two business units, an asset unit X, which implements N instruments that involve the risks, risk a to k, and a liability unit Y, which implements M instruments that

involve the risks, risk *i* to *z*. The premiums for each risk are calculated with Equation 7.15 and presented in Table 8.1. Equation 7.15 is reiterated as follows:

$$RP_i = \frac{\text{VaR Contribution}_i}{(1+r_f)\times w_0} \times (H - r_f) = \frac{\alpha \times \frac{D_i C D^T}{\sqrt{DCD^T}}}{(1+r_f)\times w_0} \times (H - r_f)$$

Table 8.1: Bank Risk Premium Calculation

Business Unit/ Instrument		Asset Risks			Risks for Both Asset and Liability			Liability Risks			Σ
		a	…	h	i	…	k	l	…	z	
Asset Unit X	1	$RP_{X1,a}$	…	$RP_{X1,h}$	$RP_{X1,i}$	…	$RP_{X1,k}$	Asset unit does not incur liability risks			$\sum_{i=a}^{k} RP_{X1,i}$
	…	…	…	…	…	…	…				…
	K	$RP_{XK,a}$	…	$RP_{XK,h}$	$RP_{XK,i}$	…	$RP_{XK,k}$				$\sum_{i=a}^{k} RP_{XK,i}$
	…	…	…	…	…	…	…				…
	N	$RP_{XN,a}$	…	$RP_{XN,h}$	$RP_{XN,i}$	…	$RP_{XN,k}$				$\sum_{i=a}^{k} RP_{XN,i}$
…	…	…	…	…	…	…	…	…	…	…	…
Liability Unit Y	1	Liability unit does not incur asset risks			$RP_{Y1,i}$	…	$RP_{Y1,k}$	$RP_{Y1,l}$	…	$RP_{Y1,z}$	$\sum_{j=i}^{z} RP_{Y1,j}$
	…				…	…	…	…	…	…	…
	I				$RP_{YI,i}$	…	$RP_{YI,k}$	$RP_{YI,l}$	…	$RP_{YI,z}$	$\sum_{j=i}^{z} RP_{YI,j}$
	…				…	…	…	…	…	…	…
	M				$RP_{YM,i}$	…	$RP_{YM,k}$	$RP_{YM,l}$	…	$RP_{YM,z}$	$\sum_{j=i}^{z} RP_{YM,j}$
Σ		$\sum_{j=1}^{N} RP_{Xj,a}$	…	$\sum_{j=1}^{N} RP_{Xj,h}$	$\sum_{j=1}^{N} RP_{X1j,i} + \sum_{j=1}^{M} RP_{Yj,i}$	…	$\sum_{j=1}^{N} RP_{Xj,k} + \sum_{j=1}^{M} RP_{Yj,k}$	$\sum_{j=1}^{M} RP_{Yj,l}$	…	$\sum_{j=1}^{M} RP_{Yj,z}$	$\sum_{i=1}^{N}\sum_{j=a}^{k} RP_{Yi,j} + \sum_{i=1}^{M}\sum_{j=i}^{z} RP_{Yi,j}$

Notes: in this table, $RP_{XK,a}$ denotes the premiums for the risk *a* incurred by the instrument *K* within the unit X.

According to the WHAT and the WHO factors designed in Chapter Six, the responsibility and controllability of the business units in bank risk management are assumed as follows:

- The asset unit X takes the responsibility of managing the asset risks, risk *a* to *d*. The remaining asset risks, risk *e* to *k*, are controlled by the ALCO.

- The liability unit Y controls the liability risks, risk *o* to *z*. The remaining liability risks, risk *i* to *n*, are managed by the ALCO.

- It is assumed that both the assets and liabilities involve the risks, risk *i* to *k*. In these circumstances, the ALCO is assumed to manage these risks.

Table 8.2 presents how the FTP model allocates the risk premiums calculated in Table 8.1 to each bank business unit. The allocation of the risk premiums with the FTP model helps derive the NIM for each business unit.

Table 8.2: Bank Risk Premium Allocation with the FTP Model

Business Unit/ Instrument		Risks under Control Asset Unit X			ALCO: Risks beyond Control Asset Unit X			ALCO: Risks beyond Control Both Units			ALCO: Risks beyond Control Liability Unit Y			Risks under Control Liability Unit Y			Sum of RP for Risks beyond Control
		a	...	d	e	...	h	i	...	k	l	...	n	o	...	z	
Asset Unit X	1	$RP_{X1,a}$	...	$RP_{X1,d}$	$RP_{X1,e}$	...	$RP_{X1,h}$	$RP_{X1,i}$	...	$RP_{X1,k}$	Asset unit does not incur liability risks						$\sum_{i=e}^{k} RP_{X1,i}$
	...	...	...		...	...	...	...	...	...							...
	K	$RP_{XK,a}$	...	$RP_{XK,d}$	$RP_{XK,e}$	...	$RP_{XK,h}$	$RP_{XK,i}$	...	$RP_{XK,k}$							$\sum_{i=e}^{k} RP_{XK,i}$
	...	...	...		...	...	...	...	...	...							...
	N	$RP_{XN,a}$	...	$RP_{XN,d}$	$RP_{XN,e}$	...	$RP_{XN,h}$	$RP_{XN,i}$	...	$RP_{XN,k}$							$\sum_{i=e}^{k} RP_{XN,i}$
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Liability Unit Y	1	Liability unit does not incur asset risks						$RP_{Y1,i}$	...	$RP_{Y1,k}$	$RP_{Y1,l}$	...	$RP_{Y1,n}$	$RP_{Y1,o}$	...	$RP_{Y1,z}$	$\sum_{j=i}^{n} RP_{Y1,j}$
	...							...	...	...	...	...	...	...	...	...	...
	I							$RP_{YI,i}$	...	$RP_{YI,k}$	$RP_{YI,l}$	...	$RP_{YI,n}$	$RP_{YI,o}$	...	$RP_{YI,z}$	$\sum_{j=i}^{n} RP_{YI,j}$
	...							...	...	...	...	...	...	...	...	...	...
	M							$RP_{YM,i}$	...	$RP_{YM,k}$	$RP_{YM,l}$	...	$RP_{YM,n}$	$RP_{YM,o}$	...	$RP_{YM,z}$	$\sum_{j=i}^{n} RP_{YM,j}$
Σ		$\sum_{i=1}^{N} RP_{Xi,a}$	...	$\sum_{i=1}^{N} RP_{Xi,d}$	$\sum_{i=1}^{N} RP_{Xi,e}$	...	$\sum_{i=1}^{N} RP_{Xi,h}$	$\sum_{j=1}^{N} RP_{Xj,i} + \sum_{j=1}^{M} RP_{Yj,i}$	...	$\sum_{i=1}^{N} RP_{Xi,k} + \sum_{i=1}^{M} RP_{Yi,k}$	$\sum_{i=1}^{M} RP_{Yi,l}$	...	$\sum_{i=1}^{M} RP_{Yi,n}$	$\sum_{i=1}^{M} RP_{Yi,o}$	...	$\sum_{i=1}^{M} RP_{Yi,z}$	$\sum_{i=1}^{N}\sum_{j=e}^{k} RP_{Xi,j} + \sum_{i=1}^{N}\sum_{j=i}^{n} RP_{Yi,j}$

(1) The NIM calculation for the asset unit X. The NIM is the difference between the market price and the funds transfer price for the assets. The funds transfer price for the asset unit is derived with Equation 7.24.

$$FTP_{\text{Asset Unit X}} = \text{Base FTP} + \text{Asset Unit } RP_{\text{Uncon}}$$

$$= \text{Base FTP} + \sum_{i=1}^{N}\sum_{j=e}^{k} (RP_{Xi,j}) \quad (8.1)$$

According to Rice (2004) and Kocakülâh and Egler (2006), the prices of the commercial banking businesses, such as deposits and loans, are determined by adjusting the risk premiums, such as liquidity risk premiums, to the LIBOR index curve. As base funds transfer price is from the LIBOR curve, the market price for bank assets can be derived as:

$$\text{Market Price}_{\text{Asset Unit X}} = \text{LIBOR} + \text{Asset Unit RP}_{\text{Total}}$$

$$= \text{Base FTP} + \sum_{i=1}^{N} \sum_{j=a}^{k} (RP_{Xi,j}) \tag{8.2}$$

In Equation 8.2, the total asset unit risk premiums are the sum of the premiums for the risks both under and beyond the control of the asset unit. Having derived the funds transfer price and market price, the NIM for the asset unit X is:

$$\text{NIM}_{\text{Asset Unit X}} = \text{Market Price}_{\text{Asset Unit X}} - \text{FTP}_{\text{Asset Unit X}}$$

$$= [\text{Base FTP} + \sum_{i=1}^{N} \sum_{j=a}^{k} (RP_{Xi,j})] - [\text{Base FTP} + \sum_{i=1}^{N} \sum_{j=e}^{k} (RP_{Xi,j})]$$

$$= \sum_{i=1}^{N} \sum_{j=a}^{k} (RP_{Xi,j}) - \sum_{i=1}^{N} \sum_{j=e}^{k} (RP_{Xi,j})$$

$$= \sum_{i=1}^{N} \sum_{j=a}^{d} (RP_{Xi,j}) \tag{8.3}$$

As shown in Table 8.2, $\sum_{i=1}^{N} \sum_{j=a}^{d} (RP_{Xi,j})$ are the total NIM allocated to the asset unit X by the FTP model.

(2) The NIM calculation for the liability unit Y. Similar to the NIM for the asset unit X, the NIM calculation for the liability unit Y needs the determination of the funds transfer price and market price for the liabilities. The funds transfer price for the liability unit is derived with Equation 7.24:

$$\text{FTP}_{\text{Liability Unit Y}} = \text{Base FTP} - \text{Liability Unit RP}_{\text{Uncon}}$$

$$= \text{Base FTP} - \sum_{i=1}^{M} \sum_{j=i}^{n} (RP_{Yi,j}) \tag{8.4}$$

According to Rice (2004) and Kocakülâh and Egler (2006), the market price for bank liabilities can be derived as:

$$\text{Market Price}_{\text{Liability Unit Y}} = \text{LIBOR - Liability Unit RP}_{\text{Total}}$$

$$= \text{Base FTP} - \sum_{i=1}^{M} \sum_{j=i}^{z} (RP_{Yi,j}) \tag{8.5}$$

The NIM for the liabilities is the difference between the funds transfer price and the market price for the liabilities. With Equation 8.4 and 8.5, the NIM for the liability unit Y is:

$$\text{NIM}_{\text{Liability Unit Y}} = \text{FTP}_{\text{Liability Unit Y}} - \text{Market Price}_{\text{Liability Unit Y}}$$

$$= [\text{Base FTP} - \sum_{i=1}^{M} \sum_{j=i}^{n} (RP_{Yi,j})] - [\text{Base FTP} - \sum_{i=1}^{M} \sum_{j=i}^{z} (RP_{Yi,j})]$$

$$= \sum_{i=1}^{M} \sum_{j=i}^{z} (RP_{Yi,j}) - \sum_{i=1}^{M} \sum_{j=i}^{n} (RP_{Yi,j})$$

$$= \sum_{i=1}^{M} \sum_{j=o}^{z} (RP_{Yi,j}) \tag{8.6}$$

As shown in Table 8.2, $\sum_{i=1}^{M} \sum_{j=o}^{z} (RP_{Yi,j})$ are the total NIM assigned to the liability unit Y by the FTP model.

8.2.2 Net Interest Margin Measurement at the Instrument Level

The FTP model developed at the instrument level can be applied to derive the NIM for the single bank funds transaction and the paired bank funds transactions.

NIM Measurement for the Single Bank Funds Transaction

With Table 8.2, the NIM for the funds transaction made by each bank instrument can be determined. For example, the NIM of the *K* instrument within the asset unit X is the difference between the asset price and the funds transfer price for the instrument. The funds transfer price derivation is from Equation 7.19.

$$\text{FTP}_{\text{Instrument K}} = \text{Base FTP} + \text{Instrument K RP}_{\text{Uncon.}}$$

$$= \text{Base FTP} + \sum_{i=e}^{k} (RP_{XK,i}) \tag{8.7}$$

As previously discussed, the market price the bank instruments can be derived as

follows:

$$\text{Market Price}_{\text{Instrument K}} = \text{LIBOR} + \text{Instrument K } RP_{\text{Total}}$$

$$= \text{Base FTP} + \sum_{i=a}^{k} (RP_{XK,i}) \qquad (8.8)$$

Thus, the NIM for the instrument K is:

$$\text{NIM}_{\text{Instrument K}} = \text{Market Price}_{\text{Instrument K}} - \text{FTP}_{\text{Instrument K}}$$

$$= [\text{Base FTP} + \sum_{i=a}^{k} (RP_{XK,i})] - [\text{Base FTP} + \sum_{i=e}^{k} (RP_{XK,i})]$$

$$= \sum_{i=a}^{k} (RP_{XK,i}) - \sum_{i=e}^{k} (RP_{XK,i})$$

$$= \sum_{i=a}^{d} (RP_{XK,i}) \qquad (8.9)$$

As shown in Table 8.2, $\sum_{i=a}^{d} (RP_{XK,i})$ is the total NIM allocated to the asset unit X that operates the instrument K.

The NIM Measurement for the Paired Funds Transactions

It is assumed that the paired funds transactions involve a bank loan and a bank deposit. The deposit is used to support the loan. In the paired transactions, mismatch risks exist when the duration of the loan is different from that of the deposit. The paired funds transactions are assumed to be a long-term loan funded with a short-term deposit[14]. The following examines how the FTP model disaggregates the components of the NIM of the transactions.

To derive the NIM for the deposit and the loan, the funds transfer price for the

[14] The financial stability review from the National Bank of Belgium (2004) shows that bank liabilities typically reprice earlier than assets. Therefore, the duration of a bank asset is generally larger than that of a bank liability.

deposit and the loan should be determined. The funds transfer prices for the deposit and loans are derived based on Equation 7.19:

$$FTP_{Deposit} = \text{Base } FTP_{Deposit} - \text{Deposit } RP_{Uncon} \quad (8.10)$$

$$FTP_{Loan} = \text{Base } FTP_{Loan} + \text{Loan } RP_{Uncon,} \quad (8.11)$$

(1) The NIM calculation for the deposit. The NIM for the deposit is the difference between the funds transfer price and the market cost of the deposit. As previously discussed, the market price for the deposit can be determined as:

$$\text{Market Cost}_{Deposit} = \text{Base } FTP_{Deposit} - \text{Deposit } RP_{Total}$$

After the determination of the market price and funds transfer price for the deposit, the NIM of the deposit is:

$$\begin{aligned} NIM_{Deposit} &= FTP_{Deposit} - \text{Market Cost}_{Deposit} \\ &= (\text{Base } FTP_{Deposit} - \text{Deposit } RP_{Uncon}) - (\text{Base } FTP_{Deposit} - \text{Deposit } RP_{Total}) \\ &= \text{Deposit } RP_{Total} - \text{Deposit } RP_{Uncon} \\ &= \text{Deposit } RP_{Con} \end{aligned} \quad (8.12)$$

In Equation 8.12, the total deposit risk premiums, Deposit RP_{Total}, are the sum of the premiums for the deposit risks both under and beyond the control of the deposit unit. The NIM calculation shows that the FTP model enables the allocation of the profit contributions, Deposit RP_{Con}, to the deposit unit. Thus the deposit unit's managers are credited for managing the risks under their control.

(2) The NIM calculation for the loan. The NIM for the loan is the difference between the market price and the funds transfer price for the loan. As previously discussed, the price of the loan can be determined as:

$$\text{Market Price}_{loan} = \text{Base } FTP_{loan} + \text{Loan } RP_{Total}$$

With the determination of the market price and funds transfer price for the loan, the NIM of the loan can be derived as:

$$NIM_{loan} = \text{Market Price}_{loan} - FTP_{loan}$$

$$= (\text{Base } FTP_{loan} + \text{Loan } RP_{Total,}) - (\text{Base } FTP_{loan} + \text{Loan } RP_{Uncon})$$

$$= \text{Loan } RP_{Total} - \text{Loan } RP_{Uncon}$$

$$= \text{Loan } RP_{Con} \qquad (8.13)$$

Equation 8.13 shows that the FTP model allocates profit contributions, Loan RP_{Con} to the loan unit. The NIM calculation results indicate that the loan unit managers are rewarded for managing the risks under their control.

(3) The NIM calculation for the ALCO. The difference between the funds transfer price and the base funds transfer price for the deposit is the NIM transferred from the deposit unit to the ALCO:

$$NIM_{\text{Deposit to ALCO}} = \text{Base } FTP_{Deposit} - FTP_{Deposit}$$

$$= \text{Base } FTP_{Deposit} - (\text{Base } FTP_{Deposit} - \text{Deposit } RP_{Uncon})$$

$$= \text{Deposit } RP_{Uncon} \qquad (8.14)$$

The difference between the funds transfer price and the base funds transfer price for the loan is the NIM transferred from the loan unit to the ALCO:

$$NIM_{\text{Loan to ALCO}} = FTP_{Loan} - \text{Base } FTP_{Loan}$$

$$= (\text{Base } FTP_{Loan} + \text{Loan } RP_{Uncon}) - \text{Base } FTP_{Loan}$$

$$= \text{Loan } RP_{Uncon} \qquad (8.15)$$

The total NIM of the ALCO is derived from finding the difference between the funds transfer price for the loan and that for the deposit:

$$NIM_{ALCO} = FTP_{Asset} - FTP_{Liability}$$

$$= (\text{Base } FTP_{Loan} + \text{Loan } RP_{Uncon}) - (\text{Base } FTP_{Deposit} - \text{Deposit } RP_{Uncon})$$

$$= (\text{Base } FTP_{Loan} - \text{Base } FTP_{Deposit}) + (\text{Loan } RP_{Uncon} + \text{Deposit } RP_{Uncon})$$

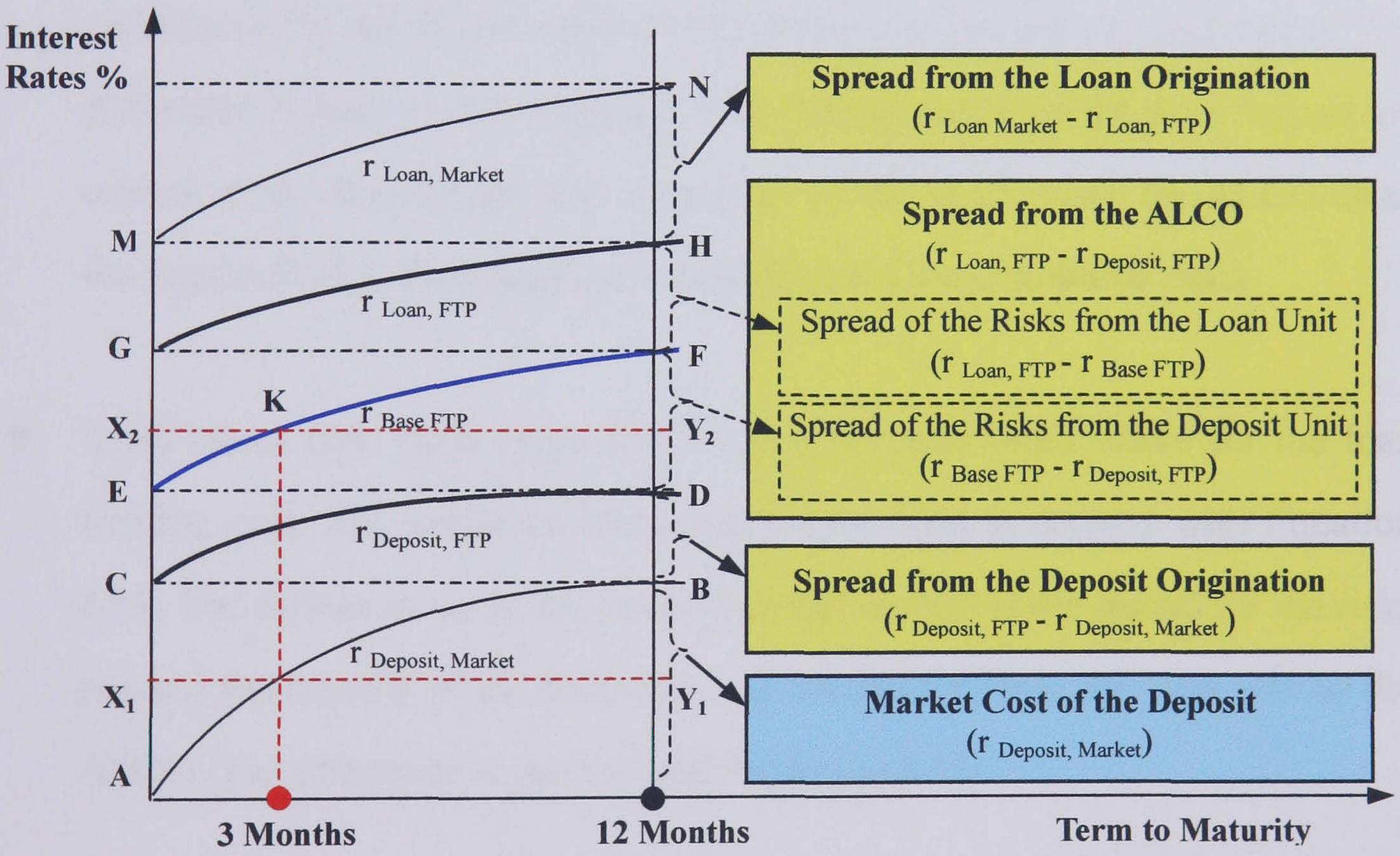
$$= \text{Mismatch Spread} + (\text{Loan } RP_{Uncon} + \text{Deposit } RP_{Uncon})$$

$$= \text{Mismatch Spread} + NIM_{\text{Loan to ALCO}} + NIM_{\text{Deposit to ALCO}} \qquad (8.16)$$

In Equation 8.16, the difference between the money market price for the loan, Base FTP_{Loan}, and that for the deposit, Base $FTP_{Deposit}$, is the mismatch spread due to the loan and deposit duration mismatching. Thus, as shown in Equation 8.16, the total NIM for the ALCO consists of three parts, mismatch spread, the NIM transferred from the loan unit and the NIM transferred from the deposit unit.

To have a better understanding on how the bankFTP model is applied to decompose the NIM profit contributions of the paired funds transactions. The NIM derived with Equation 8.12, 8.13, 8.14, 8.15 and 8.16 are compared and depicted in Figure 8.1.

Figure 8.1: The NIM Decomposition with the Bank FTP Model



AB: Market Cost Curve for the Deposit
CD: FTP price Index Curve for the Deposit Funding Credit
EF: Base FTP price Index Curve
GH: FTP price Index Curve for the Loan Funding Cost
MN: Market Yield Curve for the Loan

Figure 8.1 shows five positively sloped yield curves. The illustrations on these yield curves are presented as follows:

- Yield curve AB: yield curve AB is the market cost curve for the deposit, which consists of the expenses that incurred from obtaining the deposit from the external customers. The yield curve AB is used for the calculation of the

spread from the deposit origination.

- Yield curve CD: yield curve CD represents the FTP price index curve for the deposit funding credit. The funds transfer price for the deposit is derived based on Equation 8.10. The difference between yield curve CD and AB is a part of the spread from the deposit origination. The difference is derived with Equation 8.12. The spread is the premiums for the risks under the control of the deposit unit.

- Yield curve EF: yield curve EF is the base FTP price index curve. As discussed in the previous chapter, the base funds transfer price is the weighted average cost of interbank money market funding costs. The difference between yield curve EF and CD is a part of the spread from the deposit origination. The difference is derived with Equation 8.14. The spread is for the risks beyond the control of the deposit unit and is assigned to the ALCO since the ALCO takes the responsibility of managing the deposit unit's uncontrollable risks.

- Yield curve GH: yield curve GH is the FTP price index curve for the loan funding cost. The funds transfer price for the loan is derived with Equation 8.11. The difference between yield curve GH and EF is the spread for the risks beyond the control of the loan unit and transferred from the loan unit to the ALCO. The difference is derived with Equation 8.15.

- Yield curve MN: yield curve MN is the market yield curve for the loan. The difference between yield curve MN and GH is a part of the spread from the loan origination. The difference is derived with Equation 8.13. The spread is the premiums for the risks under the control of the loan unit.

In Figure 8.1, when it is assumed that the long-term loan duration is 12 months and the short-term deposit duration is 3 months, then the NIM due to loan and deposit

mismatching is the difference between the 12-month and the 3-month money market rate. Figure 8.1 shows that the mismatch spread equals to the distance FY_2.

8.2.3 Risk Adjusted Return on Capital Measurement

To measure relative performance, whether of a business unit, product or a customer, the return relative to the size of the investment and relative to the risk contributed by the investment must be calculated. Schroeck (2002) states that the banking industry's best practice for the performance evaluation is to employ the RAROC measure. The formula of the RAROC provided by Schroeck is as follows:

$$\text{RAROC} = \frac{\text{Risk Adjusted NI}}{\text{EC}} \tag{8.17}$$

Where:

Risk-Adjusted NI =

+ Expected Revenues (Gross Interest Income + Other Revenues [e.g., Fees])
- Cost of Funds
- Non-interest Expenses (Direct and Indirect Expenses + Allocated Overhead)
± Other TP Allocations
- Expected (Credit) Losses
+ Capital Benefit

Other revenues and non-interest expenses in Equation 8.17 are not concerned since this thesis focuses on the role of FTP in the risk-adjusted performance evaluation of the bank instruments. Thus the determination of the other revenues and non-interest expenses are out of the scope of this thesis. Integrating FTP with RAROC requires the following three rearrangements of Equation 8.17.

(1) Cost of funds, other TP allocations and capital benefit. As can be seen from the bank FTP model development, the cost of funds and other TP allocations have already been incorporated in the FTP model. Schroeck (2002) defines that

capital benefit is the benefit from the EC invested in the risk free assets. The derivation of opportunity cost of the EC in the FTP model development process indicates that the return from the EC investments in the risk free assets has already been incorporated in the FTP model. Therefore, the three items need to be integrated into one item, funds transfer price.

(2) Expected losses. Schroeck (2002) explains that expected loss is the mean of the loss distribution associated with the risks involved in the business activities. Some expected losses could be predicted and managed by the business units' managers and some could not. Therefore, the expected losses can be disaggregated into two components, the expected losses under the control of the business units' managers, and the losses beyond the control of the managers. Since the expected losses are covered by the risk premiums in the FTP model, the item "expected loss" can be replaced by the risk premiums, which can also be disaggregated into two components, the premiums for the risks beyond the control of the business units and those for the risks under the control of the units.

(3) EC. EC in Equation 8.17 can be disaggregated into two components, EC for the risks beyond the control of business units and those for the risks under the control of the units.

Therefore, integrating FTP with RAROC makes the implementation of RAROC need three broad streams: FTP, risks premium calculation and EC calculation. The risk premium calculation is only applied for the risks under the control of business units since the risks beyond the control of the units have already been incorporated in the FTP model. Thus, Equation 8.17 is rearranged as follows:

$$RAROC_{Asset} = \frac{\text{Risk Adjusted NI}}{EC}$$

$$= \frac{\text{Asset Price} - FTP_{Asset} - RP_{Con}}{(EC_{Con\ Risk} + EC_{Uncon\ Risk})} \tag{8.18}$$

$$RAROC_{Liability} = \frac{\text{Risk Adjusted NI}}{EC}$$

$$= \frac{FTP_{Liability} - \text{Liability Price} - RP_{Con}}{(EC_{Con\ Risk} + EC_{Uncon\ Risk})} \tag{8.19}$$

To demonstrate how the risk adjusted NI for the asset instruments is derived, the numerator of Equation 8.18 is decomposed and rearranged as follows:

$$\text{Risk Adjusted NI} = \text{Asset Price} - FTP_{Asset} - RP_{Con}$$

$$= \text{Asset Price} - (\text{Base FTP} + RP_{Uncon}) - RP_{Con}$$

$$= (\text{Asset Price} - \text{Money Market Cost of Funds}) - (RP_{Uncon} + RP_{Con})$$

$$= NI_{Asset} - RP_{Total}$$

Similarly, risk adjusted NI for the liability instruments in Equation 8.19 can be decomposed and rearranged as:

$$\text{Risk Adjusted NI} = FTP_{Liability} - \text{Liability Price} - RP_{Con}$$

$$= (\text{Base FTP} - RP_{Uncon}) - \text{Liability Price} - RP_{Con}$$

$$= (\text{Money Market Cost of Funds} - \text{Liability Price}) - (RP_{Uncon} + RP_{Con})$$

$$= NI_{Liability} - RP_{Total}$$

These rearrangements illustrate the concept that risk adjusted NI is derived by adjusting the total risk premiums from the NI. As the FTP model can be applied to determine the EC and the risk adjusted NIM for the instruments, the model plays a key role in deriving the RAROC.

The previous sections examine how the original term FTP model is integrated with the performance evaluation metric, whereas the following section explores how the remaining term FTP model is applied in bank performance measurement.

8.3 Net Interest Margin Measurement with the Remaining Term Bank Funds Transfer Pricing Model

To examine the remaining term bank FTP model, it is assumed that a long-term fixed rate loan is funded with a shorter duration term deposit. In this circumstance, mismatch risks exists due to the different duration of the loan and the deposit. As the loan and the deposit migrate toward maturity, their impacts on the balance sheet's overall mismatch risks change. The following sections examine the NIM of the loan, the deposit and the ALCO when the loan is originated and at the time of T when the short-term deposit matures.

8.3.1 Loan Performance Measurement

At the time of the loan origination, the original term FTP model is applied to measure the NIM of the loan. The NIM of the loan is the difference between the market price and funds transfer price for the loan:

$$\begin{aligned}
NIM_{Loan,\ Time\ 0} &= \text{Market Price}_{Loan} - FTP_{Loan,\ Time\ 0} \\
&= (\text{Base } FTP_{Loan,\ Time\ 0} + \text{Loan } RP_{Total,\ Time\ 0}) \\
&- (\text{Base } FTP_{Loan,\ Time\ 0} + \text{Loan } RP_{Uncon,\ Time\ 0}) \\
&= \text{Loan } RP_{Con,\ Time\ 0}
\end{aligned}$$

As the loan migrates toward maturity, its impacts on the NIM of the loan change. At the time T of the loan transaction, the principal cash flows of the loan and money market rate may change. These changes require that the remaining term FTP model should be applied to produce funds transfer prices. Thus, at the time T, the NIM calculation with the remaining term FTP model is:

$$\begin{aligned}
NIM_{Loan,\ Time\ T} &= \text{Market Price}_{Loan,\ Time\ T} - \text{Remaining Term } FTP_{Loan,\ Time\ T} \\
&= (\text{Base } FTP_{Loan,\ Time\ T} + \text{Loan } RP_{Total,\ Time\ T}) \\
&- (\text{Base } FTP_{Loan,\ Time\ T} + \text{Loan } RP_{Uncon,\ Time\ T}) \\
&= \text{Loan } RP_{Con,\ Time\ T}
\end{aligned}$$

When the loan is originated, the original term FTP model helps loan unit lock in

and retain its profit margin, the premiums for the risks under its control. However, at the time T, the remaining term FTP model enables the loan unit to lock in its profit margin, Loan $RP_{Con,\ Time\ T}$, which it can capture from the time T to its maturity. The difference between the NIM locked in at the loan origination and that at the time T is the profit contributions that the loan unit achieved during the time period from 0 to T. The realized profits is calculated as:

$$\text{Realized Profit}_{Loan} = NIM_{Loan,\ Time\ 0} - NIM_{Loan,\ Time\ T}$$

$$= \text{Loan } RP_{Con,\ Time\ 0} - \text{Loan } RP_{Con,\ Time\ T}$$

The realized profits have found its way over time into the reported NII of the bank. The remaining portion represents profits still at risk. Therefore, the remaining term FTP model calculates the loan unit's current position gain or loss. Clearly breaking the loan performance results in terms of historical and current risks would enable bank loan managers to examine whether their efforts spent in managing the loan bring profit to the bank and how stable are their remaining loan profits. Therefore, the applications of both the original and remaining term FTP models improve a bank's understanding of the performance of its loan unit.

8.3.2 Deposit Performance Measurement

At the time of the loan origination, the deposit is originated to support the loan. The NIM of the deposit is measured with the original term FTP model and derived as follows:

$$NIM_{Deposit,\ Time\ 0} = FTP_{Deposit,\ Time\ 0} - \text{Market Cost}_{Deposit,\ Time\ 0}$$

$$= (\text{Base } FTP_{Deposit,\ Time\ 0} - \text{Deposit } RP_{Uncon,\ Time\ 0})$$

$$- (\text{Base } FTP_{Deposit,\ Time\ 0} - \text{Deposit } RP_{Total,\ Time\ 0})$$

$$= \text{Deposit } RP_{Con,\ Time\ 0}$$

At the time T of the loan transaction, it is assumed that the original deposit matures and leaves the bank's balance sheet, thus new deposit must be originated to support the long-term loan. At the origination of the new deposit, the transaction's original

term and remaining term funds transfer price are identical. The deposit is now assigned a new funds transfer price because it is rolling over. Thus, the NIM of the new deposit is:

$$NIM_{Deposit,\ Time\ T} = FTP_{Deposit,\ Time\ T} - Market\ Cost_{Deposit,\ Time\ T}$$

$$= (Base\ FTP_{Deposit,\ Time\ T} - Deposit\ RP_{Uncon,\ Time\ T})$$

$$- (Base\ FTP_{Deposit,\ Time\ T} - Deposit\ RP_{Total,\ Time\ T})$$

$$= Deposit\ RP_{Con,\ Time\ T}$$

As the original deposit runs off the bank's balance sheet, the NIM of the original deposit, the $Deposit\ RP_{Con,\ Time\ 0}$, which is locked in by the original term FTP model, incorporated into the reported NII of the bank. At the time *T*, the funds transfer price derived based on the data from the new financial markets and bank situations is applied to calculate the deposit unit's current profit position. In this circumstance, $Deposit\ RP_{Con,\ Time\ T}$ are the profits that the deposit unit can obtain from the time *T* to its maturity. Therefore, the original and remaining term FTP models can help bank managers to identify how much profits they have earned and how much profit still at risk at different point of transaction time. Based on the existing level of the deposit risks, bank managers may find their suitable risk hedging strategies to manage their deposit profits.

If the funds transfer price, which is derived based on the historical information, is applied to evaluate the performance of the new deposit, the performance will not be accurately measured. This can be seen from the NIM measurement of the new deposit with the original term FTP model:

$$NIM_{Deposit,\ Time\ T} = FTP_{Deposit,\ Time\ 0} - Market\ Cost_{Deposit,\ Time\ T}$$

$$= (Base\ FTP_{Deposit,\ Time\ 0} - Deposit\ RP_{Uncon,\ Time\ 0})$$

$$- (Base\ FTP_{Deposit,\ Time\ T} - Deposit\ RP_{Total,\ Time\ T})$$

$$= (Base\ FTP_{Deposit,\ Time\ 0} - Base\ FTP_{Deposit,\ Time\ T})$$

$$+ (Deposit\ RP_{Total,\ Time\ T} - Deposit\ RP_{Uncon,\ Time\ 0})$$

In the above NIM calculation, the difference between the Base $FTP_{Deposit, Time\ 0}$ and the Base $FTP_{Deposit, Time\ T}$ has no economic meanings since the original deposit run off the bank's balance sheet and the new deposit has no relationship with the old one. The difference between the Deposit $RP_{Total, Time\ T}$ and the Deposit $RP_{Uncon, Time\ 0}$ also does not have any meanings since the premiums are applied for two different deposits. Therefore, the funds transfer prices derived with the data at the time 0 should not be applied to measure the performance of the deposit originated at the time *T*.

8.3.3 ALCO Performance Measurement

At the time of the loan origination, the original term FTP model is applied to measure the NIM of the ALCO. According to Equation 8.16, the NIM of the ALCO is derived as the difference between the funds transfer price for the loan and that for the deposit:

$$\begin{aligned} NIM_{ALCO,\ Time\ 0} &= FTP_{Loan, Time\ 0} - FTP_{Deposit, Time\ 0} \\ &= (\text{Base } FTP_{Loan, Time\ 0} + \text{Loan } RP_{Uncon, Time\ 0}) \\ &\quad - (\text{Base } FTP_{Deposit, Time\ 0} - \text{Deposit } RP_{Uncon, Time\ 0}) \\ &= \text{Mismatch Spread}_{Time\ 0} + (\text{Deposit } RP_{Uncon, Time\ 0} + \text{Loan } RP_{Uncon, Time\ 0}) \quad (8.20) \end{aligned}$$

The results derived with Equation 8.20 shows that the NIM of the ALCO consists of the mismatch spread and all the risk premiums beyond the control of the loan and deposit unit. As the loan and deposit transactions migrate toward maturity, their impact on the NIM of the ALCO changes. At the time of *T*, the NIM of the ALCO is derived as follows:

$$\begin{aligned} NIM_{ALCO,\ Time\ T} &= FTP_{Loan, Time\ T} - FTP_{Deposit, Time\ T} \\ &= (\text{Base } FTP_{Loan, Time\ T} + \text{Loan } RP_{Uncon, Time\ T}) \\ &\quad - (\text{Base } FTP_{Deposit, Time\ T} - \text{Deposit } RP_{Uncon, Time\ T}) \\ &= \text{Mismatch Spread}_{Time\ T} + (\text{Deposit } RP_{Uncon, Time\ T} + \text{Loan } RP_{Uncon, Time\ T}) \quad (8.21) \end{aligned}$$

As the NIM of the ALCO calculated in both Equation 8.20 and 8.21 consists of

three parts, this section discusses these three parts respectively, (1) the Mismatch Spread, (2) Deposit RP_{Uncon} and (3) Loan RP_{Uncon}.

Mismatch Spread

The mismatch spread for the ALCO changes from the total amount of the Mismatch $Spread_{Time\ 0}$ to the Mismatch $Spread_{Time\ T}$. This is due to the migration of the loan and the introduction of the new deposit that supports the remaining term loan at the time of *T*. As the loan migrates toward its maturity, the long-term duration of the loan decreases. As the duration of the deposit is assumed to be short term, the duration gap between the loan and the deposit is getting smaller. This makes the mismatch spread narrow. The clear identification of the mismatch spread at the different transactions time would help bank managers understand how much mismatch spread has been incorporated in the reported NI of the bank. The mismatch spread reported in the NI statement is the difference between the mismatch spread at the time 0 and that at the time *T*:

$$\text{The Changes of the Mismatch Spread} = \text{Mismatch Spread}_{Time\ 0} - \text{Mismatch Spread}_{Time\ T} \quad (8.22)$$

Equation 8.20, 8.21 and 8.22 shows that the original term and remaining term FTP model enables bank mangers to identify the historical and current mismatch positions and to derive the mismatch spread realized in the past. With the original term and remaining term FTP model, bank managers can fully understand the dynamics of its NIM from assuming the mismatch risk. These would help a bank appraise the performance of its mismatch risk management.

Deposit RP_{Uncon}

Both Equation 8.20 and 8.21 indicate that the ALCO is rewarded for managing the risks transferred from the loan and the deposit units. Equation 8.20 presents the amount of risk premiums incurred at the origination of the deposit transactions. At the time of *T*, the old deposit runs off the bank's balance sheet, thus the remaining risk

premiums for the old deposit becomes 0. In this circumstance, the amount of the deposit risk premiums incorporated in the NI statement of the ALCO is:

$$\text{The Changes of the Old Deposit } RP_{Uncon} = \text{Deposit } RP_{Uncon,\ Time\ 0} - 0$$

$$= \text{Deposit } RP_{Uncon,\ Time\ 0}$$

On the other hand, at the time of *T*, the new deposit is originated. As shown in Equation 8.21, the premiums for the new deposit risks are Deposit $RP_{Uncon,\ Time\ T}$. This is the unrealized profit for the ALCO since the new deposit is still on the bank's balance sheet. Separating the premiums for the old deposit from those for the new deposit would enable the ALCO to measure how effective its deposit risk management strategies were. The identifications of the deposit profits still at the risks would help the ALCO determine its deposit risk tolerance. These would facilitate the ALCO to make effective deposit risk management decisions.

Loan RP_{Uncon}

Similar with the discussions presented in the above section, the ALCO also rewarded for managing the risks transferred from the loan unit. With Equation 8.21 and 8.22, the changes of the loan risk premiums are:

$$\text{The Changes of the Loan } RP_{Uncon} = \text{Loan } RP_{Uncon,\ Time\ 0} - \text{Loan } RP_{Uncon,\ Time\ T}$$

The changes of the loan risk premiums have been incorporated in the reported NI of the bank. The remaining portion represents the loan profits still at risk. Clear identifications of the historical and current amount of the risks transferred from the loan unit would help the ALCO determine its loan risk tolerances. This would help the ALCO decide appropriate risk management strategies to control its remaining loan risks.

The following section summarizes the findings from integrating both the original and remaining term FTP models in bank performance measurement.

8.4 The Implications of the Bank Funds Transfer Pricing Model

Five functions of the bank FTP model are found from the performance measurement process discussed in the previous sections. The functions consist of (1) identifying the sources of bank profits, (2) allocating the profits among the business units, (3) solving the double counting issues incurred by the multiple pool FTP method, (4) keeping the consistency of the analytical income statements, and (5) effective bank risk management.

8.4.1 Function One: Identifying the Sources of the Bank Profits

In this thesis, the bank FTP model is developed with the VaR contribution technique, which enables the whole bank risks to be decomposed by the risk factors involved in banking businesses. The risk decomposition facilitates the calculation of the premiums for each risk. As shown in Table 8.1, the whole bank risk premiums are decomposed by the risk factors. The components of the whole risk premiums can be reformulated in the terms of the risk factor, the business unit and the instrument respectively. Accordingly, this helps bank managers identify the sources of bank profits at the risk factor, the business unit and the instrument levels.

Source of the Bank Profit Identification by the Bank Risk Factor

With Table 8.1, the total risk premiums for each risk factor can be determined. For example, the total risk premiums for the risk *h*, which is incurred by the bank assets, is derived as:

$$RP_{X1,h} + \ldots + RP_{XK,h} + \ldots + RP_{XN,h} = \sum_{j=1}^{N} (RP_{Xj,h})$$

The total risk premiums for each risk factor shows how much profit contributions are made from taking the risk. This helps bank manager identify the level of each risk in the whole bank. For example, the bank can find how much interest rate risk is accumulated in the bank as a whole.

Source of the Bank Profit Identification at the Bank Business Unit Level

Table 8.1 presents the total risk premiums for each business unit. For example, the total risk premiums for the liability unit is the sum of the premiums for the risks incurred by the liability businesses. In this case, the total risk premium is:

$$\sum_{j=i}^{z} (RP_{YI,i}) + \ldots + \sum_{j=i}^{z} (RP_{YI,i}) + \ldots + \sum_{j=i}^{z} (RP_{YM,i})$$

$$= \sum_{j=i}^{z} (RP_{YI,i} + \ldots + RP_{YI,i} + \ldots + RP_{YM,i})$$

The total risk premiums for each business unit shows how much profits are made by a business unit from managing all the risks involved in its businesses. This would help bank top management identify the level of risks for each business unit.

Source of the Bank Profit Identification at the Bank Instrument Level

According to Table 8.1, the risk premiums for each bank instrument can be determined. For example, the total risk premiums for the asset instrument *K* is the sum of the premiums for the risks involved in the instrument. In this case, the total risk premium for the instrument *K* is:

$$RP_{XK,a} + \ldots + RP_{XK,h} + RP_{XK,i} + \ldots + RP_{XK,k} = \sum_{i=a}^{k} (RP_{XK,i})$$

The total risk premiums for each instrument shows how much profit is generated for taking all the risks incurred by the instrument. This would help bank managers identify the level of risks for each bank instrument.

The integration of the FTP model with the NIM measurements for the paired funds transactions shows that the model identifies the sources of the NIM at the instrument level. It can be seen from Figure 8.1 that the FTP model disaggregates the overall NIM, equivalent to the difference between the yield curve AB and MN, into three components: spread from the loan origination, spread from the deposit origination, and spread from the ALCO. The relationship is described in the

following equation:

$$\text{Overall NIM} = \text{Spread}_{\text{Loan Origination}} + \text{Spread}_{\text{Deposit Origination}} + \text{Spread}_{\text{ALCO}}$$

The identification of the sources of the bank profits would help bank mangers understand how the bank profits are generated.

8.4.2 Function Two: Allocating the Profits among the Business Units

The bank FTP model aims at measuring the performance of the business units and instruments. This requires that the model should achieve the function of allocating profits among the business units that make contributions to the overall profits. As shown in Table 8.2, the FTP model decomposes the NIM contributions and allocates the profit contributions among the business units. According to the profit allocation processes discussed in the previous section, the following conclusions are made:

(1) Profit allocation at the bank business unit level. Equation 8.3 shows that the FTP model ensures that all the premiums for the risks under the control of the asset unit are allocated to the asset unit. Similarly, Equation 8.6 shows that with the FTP model the liability unit is credited for managing the risks under its control.

(2) Profit allocation at the bank instrument level. The FTP model enables the risk premiums to be allocated to the business unit that implement the instrument. According to Equation 8.9, the premiums for the risks incurred by the instrument *K* and under the control of the asset unit managers, are assigned to the asset unit.

(3) Profit allocation between the paired funds transactions. The FTP model is found to properly allocate the profit contributions between the business units that implement the paired funds transactions.

- Equation 8.12 shows that the FTP model allocates the Deposit RP_{Con} to the deposit unit. The profit allocation process indicates that the deposit unit is

credited for managing the risks under their control.

- According to Equation 8.13, the Loan RP_{Con} is assigned to the loan unit by the FTP model. Therefore, the FTP model ensures that the loan unit is rewarded for managing the risks under their control.

- Equation 8.14 and 8.15 show how the FTP model is applied to allocate the loan and deposit risk premiums to the ALCO. The premium allocation processes ensure that the ALCO are credited for managing the risks beyond the control of the loan and deposit unit.

- Equation 8.16 shows that the FTP model allocates the mismatch risk spread to the ALCO since it is assumed that the ALCO manages the mismatch risks.

The NIM measurement with the FTP model shows that the model can be applied to properly allocate profit contributions among the business units. Business unit managers are only rewarded for managing their controllable risks. This would enable bank mangers to understand the different profit contributions made by the business units and instruments. The proper profit allocation makes the performance evaluation of each unit is reported on the basis of where the results were incurred and who has responsibility for them. As discussed in Chapter Two, the profit contribution figures derived with the FTP system help determine provisions of the incentive system. The proper profit contribution allocation may be expected to achieve the desired motivational impact on divisional managers.

8.4.3 Function Three: Solving the Double Counting Issues

The bank FTP model eliminates the double counting issues generated from the double pool FTP method. As discussed in Chapter Three double counting problem may arise when the double pool FTP method are applied. The elimination of the double counting problem by the FTP model can be examined from the equation

developed for generating funds transfer prices. The previous section shows that the funds transfer price for the loan instrument is derived from the following equation:

$$FTP_{Loan} = \text{Base } FTP_{Loan} + \text{Loan } RP_{Uncon} \quad (8.23)$$

The funds transfer price for the deposit supporting the loan is as follows:

$$FTP_{Deposit} = \text{Base } FTP_{Deposit} - \text{Deposit } RP_{Uncon} \quad (8.24)$$

In Equation 8.23 and 8.24, both Base FTP_{Loan} and Base $FTP_{Deposit}$ are selected from the money market rate index curve. The long-term money market rate is generally larger than the short-term rate in the normal yield curve, the positively sloping yield curve. Thus the base funds transfer price for the long-term duration loan is always larger than that for the short-term duration deposit. Meanwhile, bank risk premiums are generally positive. These make the FTP_{Loan} derived with Equation 8.23 is always larger than the $FTP_{Deposit}$ derived with Equation 8.24. As discussed in Chapter Three double counting issue arises only when funds transfer price for the asset is less than that for the liability supporting the asset. Therefore, no double counting issues arise when the bank FTP model is used to measure the NIM of the paired funds transactions.

8.4.4 Function Four: Keeping the Consistency of the Analytical Income Statements

The NIM measurement of the paired funds transactions in the previous section shows that the bank FTP model enables the consistency of the analytical income statements. The following equation is from the profit decomposition process depicted in Figure 8.1.

$$\begin{aligned}\text{Overall NIM} &= \text{Spread}_{\text{Loan Origination}} + \text{Spread}_{\text{The ALCO}} + \text{Spread}_{\text{Deposit Origination}} \\ &= (r_{\text{Loan, Market}} - r_{\text{Loan, FTP}}) + (r_{\text{Loan, FTP}} - r_{\text{Deposit, FTP}}) + (r_{\text{Deposit, FTP}} - r_{\text{Deposit, Market}}) \\ &= r_{\text{Loan, Market}} + (-r_{\text{Loan, FTP}} + r_{\text{Loan, FTP}}) + (-r_{\text{Deposit, FTP}} + r_{\text{Deposit, FTP}}) - r_{\text{Deposit, Market}} \\ &= r_{\text{Loan, Market}} - r_{\text{Deposit, Market}} \quad (8.25)\end{aligned}$$

The overall NIM from the loan and deposit instrument can also be derived as:

$$\text{Overall NIM} = \text{Interest Income}_{\text{Loan}} - \text{Interest Expense}_{\text{Deposit}}$$

$$= \text{Market Price}_{\text{Loan}} - \text{Market Cost}_{\text{Deposit}}$$

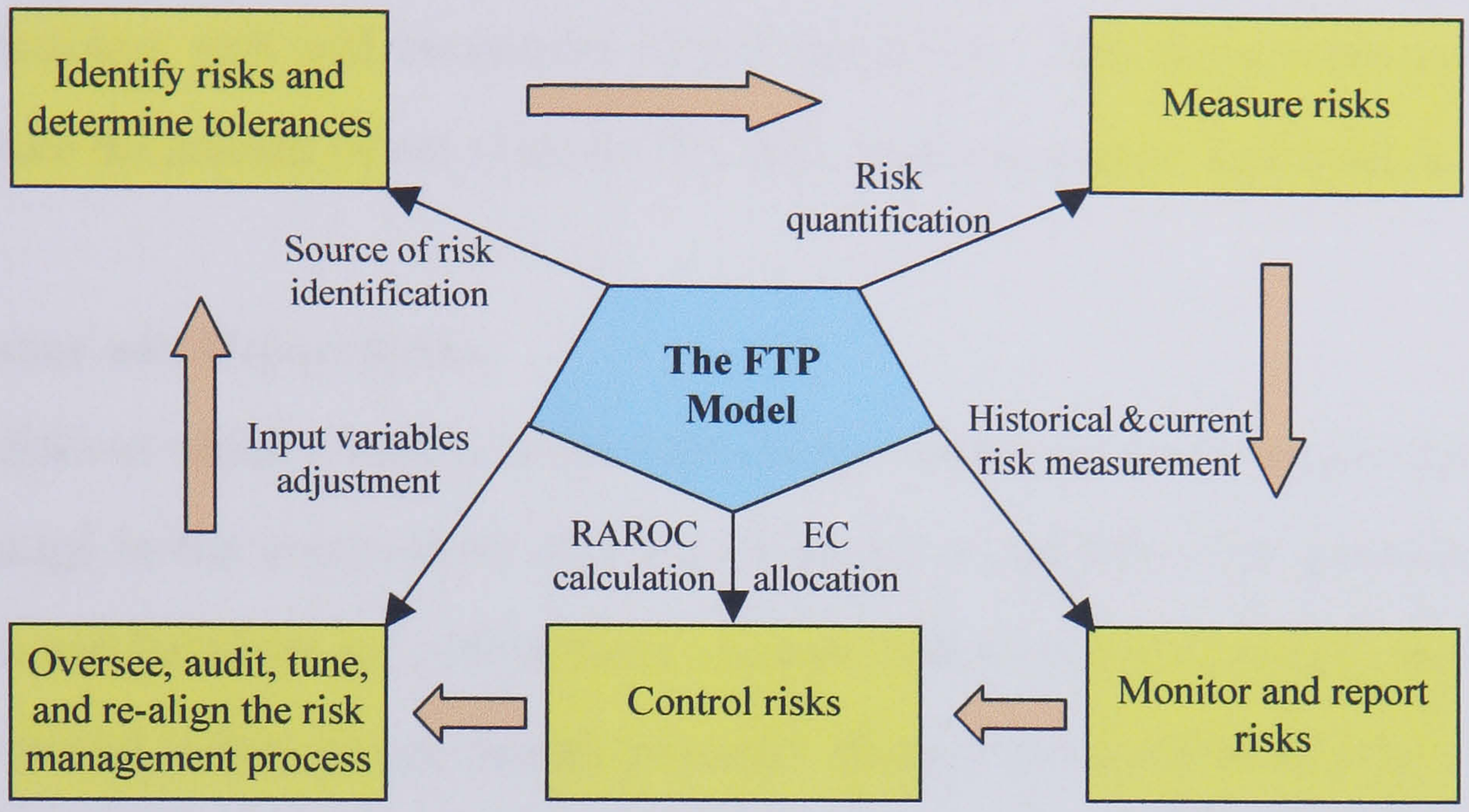
$$= r_{\text{Loan Market}} - r_{\text{Deposit, Market}} \qquad (8.26)$$

In Equation 8.26, the NIM of the paired funds transactions is the difference between the interest income, which is generated by the loan, and the interest expenses, which are incurred by the deposit. Equation 8.25 and 8.26 shows that the overall NIM derived from the two equations are the same. Therefore, the FTP model ensures the consistency of the analytical income statements of the funds transaction. Establishment of a FTP system cannot generate income. The function of the FTP model is to transfer NIM from one unit to another, and is not to change the overall NIM margin. In other words, the distance between the yield curve AB and MN in Figure 8.1 does not change due to the application of the bank FTP model developed in this thesis.

8.4.5 Function Five: Effective Bank Risk Management

The performance measurement processes discussed in the previous two sections are examined to find whether the bank FTP model can be integrated with the effectively functioning risk management process to enhance the process. According to Culp (2001), the effectively functioning risk management process consists of five general activities: identify risks and determine tolerances; measure risks; monitor and report risks; control risks; and oversee, audit, tune, and re-align the risk management process. Culp argues that some firms structure this process with more formality and centralization than others, but all firms manage risk in this five-step process whether they realize it or not. The integration of the bank FTP model with the risk management process is depicted in Figure 8.2.

Figure 8.2: The Integration of the Bank FTP Model with the Effective Risk Management Process



Identify Risks and Determine Risk Tolerances

As discussed previously the VaR contribution technique, which is applied in the bank FTP model development, enables the whole bank's risks to be decomposed by the risk factor. This helps bank managers determine the amount of bank risk generated from taking each type of the risks. For example, bank managers can find how much interest rate risk is incurred from all the banking businesses. The VaR contribution technique also decomposes the total bank risks by the business unit and instrument levels. This enables bank managers understand how much risk each business unit involves, and how much risk a bank instrument incurs.

Having identified the source and level of risks for a bank, bank top management may agree on tolerable levels of those risks required for the operation of the bank's businesses. Therefore, the bank FTP model helps top management decide bank risk tolerances. After the determination of the risk tolerances, the risks incurred by banking businesses need to be measured.

Measure Risks

Risk measurement involves the quantification of certain risk exposures for the

purpose of comparison to the defined risk tolerances. Table 8.1 shows that the bank FTP model quantifies every risk incurred by the bank instrument. As previously discussed, Table 8.1 can be reformulated to obtain the sum of the risk premiums for the business unit and instrument level respectively. This helps bank managers measure the amount of risks incurred by bank business units or instruments.

Monitor and Report Risks

The risks to which a bank is subject can change because of two reasons. The first is a change in the composition of a bank's assets or liabilities. For example, bank assets and liabilities run off the bank's balance sheet when they mature in the end. The second is that money market generally changes at the different point of time. In these circumstances, both the original term and remaining term bank FTP models can be applied to measure the risks.

As discussed in the previous section, the applications of both the original and remaining term FTP models enable bank managers to identify how much risk still exists in their businesses. With the original term FTP model, bank managers determine how much risk is locked in at the origination of the funds transactions. With the remaining term FTP model, bank managers can find how much risk runs off the bank's balance sheet, and how much risk still exists in the bank. Clear identifications of the historical and current amount of the risks would help bank managers evaluate how effective their risk management strategies were, compare the existing risks to the risk tolerances, and determine risk management strategies for the existing risks.

Control Risks

The How factor designed in Chapter Six applies the GFT pattern, which ensures that all the risks transit through the ALCO. This enables the FTP model to decompose all the risks involved in bank funds transactions and to assign the profit from the risks to the business units that take the responsibility of managing the risks. As discussed in

Chapter Six, when risks are assigned to the business units, the units must be allocated EC so that they can operate their businesses without default. Culp (2001), Schroeck (2002), and Crouhy, Galai, and Mark (2006) argue that RAROC can serve as the basis for risk capital allocation decisions. As discussed in the previous section, the bank FTP model facilitates the derivation of the RAROC. Therefore, the FTP model facilitates the EC allocation and bank risk control.

Having derived RAROC with the FTP model, bank managers can understand the risk and return profile of every business transaction and the impact of individual units in the generation of the adequate risk returns. The comparison of RAROC to a hurdle rate enables a bank to determine whether a funds transaction is generating value and thus entitled to EC. If the RAROC is greater than the hurdle rate, the transaction is deemed to add value to the bank. In the opposite case, the transaction is deemed to destroy value to the bank and should be rejected. Therefore, the FTP model helps bank managers select profitable funds transactions, thereby reducing the risks of implementing unprofitable transactions.

The FTP model ensures that the risks and associated EC are assigned the business units that have control over the risks, and that the risks beyond the control the business units are transferred to the ALCO. After adopting the risks from business units, the ALCO that consists of risk management specialists can effectively manage the risks beyond the control of business units' managers. After transferring out uncontrollable risks, business units' managers can focus on managing their client relationships, making good credit decisions, and locking in a reasonable spread for the bank based on the current environment. These facilitate all of the bank's risks to be effectively managed.

Oversee, Audit, Tune, and Re-align the Risk Management Process

According to Culp (2001), the final component of an effectively functioning risk management process is risk audit and oversight and the fine-tuning of the risk

management process itself. The bank FTP model developed in this thesis can be adjusted to refine the risk management process. For example, the definition of the WHEN factor requires that the remaining term FTP model should be developed to reflect the changing financial situations. The WHAT and WHO factors determine which risk variables should be incorporated in the FTP model. When the definitions of these factors change, the inputs to the bank FTP model will accordingly change. Therefore, the FTP model can be adjusted to coordinate the risk management process.

The above discussions show that the bank FTP model facilitates the effectively functioning of the bank risk management. The FTP model enhances the risk management process and enables bank managers to control their risks effectively.

8.5 Comparisons of the Bank Funds Transfer Pricing Model with the Pool Based Funds Transfer Pricing and MMFTP methods

The comparisons of the single pool FTP, the double pool FTP, the multiple pool FTP and the MMFTP methods have been summarized and presented in Table 3.12. This section compares the bank FTP model developed in this thesis with these methods.

According to the AMIfs Research Committee (2001), the MMFTP method is most effective method in measuring bank profit contributions and managing bank risks. The bank FTP model developed in this thesis incorporates the concept of the MMFTP method, thus the FTP model has the same advantages as the MMFTP method over the pool based FTP methods. The following outlines the advantages of the bank FTP model developed in this thesis.

The Bank FTP Model Vs. the Single Pool FTP Method

As discussed in Chapter Three single pool FTP method assigns an identical price for all the bank funds transactions. It treats all bank funds identically and is simple

to understand and to report results. However, it does not consider varying contribution of funds and risks in measurement.

The bank FTP model developed in this thesis can be applied to identify the profit contributions by risk factor, business unit and instrument levels. It achieves the functions of effective bank risk management and accurate performance measurement. Therefore, the FTP model is more effective in bank performance measurement and risk management than the single pool FTP method.

The Bank FTP Model Vs. the Double Pool FTP Method

In the double pool FTP method, one pool is for funds provided, another pool for funds used. Each pool has a price. One pool carries an asset yield based price; another pool carries a cost of funds based price. This method has similar disadvantages as those of the single pool method. As discussed in Chapter Three the double pool FTP method also has the double counting issues. This makes the inconsistency of the bank's analytical income statements.

The bank FTP model developed in this thesis solves the double counting issues and keeps the consistency of the bank's analytical income statements. As the double pool FTP method has similar disadvantages as the single pool FTP method in bank performance measurement and risk management, the bank FTP model developed in this thesis is more effective than the double pool FTP method.

The Bank FTP Model Vs. the Multiple Pool FTP Method

Chapter Three discusses that the multiple pool FTP method allows for limited profit contribution differentiation at bank instrument level and crudely address some mismatch risk issues. Therefore, the multiple pool FTP method cannot be applied to measure the performance of all the bank instruments.

The bank FTP model developed in this thesis can identify the profit contributions

made by all the bank instruments and can accurately measure both the current and historical mismatch risk positions. Therefore, the bank FTP model is more effective than the multiple pool FTP method.

The Bank FTP Model Vs. the MMFTP Method

The MMFTP method assigns a market price based matched repricing term funds transfer price to each funds transaction. As discussed in Chapter three, the MMFTP measures product and customer profit contribution and insulates the profit contribution from interest rate risk. The MMFTP method focuses mainly on managing interest rate risk associated with funds transactions.

In this thesis, the bank FTP model is developed based on the concept of the MMFTP method. Thus, the FTP model can also identify and measure interest rate risk, especially the mismatch risk. As the GFT pattern and VaR contribution technique are applied in the bank FTP model development, the model can be applied to decompose all the risks involved in bank funds transactions, and to properly assign the risks to the business units that can effectively control the risks. Therefore, the bank FTP model developed in this thesis can be applied to manage not only interest rate risk, but also all the other risks involved in bank funds transactions. This enables the bank FTP model to achieve more powerful functions in risk management than the MMFTP method.

8.6 Summary

This chapter examines the functions of the bank FTP model by integrating the FTP model with two performance metrics, NIM and RAROC. The performance measurement process shows that the bank FTP model achieves five important functions, identifying the sources of bank profits, allocating the profits among business units, solving the double counting issues incurred by the double pool methods, keeping the consistency of analytical income statements, and effectively managing bank risks.

The application of the original and remaining term bank FTP models in the performance measurement of the loan, the deposit and the ALCO shows that the FTP models can be used to derive the profits result from decisions implemented in the past and identify the current profits at risks. Identifications of the current profits at risks would help the top management determine appropriate risk management strategies. This enables the bank top managements to properly appraise the performance of business units and the ALCO.

This chapter also makes a comparison between the bank FTP model with the current pool based FTP methods and the MMFTP method. The FTP model is found to achieve more powerful functions in bank risk management and performance measurement than the other FTP methods.

Chapter Nine: The Organizational Application of the Bank Funds Transfer Pricing Model

9.1 Introduction

This chapter presents the organizational application of the bank FTP model. According to the degree to which bank business unit managers are delegated authority over risk management decisions, this study classifies bank forms into three types, fully decentralized form, partially decentralized form, and fully centralized form. The primary aim of this chapter is to test whether the FTP model developed in this thesis is effective in risk management and performance measurement in these banks. The FTP model must enable bank managers to effectively control bank risks. As bank performance evaluation results are important inputs to the bank incentive system, the FTP model must ensure that bank profit contributions are properly allocated with the bank, and bank managers are only held responsible for the risks they have control over.

The empirical investigations conducted in this thesis show that bank funds transfers are made within banks rather than between banks. However, to have a complete view of the effectiveness of the bank FTP model, it is essential to consider the application of the model for both internal and external funds transfer in each type of the banks.

The first section of this chapter designs scenarios for the organizational testing of the bank FTP model. The second section presents the implications of the FTP model in the fully decentralized bank followed by the third section, the implications of the FTP model in the fully centralized bank. The fourth section is the implications of the FTP model in the partially decentralized bank. The fifth section generalizes the results from the application of the bank FTP model in the different scenarios. The final section is the summary.

9.2 Scenario Design for the Organizational Testing of the Bank Funds Transfer Pricing Model

In order to test the FTP model in the different banking structures, this chapter designs the scenarios that exploit the differences in the three types of bank structure and the differences in the two types of funds transfer. The following discusses the types of bank form and the types of funds transfer. The scenarios are designed based on the types of bank form and funds transfer.

9.2.1 The Types of Bank Form

In the decentralized banks, the top management, which in this thesis is assumed to be the ALCO, delegates bank risk management decision-making authority to the business units and assigns the responsibility of managing the risks to the units that have control over the risks. As FTP is generally considered as the decision-making inputs for the top management, the ALCO determines the funds transfer prices. The ALCO also measure the business units' performances, and the bank's managerial incentives are designed based on the performance measurements. According to the degree to which business unit managers delegate authority over risk management decisions, bank forms are classified into three types, fully decentralized form, fully centralized form and partially decentralized form.

Fully Decentralized Bank Form

In the fully decentralized bank, business unit managers are given full authority to make their business decisions. Business unit managers are free to determine their asset and liability business volumes and prices, make risk management decisions related to their businesses, and need to control all the risks involved in their businesses. In this type of the bank, the ALCO does not have any interference on business unit risk management decisions.

Fully Centralized Bank Form

In the fully centralized bank, business unit managers are not given any authority to

make their business decisions. The ALCO holds all the risk management decision-making authority. The ALCO gives the business unit managers the instructions on the asset and liability business volumes and prices. Business unit managers control no risks, and make funds transactions according to the instructions given by the ALCO.

Partially Decentralized Bank Form

In the partially decentralized bank, business unit managers are given some authority to make their risk management decisions, and the ALCO takes the remaining authority. Thus both the ALCO and the business unit managers hold some risk management decision-making authority. In this bank, the ALCO controls the overall bank risks and determines the bank's asset and liability business volumes and prices. Therefore, this is a relatively more centralized bank form.

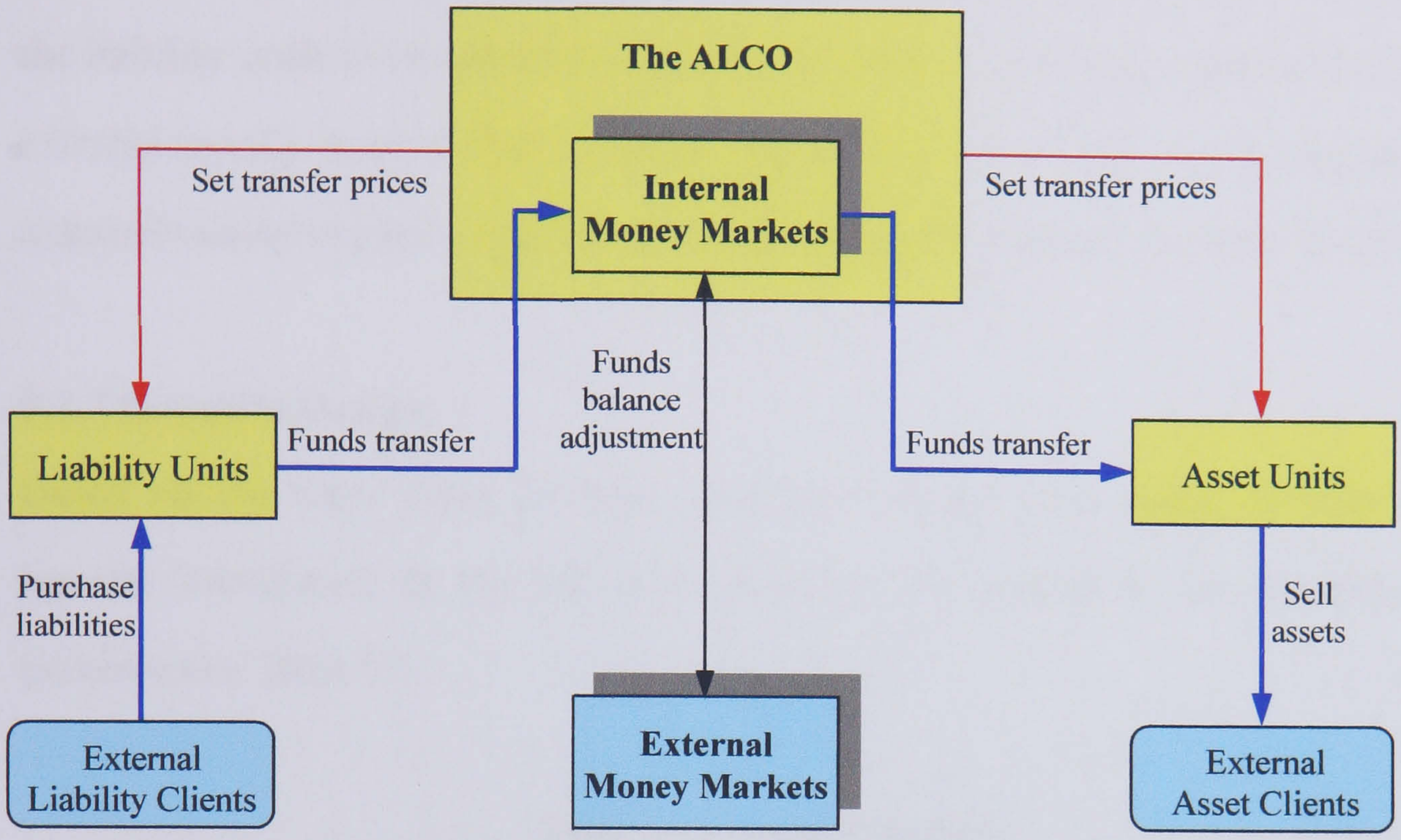
9.2.2 The Types of Bank Funds Transfer

The funds transfer within a bank generally consists of internal transfer and external transfer. The internal funds transfer exists between business units within a bank, whereas the external funds transfer are made between different banks. The types of bank funds transfer are illustrated as follows.

Internal Funds Transfer

As discussed in Chapter Six, for the internal funds transfer, bank funds are transferred from the liability units, the funds providers, to the internal money markets, the ALCO, from which the funds are then transferred to the asset units, the funds users. Therefore, when it is assumed that funds are transferred internally, no funds are exchanged between business units and the external money markets. The flow of funds for the internal funds transfer within a bank is depicted in Figure 9.1

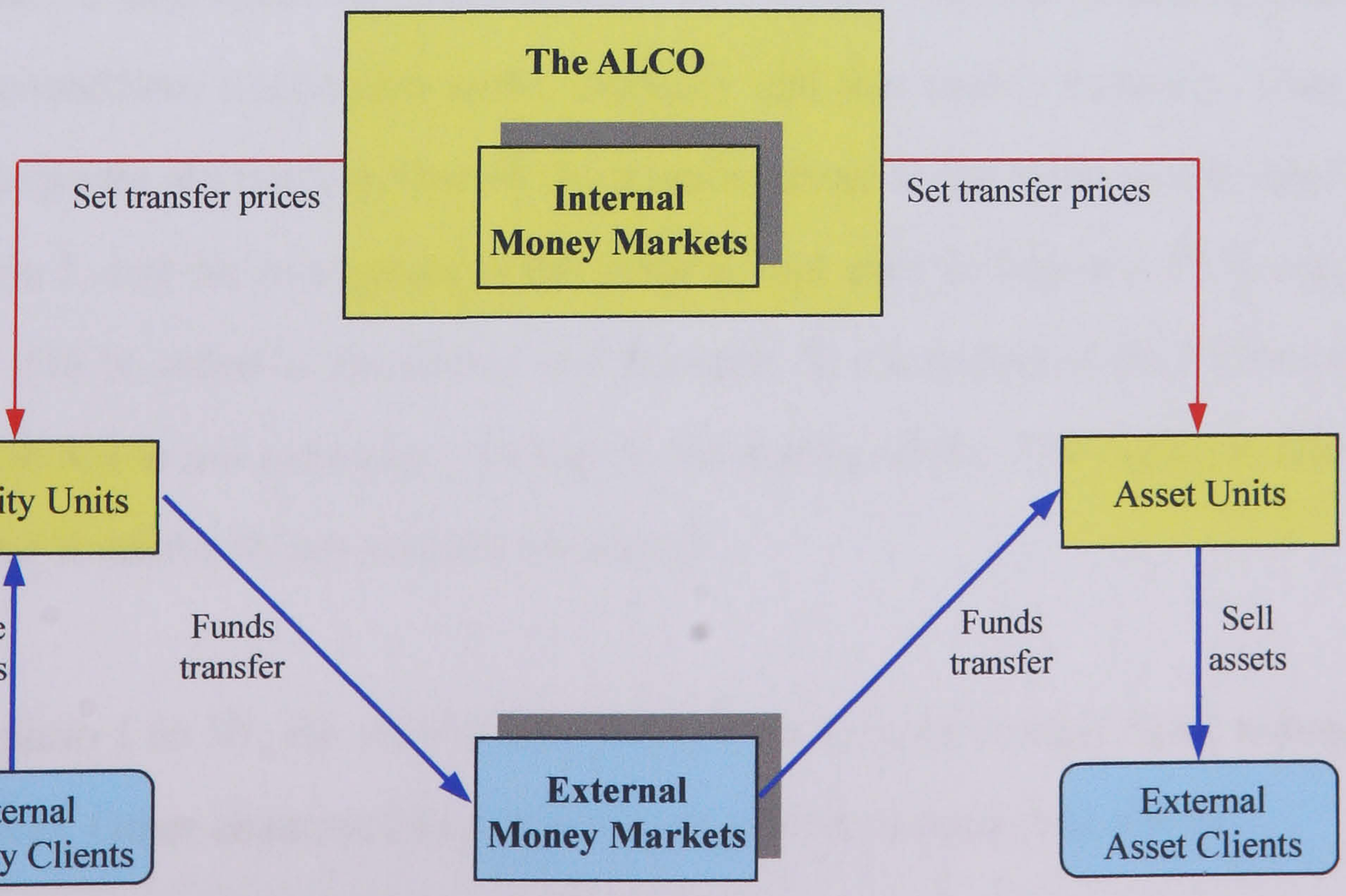
Figure 9.1: The Flow of Funds for the Internal Funds Transfer within a Bank



External Funds Transfer

For the external funds transfer, liability units sell funds directly to the external money markets, and asset units buy funds directly from the external money markets. When it is assumed that bank funds are transferred externally, no funds transfers are made between business units and the ALCO within a bank. The flow of funds for the external funds transfer within a bank is depicted in Figure 9.2

Figure 9.2: The Flow of Funds for the External Funds Transfer within a Bank



Part Internal and Remaining Part External Funds Transfer

For the part internal and remaining part external funds transfer, part of funds from the liability units is transferred to the ALCO, and the remaining part is sold to the external money market. Part of funds required by the asset units is bought from external money markets, and the remaining part is transferred from the ALCO.

9.2.3 Scenario Design

Based on the three types of bank structure and the three types of bank funds transfer introduced in the previous sections, nine scenarios are designed and presented in Table 9.1.

Table 9.1: Scenario Design

Funds Transfer / **Bank Form**	External Funds Transfer	Internal Funds Transfer	Part Internal and Remaining Part External Funds Transfer
Fully Decentralized Bank	**Scenario I**	**Scenario II**	**Scenario VII**
Fully Centralized Bank	**Scenario III**	**Scenario IV**	**Scenario VIII**
Partially Decentralized Bank	**Scenario V**	**Scenario VI**	**Scenario IX**

In Table 9.1, Scenario VII is essentially the combination of Scenario I and Scenario II. The funds transactions made in Scenario VII can be decomposed into two transactions, transaction made internally and that made externally. Thus, two transfer prices are needed. One of the transfer prices is the same as that applied in Scenario I, and the other price is the same as that used in Scenario II. As the FTP model will be tested in Scenario I and Scenario II, the testing of the FTP model in Scenario VII is not necessary. Similarly, the testing of the FTP model in Scenario VIII and Scenario IX are also not discussed.

In Scenario I to VI, the ALCO sets transfer prices and designs bank managerial incentives. Other characteristics of the scenarios are presented as follows.

Scenario I

In Scenario I, funds are transferred externally in the fully decentralized bank. Bank business units make funds transactions with the external money markets. Business unit managers are given full authority to make their business decisions, which include the determination of the bank asset and liability business volumes and prices, and all the bank risk management decisions. The ALCO does not possess any bank risk management authority.

Scenario II

In Scenario II, funds are transferred internally within the fully decentralized bank. Bank funds are transferred between business units and the ALCO. Similar to Scenario I, business unit managers have full authority to make their business management decisions, and the ALCO has no bank risk management authority.

Scenario III

In Scenario III, funds are transferred externally in the fully centralized bank. Bank business units make funds transactions with the external money markets. Business unit managers are given no authority to make their business management decisions. The ALCO has full bank risk management authority and determines the bank's asset and liability business volumes and prices.

Scenario IV

In Scenario IV, funds are transferred internally within the fully centralized bank. Bank funds are transferred between business units and the ALCO. Similar to Scenario III, business unit managers have no authority to make their business management decisions. The ALCO controls all the bank business decision-making authority.

Scenario V

In Scenario V, funds are transferred externally in the partially decentralized bank.

Bank business units make funds transactions with the external money markets. Business unit managers are given some authority to make their bank risk management decisions. The ALCO possesses the remaining risk management authority, and determines the bank's asset and liability business volumes and prices.

Scenario VI

In Scenario VI, funds are transferred internally within the partially decentralized bank. Funds are transferred between business units and the ALCO. Similar to Scenario V, business unit managers have some risk management decision-making authority, and the ALCO has the remaining decision-making authority.

It is necessary to make a summary of the characteristics of each scenario so that the different scenarios can be compared. The summary is presented in Table 9.2.

Table 9.2: A Summary of the Characteristics of the Scenarios

	Types of Bank Form	Types of Funds Transfer	Individuals Involved	Responsibility Assignments
Scenario I	Fully decentralized	External transfer	Business units External markets	Unit managers: Full authority The ALCO: No authority
Scenario II	Fully decentralized	Internal transfer	Business units The ALCO	Unit managers: Full authority The ALCO: No authority
Scenario III	Fully centralized	External transfer	Business units External markets	Unit managers: No authority The ALCO: Full authority
Scenario IV	Fully centralized	Internal transfer	Business units The ALCO	Unit managers: No authority The ALCO: Full authority
Scenario V	Partially decentralized	External transfer	Business units External markets	Unit managers: Some authority The ALCO: Remaining authority
Scenario VI	Partially decentralized	Internal transfer	Business units The ALCO	Unit managers: Some authority The ALCO: Remaining authority

As the primary aim of the bank FTP model developed in this thesis is to achieve the objectives of effective bank risk management and accurate bank performance measurement, the following sections testify whether the FTP model fulfils these

objectives in the six scenarios presented in Table 9.2.

9.3 Implications of the Funds Transfer Pricing Model in the Fully Decentralized Bank

In the fully decentralized bank, The ALCO assigns all the decision-making authority to the business units, determines funds transfer prices, and set the performance evaluation and reward system. Business units' managers need to control all the risk involved in their businesses.

9.3.1 Scenario I: External Funds Transfer within the Fully Decentralized Bank

According to the characteristics of Scenario I designed in the previous section, the liability units sell funds to the external money markets, and the asset units buy funds from the external money markets. The following discusses the implications of the bank FTP model in Scenario I.

Application of the Bank FTP Model

In Scenario I, the liability and asset units have been given full authority to manage the risks involved in their funds transactions. To derive the funds transfer prices for the assets and liabilities, the bank FTP model developed in Chapter Seven is reiterated as follows:

$$FTP_{Liability} = \text{Base FTP} - \text{Liability } RP_{Uncon} \tag{9.1}$$

$$FTP_{Asset} = \text{Base FTP} + \text{Asset } RP_{Uncon} \tag{9.2}$$

(1) The liability unit performance evaluation. Equation 9.1 assumes that the risks beyond the control of the liability units are transferred to the ALCO. However, in Scenario I, no risks are transferred to the ALCO. Thus the funds transfer price for the liability is derived as:

$$\begin{aligned} FTP_{Liability} &= (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) + \text{Liability } RP_{Uncon} \\ &= \text{Base } FTP_{Liability} \end{aligned} \tag{9.3}$$

The NIM of the liability is the difference between the funds transfer price and the market price of the liability:

$$\begin{aligned} NIM_{Liability} &= FTP_{Liability,} - \text{Market Price}_{Liability} \\ &= \text{Base } FTP_{Liability} - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) \\ &= \text{Liability } RP_{Total} \end{aligned} \tag{9.4}$$

As discussed in the previous chapter, the market price of the liability is the difference between the base FTP and the total risk premiums for the liability. Equation 9.4 shows that the FTP model enables all the liability business profit contributions to be allocated to the liability units. This is due to the reason that the liability units are no longer transferring the risks beyond their control to the ALCO. Therefore, the liability units are credited for managing all the liability risks.

(2) The asset unit performance evaluation. In Equation 9.2, the FTP model attempts to transfer the risks beyond the control of the asset units to the ALCO. However, in Scenario I, instead of transferring the risks to the ALCO, the asset units manage all the risks involved in their asset businesses. Thus, based on Equation 9.2, the funds transfer price for the asset is derived as follows:

$$\begin{aligned} FTP_{Asset} &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) - \text{Asset } RP_{Uncon} \\ &= \text{Base } FTP_{Asset} \end{aligned} \tag{9.5}$$

With the funds transfer price derived, the NIM of the asset can be calculated as follows:

$$\begin{aligned} NIM_{Asset} &= \text{Market Price}_{Asset} - FTP_{Asset} \\ &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) - \text{Base } FTP_{Asset} \\ &= \text{Asset } RP_{Total} \end{aligned} \tag{9.6}$$

As discussed in the previous chapter, the market price of the asset in Equation 9.6 is the sum of the base FTP and the total risk premiums for the asset. The derivation of the NIM with Equation 9.6 shows that the FTP model assigns all the asset

business profit contributions to the asset units. This is because the asset units are no longer transferring the risks beyond their control to the ALCO. Thus asset units are rewarded for managing all the risks involved in their business transactions.

(3) The ALCO performance evaluation. In Scenario I, as the ALCO is not involved in making any business decisions, no NIM is allocated to the ALCO.

Implications of the FTP Model

In Scenario I, bank liability units sell funds to the external money markets, and bank asset units buy funds from the external money markets. As the external money markets are competitive, the liability units can sell as much funds as they have to the markets, and the asset units can buy as much funds as they want from the markets. Therefore, no asset and liability mismatch risks exist in the bank. In this scenario, the mismatch risks of the bank are indeed assumed by the external money markets. However, three disadvantages are found from the applications of the bank FTP model in this scenario.

(1) Disadvantage one: the bank FTP model cannot achieve effective risk management. Due to the bounded rationality, bank business unit managers generally do not have the capabilities to control all the risks involved in their businesses. Thus business units' uncontrollable risks should be transferred out of the business units. Both Equation 9.3 and 9.5 show that the bank FTP model in Scenario I does not decompose the total risks into the business units' controllable and uncontrollable risks. This makes the FTP model unable to transfer the business unit's uncontrollable risks to the ALCO.

In this circumstance, business unit managers may not perform well because of the uncontrollable risks they are managing. Thus the bank actually penalizes these business units for managing the uncontrollable risks and encourages them to turn their focus away from their primary tasks toward the risks that they do

not have the ability to manage. Therefore, the bank FTP model is not effective in risk management in Scenario I.

(2) Disadvantage two: the application of the bank FTP model in Scenario I may result in poor bank performance measurement. Funds transfer prices are determined by the ALCO, however, business unit managers possess all the information related to the inputs to the bank FTP model. Therefore, the ALCO needs to obtain the information from the business units to generate transfer prices. In a bank, funds providers try to maximize the transfer prices for the funds transferred, and the funds users try to minimize the transfer prices for the funds transferred to them. In these circumstances, due to the opportunism, business unit managers may engage in private information withholding and misrepresentation, which may result in sub-optimization. Inputting the inaccurate information in the bank FTP model may generate poor funds transfer prices. This results in inappropriate business units' performance evaluation, which may cause poor bank managerial incentive design.

On the other hand, according to Equation 9.4 and Equation 9.6, the bank FTP model allocates all the risk premiums to the business unit managers. Thus the managers' performances are measured based on some uncontrollable risk factors. As discussed previously, the results from the performance measurement are used to determine the provisions of the managerial incentive system. The inappropriate performance measurement may result in poor managerial incentive design, which may cause detriment to the bank as a whole.

(3) Disadvantage three: the bank asset and liability prices offered to the external clients are not competitive. As shown from the empirical investigations conducted in Chapter Five, funds transfer prices are generally used for the purpose of bank product pricing. The cost of risks and business mark-up are also considered in the asset and liability prices. Asset units are charged for

using funds, and funds transfer prices are the cost component for the assets. Liability units are credited for providing funds, and funds transfer prices are the revenue component for the liabilities. Based on the funds transfer prices provided by the ALCO, bank unit managers determine asset and liability prices as follows:

$$\begin{aligned}\text{Asset Price} &= FTP_{Asset} + RP + \text{Business Mark-up} \\ &= FTP_{Asset} + \text{Asset } RP_{Total} + \text{Business Mark-up} \qquad (9.7)\end{aligned}$$

$$\begin{aligned}\text{Liability Price} &= FTP_{Liability} - RP - \text{Business Mark-up} \\ &= FTP_{Liability} - \text{Liability } RP_{Total} - \text{Business Mark-up} \qquad (9.8)\end{aligned}$$

According to the concept of the VaR contribution discussed in Chapter Four, the aggregation of the stand-alone VaR for each bank instrument is generally larger than the total VaR required by a bank. This is because a portfolio of bank instruments can produce risk diversification effects. In Scenario I, no bank funds transit through the internal money markets. Thus the bank does not benefit from risk diversification effects. In this circumstance, the EC allocated to the business unit managers is higher than their actual EC requirements. According to the bank FTP model, the higher the EC is, the higher the Asset RP_{Total} is for the asset instruments. This makes the asset prices generated with Equation 9.7 higher than the external market prices. Therefore, the bank's asset prices are not competitive in the external banking asset markets. This would affect the bank's market shares of its asset businesses; thereby reduce the bank's profitability.

On the other hand, the higher the EC is, the higher the Liability RP_{Total} is for the liability instruments. This makes the bank's liability prices derived with Equation 9.8, lower than the external market liability prices. As lower bank liability prices are not competitive in the liability markets, the bank's liability business market shares would be unfavorably affected. This would also reduce

the bank's profitability.

9.3.2 Scenario II: Internal Funds Transfer within the Fully Decentralized Bank

In Scenario II, the funds obtained by the liability units are transferred to the internal money markets, from which the funds are then transferred to the asset units. In this type of bank, the ALCO functions as a clearinghouse. The ALCO actively trades funds with the external money markets to adjust the funding balances of the whole bank, but it does not control any risks. In this circumstance, the ALCO functions essentially the same as the external money markets.

Application of the bank FTP Model

In Scenario II, the liability and asset units are also given full authority to manage the risks involved in their funds transactions. Therefore, the funds transfer prices generated with the bank FTP model are the same as those derived in Scenario I.

(1) The liability unit performance evaluation. The funds transfer price for the liability is reiterated from Equitation 9.3:

$$FTP_{Liability} = (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) + \text{Liability } RP_{Uncon}$$

$$= \text{Base } FTP_{Liability}$$

The NIM of the liability is the difference between the funds transfer price and the market price of the liability:

$$NIM_{Liability} = FTP_{Liability,} - \text{Market Price}_{Liability}$$

$$= \text{Base } FTP_{Liability} - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total})$$

$$= \text{Liability } RP_{Total}$$

(2) The asset unit performance evaluation. The funds transfer price for the asset is reiterated from Equation 9.5:

$$FTP_{Asset} = (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) - \text{Asset } RP_{Uncon}$$

$$= \text{Base FTP}_{\text{Asset}}$$

The NIM of the asset is the difference between the market price of the asset and the funds transfer price:

$$\text{NIM}_{\text{Asset}} = \text{Market Price}_{\text{Asset}} - \text{FTP}_{\text{Asset}}$$

$$= (\text{Base FTP}_{\text{Asset}} + \text{Asset RP}_{\text{Total}}) - \text{Base FTP}_{\text{Asset}}$$

$$= \text{Asset RP}_{\text{Total}}$$

The NIM calculation above shows that all the profit contributions are assigned to the business units. This reflects the fact that all the risks are managed by the business units' managers. However, in this case, the NIM for the ALCO needs to be examined as the ALCO is involved in the internal funds transfer transactions.

(3) The ALCO performance evaluation. The NIM for the ALCO is the difference between the money market price and the funds transfer price. When there are any funds left after transferring the funds to the asset units, the ALCO can sell the surplus funds to the external money market, and the NIM for the ALCO is:

$$\text{NIM}_{\text{ALCO}} = \text{LIBOR} - \text{FTP}_{\text{Liability}}$$

$$= \text{Base FTP}_{\text{Liability}} - \text{Base FTP}_{\text{Liability}}$$

$$= 0$$

When there is any deficit of the funds, the ALCO may buy the funds from the external money market, and the NIM of the ALCO is:

$$\text{NIM}_{\text{ALCO}} = \text{FTP}_{\text{Asset}} - \text{LIBOR}$$

$$= \text{Base FTP}_{\text{Asset}} - \text{Base FTP}_{\text{Asset}}$$

$$= 0$$

The above calculations indicate that the total NIM for the ALCO is 0. This confirms the fact that the ALCO does not hold any responsibility of managing bank risks, thus the FTP model does not allocate any risk premiums to the ALCO.

Implications of the Bank FTP Model

No advantages are found from the application of the bank FTP model in Scenario II. Instead, four disadvantages of the FTP model are discovered. The first three of them are the same as those found in Scenario I, and outlined as follows:

(1) The FTP model cannot be applied to effectively manage bank risks. Similar to the first disadvantage found in Scenario I, the FTP model does not decompose the whole risks involved in funds transaction into the business units' controllable and uncontrollable risks, thus the model cannot be applied to assign the risks to the business units that have control over the risks.

(2) The FTP model cannot properly measure the performance of banking businesses. Similar to the second disadvantage found in Scenario I, there is also information withholding issues in Scenario II and the business units' performances are measured based on some factors beyond their control. Therefore, bank managerial incentive system may not be properly designed.

(3) The funds transfer prices produced with the FTP model also lead to the uncompetitive bank asset or liability prices. This is because the business unit managers determine bank asset and liability prices, and the managers do not consider bank risk diversification effects when they are determining their prices. For example, the liability unit managers determine their liability prices solely based on the risk factors involved in their liability businesses and the risk factors involved in the bank's asset businesses are not considered. Therefore, the risk diversification effects generated from combining the bank's assets and liabilities are not considered in the liability price derivation.

In addition to the three disadvantages found in Scenario I, one more disadvantage of the bank FTP model is found in Scenario II.

(4) When the FTP model is applied in Scenario II, mismatch risks are left unmanaged. As discussed in the previous chapter, the NIM of banking businesses generally consists of NIM from the assets and liabilities, and the mismatch spread. The application of the FTP model in this scenario shows that the NIM for the whole bank only consists of the NIM for the assets and liabilities. The model does not allocate the mismatch risks to the business unit managers, although they are determined to manage all the bank risks, including the mismatch risks.

With the FTP model, liability unit managers only manage their liability risks, and asset unit managers only manage their asset risks. Both managers do not consider the mismatch risks incurred from assets and liability duration mismatching. As the ALCO does not control any risks, the mismatch risks are left unmanaged. Due to the opportunism and business unit managers' freedom to determine their business volumes, both liability and asset units' managers may conduct large amount banking businesses so that they may get large rewards. In this circumstance, the mismatch risks could become large and deteriorate the bank's risk position as a whole. Therefore, the FTP model is not effective in mismatch risk management in Scenario II.

9.4 Implications of the Funds Transfer Pricing Model in the Fully Centralized Bank

In the fully centralized bank, the ALCO controls all the risks involved in bank funds transactions, and business unit managers are given no risk management authority. The ALCO gives the business units instructions on making funds transactions. With the instructions, business unit managers conduct funds transactions and do not deal with any risks. In this bank, the ALCO determines funds transfer prices and designs the bank's managerial incentive system.

9.4.1 Scenario III: External Funds Transfer within the Fully Centralized Bank

In Scenario III, according to the instructions given by the ALCO, both asset and liability units make funds transactions with the external money market. The ALCO decides risk-hedging strategies to balance the whole bank's risk position.

Application of the Bank FTP Model

(1) The liability unit performance evaluation. In Scenario III, the ALCO controls all the risks involved in the liability businesses. Thus, both the liability unit controllable and uncontrollable risks are transferred to the ALCO. In this circumstance, based on Equation 9.1, the funds transfer price for the liability is:

$$\begin{aligned} FTP_{Liability} &= (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) - \text{Liability } RP_{Con} \\ &= \text{Base } FTP_{Liability} - \text{Liability } RP_{Total} \end{aligned} \tag{9.9}$$

The NIM of the liability is derived as follows[15]:

$$\begin{aligned} NIM_{Liability} &= FTP_{Liability} - \text{Market Price}_{Liability} \\ &= (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) \\ &= 0 \end{aligned} \tag{9.10}$$

The NIM derived with Equation 9.10 shows that the FTP model does not assign any liability business profit contributions to the liability units. This is because the liability units transfer all their risks to the ALCO and no longer manage the risks under their control. Accordingly, the liability unit managers are not rewarded for incurring the risks under their control.

(2) The asset unit performance evaluation. Equation 9.2 shows that asset units transfer the risks beyond their control to the ALCO, but manage the risks under their control. However, in Scenario III, all the risks are transferred to the ALCO. Therefore, based on Equation 9.2, the funds transfer price for the asset is derived as

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[15] As the NIM for the asset instruments does not consider any business mark-up, the NIM for the asset is 0.

follows:

$$\begin{aligned} FTP_{Asset} &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) + \text{Asset } RP_{Con} \\ &= \text{Base } FTP_{Asset} + \text{Asset } RP_{Total} \end{aligned} \tag{9.11}$$

With the funds transfer price derived, the NIM for the assets is:

$$\begin{aligned} NIM_{Asset} &= \text{Market Price}_{Asset} - FTP_{Asset} \\ &= \text{Base } FTP_{Asset} + \text{Asset } RP_{Total} - (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) \\ &= 0 \end{aligned} \tag{9.12}$$

The NIM derived with Equation 9.12 shows that the FTP model assigns no asset business profit contributions to the asset units since all the risks are centrally managed by the ALCO. The asset units are not rewarded any profits since they transfer all their risks to the ALCO and does not manage any risks.

(3) The ALCO performance evaluation. When the ALCO instructs the liability units to purchase funds from the external clients, and then sell the funds to the external money markets, the NIM for the ALCO is the difference between money market price and the liability price.

$$\begin{aligned} NIM_{ALCO} &= \text{LIBOR} - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) \\ &= \text{Base } FTP_{Liability} - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) \\ &= \text{Liability } RP_{Total} \end{aligned} \tag{9.13}$$

Similarly, the NIM for the ALCO from the asset business is:

$$\begin{aligned} NIM_{ALCO} &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) - \text{LIBOR} \\ &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) - \text{Base } FTP_{Asset} \\ &= \text{Asset } RP_{Total} \end{aligned} \tag{9.14}$$

According to the ALCO NIM calculations with Equation 9.13 and Equation 9.14, the FTP model ensures that all the asset and liability business profit contributions are allocated to the ALCO. As all the funds purchased by the liability units are sold

directly to the external money markets, and all the funds used by the asset units are directly bought from the external money markets, no mismatch risks exists within the bank. However, the mismatch risks exist in Scenario IV.

Implications of the Bank FTP Model

According to Equation 9.11 and 9.12, the bank FTP model ensures that all the business profit contributions are allocated to the ALCO since all the risks are centrally managed by the ALCO. The FTP model also ensures that the business unit managers are not rewarded since the managers do not control any risks. No advantages are discovered from the applications of the FTP model in Scenario III. Instead, three disadvantages of the FTP model are found in this scenario.

(1) Disadvantage one: the application of the FTP model in Scenario III leads to the ineffective bank risk management. Due to the bounded rationality, the ALCO may not have the capabilities to manage all the risks involved in the business unit funds transactions. For example, the ALCO generally does not have as much information on the credibility of the customers as the business unit managers who establish close relationships with the customers. Thus the ALCO may not effectively manage credit risks associated with the business transactions.

Both Equation 9.9 and 9.11 indicate that the FTP model does not separate the business units' controllable risks from the overall risks. This makes the FTP model unable to assign the business unit controllable risks to the business units. Instead, these risks are transferred to the ALCO, who may not have the capabilities to manage these risks. Therefore, in Scenario III, the FTP model is not effective in bank risk management.

(2) Disadvantage two: the application of the FTP model in this type of the bank results in poor performance measurement. Equation 9.13 and Equation 9.14

shows that the FTP model allocates all the bank business profits to the ALCO. As the ALCO may not effectively manage all the business risks, the ALCO performance is measured based on some risk factors beyond its control. This may results in poor performance measurement of the ALCO.

On the other hand, according to Equation 9.10 and Equation 9.12, business units are not credited for incurring the risks under their control. The performances of the business unit mangers are not measured based on all the factors under their control and do not reflect the amount that business unit activities contribute to the pool of the overall bank profits. The inappropriate performance measurement may results in poor managerial incentive design. This may not motivate business unit managers to pursue their own self-interest in a manner that is conducive to the success of the bank as a whole.

(3) Disadvantage three: the application of the FTP model makes the bank's asset and liability prices not competitive. The uncompetitive prices results from the unfavorable funds transfer prices, which are generated without considering the risk diversification effects. For Equation 9.9 and Equation 9.11, the higher the EC is, the higher the transfer prices are for the asset instruments and the lower transfer prices are for the liability instruments. As discussed in Scenario I, these make the bank asset and liability prices uncompetitive in the external banking business markets and the bank's profits may be decreased.

9.4.2 Scenario IV: Internal Funds Transfer within the Fully Centralized Bank

In Scenario IV, the funds purchased by the liability units from external liability clients are transferred to the asset units through the ALCO. The ALCO functions as both a clearinghouse and a risk manager. Therefore, the ALCO not only adjusts the funding balances of the whole bank, but also controls any risks involved in the funds transactions.

Application of the Bank FTP Model

The funds transfer prices generated by the bank FTP model in this case are different from those derived in Scenario III. When all the bank assets and liabilities transit through the ALCO, the ALCO benefits from the risk diversification effects. Therefore, the total risk premiums for each bank instrument are less than those derived without considering the risk diversification effects.

(1) The liability unit performance evaluation. As both the liability unit controllable and uncontrollable risks are transferred to the ALCO, based on Equation 9.1, the funds transfer price for the liability is:

$$\begin{aligned} FTP_{Liability} &= (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) - \text{Liability } RP_{Con} \\ &= \text{Base } FTP_{Liability} - \text{Liability } RP_{Total} \end{aligned} \tag{9.15}$$

The Liability RP_{Total} in Equation 9.15 is less than that in Equation 9.9 due to the risk diversification effects. Therefore, the funds transfer prices derived with Equation 9.15 is higher than the price derived with Equation 9.9. The NIM of the liability is derived as follows:

$$\begin{aligned} NIM_{Liability} &= FTP_{Liability} - \text{Market Price}_{Liability} \\ &= (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) \\ &= 0 \end{aligned} \tag{9.16}$$

The NIM for the liability in this case is the same as that derived in Scenario III. This is due to the same reason that the liability units no longer manage the risks under their control. Therefore, the FTP model does not assign any profits to the liability units.

(2) The asset unit performance evaluation. The equation used to generate funds transfer prices in this case is the same as the one derived in Scenario III.

$$\begin{aligned} FTP_{Asset} &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) + \text{Asset } RP_{Con} \\ &= \text{Base } FTP_{Asset} + \text{Asset } RP_{Total} \end{aligned} \tag{9.17}$$

As the Asset RP_{Total} in Equation 9.17 is less than that in Equation 9.11, the funds transfer price derived with Equation 9.17 is lower than that derived with Equation 9.11. The NIM of the asset is calculated as:

$$\begin{aligned} NIM_{Asset} &= \text{Market Price}_{Asset} - FTP_{Asset} \\ &= \text{Base } FTP_{Asset} + \text{Asset } RP_{Total} - (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) \\ &= 0 \end{aligned} \tag{9.18}$$

The NIM for the asset units is 0 since the asset managers do not deal with any risks. Therefore, the FTP model does not allocate any profits to the managers.

(3) The ALCO performance evaluation. As all the funds transactions transit through the ALCO, bank asset and liability mismatch risks exist. The ALCO takes the responsibility of managing the mismatch risks. As discussed in the previous chapter, the NIM of the ALCO is the difference between the funds transfer prices for the assets and those for the liabilities. With Equation 9.9 and Equation 9.11, the NIM for the ALCO is derived as follows:

$$\begin{aligned} NIM_{ALCO} &= FTP_{Asset} - FTP_{Liability} \\ &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) \\ &= \text{Asset } RP_{Total} + \text{Liability } RP_{Total} + (\text{Base } FTP_{Asset} - \text{Base } FTP_{Liability}) \\ &= \text{Asset } RP_{Total} + \text{Liability } RP_{Total} + \text{Mismatch Spread} \end{aligned} \tag{9.19}$$

Equation 9.19 shows that the ALCO is rewarded from managing not only all the risks incurred by the business units, but also the mismatch risks.

Implications of the Bank FTP Model

Two advantages of the bank FTP model are found from the application of the model in Scenario IV.

(1) Advantage one: the FTP model ensures that bank asset and liability prices are competitive in the external banking business markets. With the FTP model, the

bank asset and liability prices offered to the external clients become more competitive compared with those derived in Scenario III. The liability price is higher because of the higher funds transfer prices. Higher prices offered to the clients for buying their funds would make the liability prices more competitive. On the other hand, the asset price becomes lower due to lower funds transfer prices. Lower prices charged the customers for selling funds to them would make the asset prices more competitive.

(2) Advantage two: the FTP model enables bank mismatch risks to be properly managed. When the mismatch risks are centrally managed by the ALCO who have the capabilities to control the risks, the FTP model ensures that the mismatch spreads are allocated to the ALCO. Therefore, bank mismatch risks are effectively managed and the ALCO is rewarded for managing the risks.

However, the application of the FTP model in Scenario IV also suffers from the first two disadvantages found in Scenario III.

(1) Disadvantage one: the FTP model cannot effective manage bank risks. This is because the FTP model is unable to separate the business units' controllable risks from their uncontrollable risks. Due to the bounded rationality, the ALCO may not effectively manage all the risks. The ALCO may manage the risks that can be effectively controlled by the business units.

(2) Disadvantage two: the application of the FTP model in Scenario IV may result in poor performance measurement. The business unit mangers' performances are not evaluated based on the factors under their control. On the other hand, the ALCO performance is measured on some factors beyond their control. These may results in poor bank managerial incentive design.

9.5 Implications of the Funds Transfer Pricing Model in the Partially Decentralized Bank

In the partially decentralized bank, the ALCO controls some risks involved in business transactions, and business unit managers are given the authority to manage the remaining risks in the transactions. The ALCO manages the risks that it has capability to control. Similarly, the business unit managers are given the risk management authority to deal with the risks under their control. Thus the FTP model should be capable of decomposing the whole bank risks and properly assign the decomposed risks among the business units. In this type of bank, the ALCO determines the transfer prices and designs the bank's managerial incentive system.

9.5.1 Scenario V: External Funds Transfer within the Partially Decentralized Bank

In Scenario V, the ALCO is not directly involved in conducting bank funds transactions, but give instructions on funds transaction volumes and prices. The ALCO also needs to manage business units' uncontrollable risks, and plays the role of balancing the bank's overall risk position.

Application of the Bank FTP Model

(1) The liability unit performance evaluation. In Scenario V, the ALCO manages the risks beyond the control of the liability business units. Thus, the liability unit's uncontrollable risks are transferred to the ALCO. In this circumstance, the funds transfer price for the liability is derived as:

$$FTP_{Liability} = \text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon} \tag{9.20}$$

Equation 9.20 is the same as Equation 9.1. This is the bank FTP model developed in this thesis. The NIM of the liability is the difference between the funds transfer price and market price for the liability:

$$NIM_{Liability} = FTP_{Liability} - \text{Market Price}_{Liability}$$

$$= (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total})$$

$$= \text{Liability } RP_{Con} \tag{9.21}$$

The calculation in Equation 9.21 shows that the FTP model ensures all the premiums for the risks under the control of the liability unit are assigned to the liability unit. Thus the liability unit managers are credited for incurring and managing the risks under their control.

(2) The asset unit performance evaluation. Similarly, the Equation used for generating transfer prices for the assets in this bank is the same as Equation 9.2 and is reiterated as follows:

$$FTP_{Asset} = \text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon} \tag{9.22}$$

The NIM of the asset is the difference between the market price and funds transfer price of the asset:

$$\begin{aligned} NIM_{Asset} &= \text{Market Price}_{Asset} - FTP_{Asset} \\ &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) - (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) \\ &= \text{Asset } RP_{Con} \end{aligned} \tag{9.23}$$

According to Equation 9.23, the FTP model ensures that the asset unit managers are rewarded for managing the risks under their control.

(3) The ALCO performance evaluation. The NIM for the ALCO is the difference between the money market price and the funds transfer price for the liability.

$$\begin{aligned} NIM_{ALCO} &= \text{LIBOR} - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) \\ &= \text{Base } FTP_{Liability} - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) \\ &= \text{Liability } RP_{Uncon} \end{aligned} \tag{9.24}$$

In Scenario V, the ALCO instructs business unit managers to conduct funds transactions. The ALCO also involved in managing the risks beyond the control of the liability units. Therefore, the ALCO is rewarded for managing the liability

transactions.

Similarly, the ALCO also involved in managing asset businesses. The NIM for the ALCO from the asset business is:

$$NIM_{ALCO} = (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) - \text{LIBOR}$$

$$= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) - \text{Base } FTP_{Asset}$$

$$= \text{Asset } RP_{Uncon} \qquad (9.25)$$

The ALCO NIM calculations with Equation 9.24 and Equation 9.25 show that the FTP model ensures that the ALCO is rewarded from managing the business units' uncontrollable risks.

Implications of the Bank FTP Model

Application of the bank FTP model in Scenario V discovers that the model has two advantages as discussed below.

(1) Advantage one: the application of the FTP model in Scenario V leads to effective bank risk management. According to 9.20 and 9.22, the FTP model decomposes the whole bank risks into business units' controllable and uncontrollable risks. This would facilitate the business units' uncontrollable risks to be transferred to the ALCO. In this scenario, business units' managers have the capabilities of controlling the risks assigned to them, and are delegated the authority to deal with the risks. Thus the business units can effectively manage their risks. On the other hand, the ALCO manages all the risks beyond the control of the business units. In these circumstances, all the bank risks can be effectively managed.

(2) Advantage two: the application of the FTP model in this bank results in proper performance measurement. According to Equation 9.21, Equation 9.23, Equation 9.24 and Equation 9.25, all the premiums for the risks under the

control of business units are assigned to the units' managers who take the responsibility of dealing with the risks. The performances of these mangers are measured based on their controllable factors and reflect the amount that business unit activities contribute to the bank's profits as a whole. The appropriate performance measurement may results in proper managerial incentive design, which may motivate business unit managers to make profit contributions to the bank as a whole.

However, the bank FTP model in Scenario V suffers from one disadvantage. As the bank's business transactions do not transit through the internal money markets, the bank does not benefit from the risk diversification effects. Thus, similar to the disadvantage found in the application of the FTP model in Scenario I and Scenario III, the bank asset and liability prices determined based on the FTP model are also not competitive. This would adversely affect the bank's business market shares; thereby reduce the bank's profitability.

9.5.2 Scenario VI: Internal Funds Transfer within the Partially Decentralized Bank

In Scenario VI, business units make funds transactions with the external clients, and manage the risks under their control. The ALCO take the responsibility of balancing the bank's funds and managing the risks beyond the control of the business units.

Application of the Bank FTP Model

For the funds transferred internally, the equation for generating the transfer prices have the same form as those derived in Scenario V. However, as all the assets and liabilities transit through the ALCO, the ALCO inputs the FTP model with the data considering the risk diversification effects. This makes the funds transfer prices derived in Scenario VI are different from those derived in Scenario V.

(1) The liability unit performance evaluation. With the FTP model, the funds transfer prices for the liabilities are derived as follows:

$$FTP_{Liability} = \text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon} \quad (9.26)$$

Due to the risk diversification effects, the Liability RP_{Uncon} in Equation 9.26 is less than that derived with Equation 9.20. Thus the funds transfer price derived with Equation 9.26 is higher than that derived with Equation 9.20. The NIM of the liability is derived as:

$$\begin{aligned} NIM_{Liability} &= FTP_{Liability} - \text{Market Price}_{Liability} \\ &= (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Total}) \\ &= \text{Liability } RP_{Con} \end{aligned} \quad (9.27)$$

Equation 9.27 shows that all the premiums for the risks under the control of the liability units are assigned to the liability units. The liability units' managers are rewarded from managing their controllable risks.

(2) The asset unit performance evaluation. With the FTP model, the funds transfer prices for the assets are derived as:

$$FTP_{Asset} = \text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon} \quad (9.28)$$

Similarly, due to the risk diversification effects, the Asset RP_{Uncon} in Equation 9.28 is less than that in Equation 9.22. This makes the transfer price derived with the Equation 9.28 lower than that derived with Equation 9.22. The NIM of the asset unit is:

$$\begin{aligned} NIM_{Asset} &= \text{Market Price}_{Asset} - FTP_{Asset} \\ &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Total}) - (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) \\ &= \text{Asset } RP_{Con} \end{aligned} \quad (9.29)$$

According to Equation 9.29, all the premiums for the risks under the control of the asset unit are assigned to the asset unit. Thus, the FTP model ensures that the asset

managers are rewarded for managing their controllable risks.

(3) The ALCO performance evaluation. The ALCO gives business units instructions on making funds transaction and is involved in managing the risks incurred from the funds transactions. The NIM of the ALCO is the difference between the funds transfer price for the assets and that for the liabilities.

$$\begin{aligned} NIM_{ALCO} &= FTP_{Asset} - FTP_{Liability} \\ &= (\text{Base } FTP_{Asset} + \text{Asset } RP_{Uncon}) - (\text{Base } FTP_{Liability} - \text{Liability } RP_{Uncon}) \\ &= \text{Asset } RP_{Uncon} + \text{Liability } RP_{Uncon} + (\text{Base } FTP_{Asset} - \text{Base } FTP_{Liability}) \\ &= \text{Asset } RP_{Uncon} + \text{Liability } RP_{Uncon} + \text{Mismatch Spread} \end{aligned} \quad (9.30)$$

Equation 9.30 shows that the FTP model enables all the premiums for the risks beyond the control of business units and the mismatch spread to be allocated to the ALCO. This is because the ALCO takes the responsibility of managing these risks.

Implications of the Bank FTP Model

Four advantages are found from the application of the FTP model in Scenario VI. Three of them are the same as those found in Scenario V, and outlined as follows:

(1) Advantage one: the FTP model achieves effective bank risk management. According to Equation 9.26 and Equation 9.28, the FTP model ensures that bank risks are properly decomposed. These facilitate the risks beyond the control of business units are transferred to the ALCO. With the assigned risk management authority, business units may effectively manage the risks under their control.

(2) Advantage two: the FTP model achieves appropriate bank performance measurement. According to Equation 9.27, Equation 9.29 and Equation 9.30, business units and the ALCO performances are measured based on their controllable factors. The appropriate performance measurement may results in

proper managerial incentive design.

(3) Advantage three: the FTP model ensures that the mismatch risks are properly managed by the ALCO. When the ALCO takes the responsibility of managing the mismatch risks, according to Equation 9.30, the FTP model ensures that the ALCO is rewarded for managing the mismatch risks.

In addition to the above three advantages, the application of the FTP model in Scenario VI found one more advantage of the FTP model.

(4) Advantage four: the FTP model ensures that the bank's asset and liability prices are competitive. According to Equation 9.26, the liability price offered to the external clients is higher because of the higher transfer price for the liability. According to Equation 9.28, the asset price charged on the external clients becomes lower due to the lower funds transfer prices for the asset. These may make bank asset and liability prices competitive in the external bank business markets, and thereby may improve the bank's profitability.

The application of the bank FTP model in Scenario VI shows great advantages of the FTP model. The following section gives a generalization of the advantages and disadvantages of the FTP model in the different scenarios.

9.6 Comparisons of the Applications of the Funds Transfer Pricing Model in the Different Scenarios

This section summarizes and compares the functions achieved from applying the bank FTP model for both internal and external funds transfer within the different types of banks. The FTP model is applied in the different scenarios to find whether the model achieve effective risk management, proper bank performance evaluation, competitive bank asset and liability prices in the external banking business markets, and effective mismatch risk management. As previously discussed, for the external

funds transfer, no mismatch risks exist within the bank. Therefore, the FTP function of mismatch risk management is not compared for the external funds transfer within each type of the bank. The comparisons of the applications of the FTP model in the different scenarios are summarized and presented in Table 9.3.

Table 9.3: Comparisons of the Applications of the Funds Transfer Pricing Model in the Different Scenarios

	External Funds Transfer	Internal Funds Transfer
Fully Decentralized Bank	**Scenario I** **1. Effective risk management** Yes ☐ No ☑ **2. Proper performance evaluation** Yes ☐ No ☑ **3. Competitive Bank A/L prices** Yes ☐ No ☑	**Scenario II** **1. Effective risk management** Yes ☐ No ☑ **2. Proper performance evaluation** Yes ☐ No ☑ **3. Competitive Bank A/L prices** Yes ☐ No ☑ **4. Mismatch risks management** Yes ☐ No ☑
Fully Centralized Bank	**Scenario III** **1. Effective risk management** Yes ☐ No ☑ **2. Proper performance evaluation** Yes ☐ No ☑ **3. Competitive Bank A/L prices** Yes ☐ No ☑	**Scenario IV** **1. Effective risk management** Yes ☐ No ☑ **2. Proper performance evaluation** Yes ☐ No ☑ **3. Competitive Bank A/L prices** Yes ☑ No ☐ **4. Mismatch risks management** Yes ☑ No ☐
Partially Decentralized Bank	**Scenario V** **1. Effective risk management** Yes ☑ No ☐ **2. Proper performance evaluation** Yes ☑ No ☐ **3. Competitive Bank A/L prices** Yes ☐ No ☑	**Scenario VI** **1. Effective risk management** Yes ☑ No ☐ **2. Proper performance evaluation** Yes ☑ No ☐ **3. Competitive Bank A/L prices** Yes ☑ No ☐ **4. Mismatch risks management** Yes ☑ No ☐

Note: in this table, the functions checked by the "√ " denote that the FTP model achieves the functions. A/L stands for asset and liability.

Table 9.1 indicates that the bank FTP model is most effectively used in Scenario VI, the internal funds transfer within the partially decentralized bank. In Scenario VI, the FTP model ensures that bank risks are effectively managed and bank performances are properly measured. With the FTP model, bank asset and liability prices are competitive in the external banking business markets, and bank mismatch risks are properly managed. However, Table 9.1 presents that the FTP model is found ineffective in other five scenarios.

Table 9.1 shows that the FTP model is relatively more effective for the funds transferred internally than those transferred externally. According to the transaction cost economics theory discussed in Chapter Two, transactions tend to be made internally when the asset specificity is high, and the frequency and volume of the transactions are large. Commercial banks are found to have high asset specificity, and large frequency and volume of funds transactions. These are discussed below:

(1) Commercial banks have higher asset specificity. Bank asset managers have specialties in dealing with asset businesses, and they generally do not have the capabilities to make bank liability businesses. On the other hand, bank liability managers have specialties in making bank liability businesses, and they are generally not able to conduct bank asset businesses.

(2) As the intermediate products, banks internal funds have high transaction frequency and volume. Banks act as the intermediaries across markets for funds gathered and invested. They routinely receive and invest funds from their customers. Deposits and other funds flow into the banks through its numerous collection channels. These funds flow out through delivery channels for investment in loans and other financial assets. For example, banks generally have a great amount of deposits obtained from numerous external clients, and these deposits needs to be internally transacted to support bank asset businesses, such as commercial loans. Thus the frequency and volume of the

internal funds transactions are large.

In these circumstances, according to transaction cost economics theory, funds should be transferred internally. The empirical investigations conducted in this thesis also confirm the view that bank funds are required to be transferred internally. As the bank FTP model is more effective for the funds transactions made internally, the FTP model developed in this thesis has great practical value in managing current bank funds transactions.

9.7 Summary

This chapter attempts to apply the bank FTP model for the funds transferred internally and externally in the fully decentralized, fully centralized and partially decentralized bank. The FTP model is examined in six scenarios to find whether it achieves effective bank risk management, proper bank performance evaluation, competitive asset and liability prices in external banking business markets, and effective mismatch risk management.

The bank FTP model is found to achieve all the four functions for the internal funds transfer within the partially decentralized bank. However, the FTP model is found not to achieve all these functions in the other types of bank. Therefore, the model is not effective in these banks. The FTP model is found to be more effective for evaluating the funds transferred internally than those transferred externally. As current banks tend to transfer funds internally, the FTP model developed in this thesis has great practical value.

Chapter Ten: Bank Funds Transfer Price Derivation: A Case Study

10.1 Introduction

This chapter demonstrates how funds transfer prices are generated with the bank FTP model developed in this thesis. The funds transfer prices are then applied to measure the NIM and RAROC of bank business units and instruments. To demonstrate how funds transfer prices are generated, a case study of a Chinese commercial bank, Bank XYZ, has been conducted. The bank's name is anonymous due to the confidential reasons. This chapter also contrasts the FTP model developed in this thesis with the FTP method applied by Bank XYZ.

The first section of this chapter introduces the background of the Bank XYZ. This section describes the business activities of the bank. The second section illustrates the process of developing funds transfer prices at the bank instrument and business unit levels. The third section examines whether the FTP model is more effective in risk management than the bank's FTP method. The final section is the summary.

10.2 Bank XYZ Background

Bank XYZ is a state owned bank operating in a commercial capacity. To operate banking businesses and manage the risks associated with the business activities, Bank XYZ takes the decentralized organizational structure. Various branches are established to control a diversity of banking activities. The main business activities for the bank are to obtain deposits from customers and to make loans to customers.

Funds Transfer Pricing Policies in Bank XYZ

The main purpose of FTP for Bank XYZ is to motive branch managers to select bank products that bring profits to the bank. The interviewee indicated that the bank also attempts to manage bank risks with its FTP method. The interviewee stated that Bank XYZ applies single pool FTP method. Two funds transfer prices

are currently used in the bank, 3% is used for all the funds transactions in Chinese currency, RMB, and 5% is used for all the funds transactions in USD.

Bank XYZ Product Characteristics

The features of the major businesses for Bank XYZ are obtained from the telephone interview, and are presented in Table 10.1[16].

Table 10.1: The Features of the Main Products in Bank XYZ

Financial Products		Interest Rate Types	Cancellation of Contract	Characteristics of Cash Flows	Types of Risks Associated
Assets	Short Term Commercial Loans in RMB	Fixed Prime Rate	Withdrawal with Penalties	One Time Repayment at Maturity	CR, IRR, LR, and PR
	Long Term Commercial Loans in RMB	Fixed Prime Rate	Withdrawal with Penalties	One Time Repayment at Maturity	CR, IRR, LR, and PR
	Mortgages in USD	Fixed Rated Linked to LIBOR	Withdrawal at Any Time	Monthly Interests and Principals Repayment	CR, IRR, LR, PR and ERR
	Short Term Commercial Loans in USD	Fixed Rated Linked to LIBOR	Withdrawal with Penalties	One Time Repayment at Maturity	CR, IRR, LR, PR and ERR
Liabilities	Short Term Deposits in RMB	Fixed Prime Rate	Withdrawal at Any Time	One Time Repayment at Maturity	IRR, LR, and WR
	Long Term Deposits in RMB	Fixed Prime Rate	Withdrawal with Penalties	One Time Repayment at Maturity	IRR, LR, and WR
	Short Term Deposits in USD	Fixed Rated Linked to LIBOR	Withdrawal at Any Time	One Time Repayment at Maturity	IRR, LR, WR, and ERR
Assets/ Liabilities	Short Term Interbank Loans	Negotiated Market Rates	No Withdrawal	One Time Repayment at Maturity	Limited IRR

Table 10.1 shows that six risk variables, which consist of interest rate risk, liquidity risk, credit risk, prepayment risk, withdrawal risk and exchange rate risk, are involved in the bank's businesses. The interviewee stated that interest rate risk and credit risk are the major risks that Chinese commercial banks face. According to the interviewee, the Chinese interbank market is a very actively traded fund market, and most Chinese commercial banks take the view that there are almost no risks

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[16] In the tables and equations of this chapter, **IRR** stands for interest rate risk, **LR** for liquidity risk, **CR** for credit risk, **PR** for prepayment risk, **WR** for withdrawal risk, and **ERR** for exchange rate risk.

associated with the interbank loan transactions.

10.3 Funds Transfer Prices Derivation for Bank XYZ

10.3.1 Data for the Funds Transfer Pricing Model

The data inaccessible from the public resources are obtained through the telephone interview with a FTP professional of Bank XYZ. Some of the data for the case study are also obtained from the public resources.

Interest Rate for the Bank Product Pricing

The interest rates related to the bank product pricing consist of Shanghai Interbank Offered Rate (SHIBOR), LIBOR and the prime interest rate. These rates information are obtained from the public resources and presented in Table 10.2.

Table 10.2: SHIBOR and LIBOR for Interbank Loans and the Prime Interest Rate (31 December 2006)

Maturity	SHIBOR (%) RMB	LIBOR (%) USD	Prime Interest Rates (%) RMB	
			For Deposits (%)	For Loans (%)
Overnight	1.5675	5.34250	0.72	5.58
1 week	1.6321	5.31375	1.62	5.58
2 week	1.9753	5.31438	1.62	5.58
1 month	2.5833	5.32188	1.62	5.58
2 months	N/A	5.34563	1.62	5.58
3 months	2.8082	5.36000	1.80	5.58
4 months	N/A	5.36000	1.80	5.58
5 months	N/A	5.36650	1.80	5.58
6 months	2.8685	5.37000	2.25	5.58
7 months	N/A	5.36713	2.25	6.12
8 months	N/A	5.36038	2.25	6.12
9 months	2.9301	5.35938	2.25	6.12
10 months	N/A	5.34938	2.25	6.12
11 months	N/A	5.33938	2.25	6.12
12 months	3.0021	5.32938	2.52	6.12
24 months	N/A	N/A	3.06	6.30
36 months	N/A	N/A	3.69	6.30
60 months	N/A	N/A	4.14	6.48
60 months-	N/A	N/A	4.14	6.84

Source: Prime interest rates and the SHIBOR are obtained from the office website of the PBOC; The LIBOR is obtained from the British Bankers' Association (BBA).

In Table 10.2, the SHIBOR is used for the derivation of base funds transfer prices for the funds transactions denominated in RMB, whereas the LIBOR is used for

deriving the base funds transfer prices for the funds transactions denominated in USD.

Data Summary for the Bank Business Units and Products

Table 10.3 presents the characteristics of bank business units and products. The data for the commercial loans and deposits are summarized for the year 2006.

Table 10.3: Data Summary for the Bank Business Units and Products

Branch	Product	Currency	Maturity (Months)	Amount (Millions)	Type of Interest Rate	Contract	Cash Flows	Type of Risks
Unit 1 (AU_1)	Loan A_1	RMB	6	1100	Fixed& Linked to Prime Rate	Withdrawal with Penalties	One Time Repayment at Maturity	CR, IRR, LR & PR
	Loan A_2		12	1300				
	Loan A_3		24	2600				
Unit 2 (AU_2)	Loan A_4	RMB	36	3300	Fixed& Linked to Prime Rate	Withdrawal with Penalties	One Time Repayment at Maturity	CR, IRR, LR & PR
	Loan A_5		60	7800				
Unit 3 (AU_3)	Loan A_6	USD	12 - 36	900	Fixed& Linked to LIBOR	Withdrawal At Any Time	One Time Repayment at Maturity	CR, IRR, LR, PR & ERR
	Mortgage A_7		12 - 120	4100			Monthly Repayment (Principals & Interests)	
Unit 4 (LU_1)	Deposit D_1	RMB	Current	5600	Fixed Prime Rate	Withdrawal At Any Time	One Time Repayment at Maturity	IR, LR & WR
	Deposit D_2		3	3100		Withdrawal with Penalties		
	Deposit D_3		6	2500				
	Deposit D_4		12	2200				
	Deposit D_5		24	1200				
Unit 5 (LU_2)	Deposit D_6	RMB	36	900	Fixed Prime Rate	Withdrawal with Penalties	One Time Repayment at Maturity	IR, LR & WR
	Deposit D_7		60	600				
Unit 6 (LU_3)	Deposit D_8	USD	12 - 36	5000	Fixed& Linked to LIBOR	Withdrawal with Penalties	One Time Repayment at Maturity	IR, LR, WR & ERR

Notes: In this table, AU stands for asset unit and LU for liability unit.

Correlation Coefficients and Standard Deviation of the Risks Variables

Data for the correlation coefficients among the risk variables and standard deviation of risks are provided by Bank XYZ, and are presented in Table 10.4

Table 10.4: Correlation Coefficients and Standard Deviation of the Risks Variables

	IRR	LR	PR	WR	ERR	CR
IRR	**1.000**	0.180	-0.400	0.600	-0.003	0.100
LR	0.180	**1.000**	0.000	0.500	0.001	0.300
PR	-0.400	0.000	**1.000**	0.000	0.001	0.001
WR	0.600	0.500	0.000	**1.000**	0.001	0.001
EER	-0.003	0.001	0.001	0.001	**1.000**	0.300
CR	0.100	0.300	0.001	0.001	0.300	**1.000**
Standard Deviation	0.013	0.001	0.010	0.015	0.005	0.150

The Sensitivity Vector for the Bank Products

Data for the sensitivity vector is provided by the bank and presented in Table 10.5.

Table 10.5: The Sensitivity Vector for Bank Products

(In Millions)

Branch	Product	Maturity (Months)	IRR	LR	PR	WR	ERR	CR
Unit 1 (AU_1)	Loan A_1	6	-1041.86	165.00	61.38	0.00	0.00	220.00
	Loan A_2	12	-1225.03	260.00	79.56	0.00	0.00	260.00
	Loan A_3	24	-4564.72	650.00	175.03	0.00	0.00	520.00
Unit 2 (AU_2)	Loan A_4	36	-8026.09	990.00	239.09	0.00	0.00	660.00
	Loan A_5	60	-26288.62	2730.00	640.22	0.00	0.00	1560.00
Unit 3 (AU_3)	Loan A_6	12 - 36	-825.69	180.00	81.00	0.00	157.26	180.00
	Mortgage A_7	12 - 120	-3761.47	820.00	369.00	0.00	1415.33	4100.00
Unit 4 (LU_1)	Deposit D_1	Current	-4940.26	3360.00	0.00	312.48	0.00	0.00
	Deposit D_2	3	-2786.36	1860.00	0.00	172.98	0.00	0.00
	Deposit D_3	6	-2254.76	1500.00	0.00	139.50	0.00	0.00
	Deposit D_4	12	-1987.58	1320.00	0.00	122.76	0.00	0.00
	Deposit D_5	24	-2076.89	240.00	0.00	66.96	0.00	0.00
Unit 5 (LU_2)	Deposit D_6	36	-2249.61	180.00	0.00	50.22	0.00	0.00
	Deposit D_7	60	-2317.22	120.00	0.00	33.48	0.00	0.00
Unit 6 (LU_3)	Deposit D_8	12 - 36	-8788.17	1250.00	0.00	250.00	786.29	0.00
Overall Sensitivity Vector			-73134.34	15625.00	1645.28	1148.38	2358.88	7500.00

Notes: In this table, AU stands for asset unit and LU for liability unit.

10.3.2 Funds Transfer Prices Derivation at the Instruments Level

Table 10.3 shows that mortgages in USD have more complicated cash flow structure and are subject to more risk factors compared with the other products. Thus, this study develops the funds transfer price for the mortgage. According to Chapter Seven, three steps are designed to derive funds transfer prices: (1)

determining base funds transfer price, (2) deriving risk premiums, and (3) adjusting base funds transfer price.

Step One: Determining Base Funds Transfer Price

To derive the base funds transfer price for the mortgage, the mortgage is assumed to be a fully amortizing $1000 one-year 9% fixed rate loan with twelve equal monthly payments due at maturity. Chapter Seven shows that three steps are needed to derive the base funds transfer price.

Step one: annual payment determination. The monthly payment made by the mortgage is derived from Equation 7.5.

$$A = \frac{P(1+r)^n \times r}{(1+r)^n - 1} = 1000 \times [(1+9\%/12)^{12} \times 9\%/12] / [(1+9\%/12)^{12} - 1] = 87.45 \qquad (10.1)$$

Step two: annual principal payment determination. According to Equation 7.6 and 7.7, the fully amortizing $1000 mortgage gets twelve equal monthly payments, including principal and interest are calculated and presented in Table 10.6.

Table 10.6: Monthly Payment of the Amortizing Mortgage
(In USD)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Payments	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	87.45	1049.42
Principals	79.95	80.55	81.16	81.76	82.38	82.99	83.62	84.24	84.88	85.51	86.15	86.80	1000.00
Interests	7.50	6.90	6.30	5.69	5.07	4.46	3.83	3.21	2.58	1.94	1.30	0.65	49.42

According to the notional funding solution introduced in Chapter Four, instead of viewing this as a $1000 mortgage, it can be viewed as a series of 12 bullet loans, each equal to the principal paid in each month. In other words, Bank XYZ makes a notional loan for $79.95 in January, a loan for $80.55 in February, and a loan for $81.16 in March, and so on.

Step three: internal rate of return r calculation. The application of the concept of

the MMFTP method requires that the notional loans derived in the previous step be funded by the notional debts with the same maturities. Given the time profile of the loan, the base funds transfer price for the loan can be considered as the weighted average cost of the debts of various maturities that match the principal payments of the loan. The data summarized for the derivation of base funds transfer price is presented in Table 10.7. The base funds transfer price is the rate r that makes Equation 7.9 hold. Equation 7.9 is reiterated as follows:

$$P = \sum_{j=1}^{N} \frac{P_j \times (1 + r_j)^j}{(1 + r)^j} \qquad (10.2)$$

Table 10.7: Base Funds Transfer Price Derivation with the Trial-and-Error Method

Time	Principal payment	Interest Payment	Total Payment	LIBOR (%) (2007.12.31)	Monthly Rate	$P_j \times (1+r_j)^j$	$\frac{P_j \times (1+r_j)^j}{(1+r)^j}$
j	P_j	I_j	A= $P_j + I_j$	*LIBOR*	r_j =*LIBOR*/12		
1	79.95	7.50	87.45	5.32%	0.4435%	80.31	79.95
2	80.55	6.90	87.45	5.35%	0.4455%	81.27	80.55
3	81.16	6.30	87.45	5.36%	0.4467%	82.25	81.16
4	81.76	5.69	87.45	5.36%	0.4467%	83.23	81.77
5	82.38	5.07	87.45	5.37%	0.4472%	84.24	82.38
6	82.99	4.46	87.45	5.37%	0.4475%	85.25	83.00
7	83.62	3.83	87.45	5.37%	0.4473%	86.27	83.63
8	84.24	3.21	87.45	5.36%	0.4467%	87.30	84.25
9	84.88	2.58	87.45	5.36%	0.4466%	88.35	84.88
10	85.51	1.94	87.45	5.35%	0.4458%	89.40	85.51
11	86.15	1.30	87.45	5.34%	0.4449%	90.47	86.15
12	86.80	0.65	87.45	5.33%	0.4441%	91.54	86.78
Total	1000	49.42					1000.01

After conducting the trial-and-error method with the data in Table 10.7, the internal rate of return is derived as 0.4459%, which is annualized as follows:

0.4459%*12 = 5.351%

The rate 5.351% is the annual base funds transfer price for the mortgage. To adjust the base funds transfer price, risk premiums are derived in the following step.

Step Two: Deriving Risk Premiums

According to Chapter Seven, three steps are followed to derive the risk premiums.

Table 10.3 shows that the bank's mortgage businesses involve six risk variables, which consist interest rate risk, liquidity risk, foreign exchange rate risk, prepayment risk, deposit withdrawal risk and credit risk. Therefore, the six risk variables should be incorporated in the FTP model. To calculate the VaR for the mortgage, the two standards set by the Basel Accord II (1996) are applied[17].

Step one: VaR contribution derivation. The VaR contribution for the mortgage by risk factors can be derived by Equation 7.14, which is reiterated as follows:

$$\text{VaR Contribution}_i = \alpha \times \frac{D_i C D^T}{\sqrt{DCD^T}} \tag{10.3}$$

In this case, α is determined to be 3 according the Basel Accord II; the sensitivity vector D is obtained from Table 10.5.

$$D = [d_{IRR} \quad d_{LR} \quad d_{PR} \quad d_{WR} \quad d_{ERR} \quad d_{CR}] = [-73134 \quad 15625 \quad 1645 \quad 1148 \quad 2358 \quad 7500]$$

$$D^T = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \\ d_4 \\ d_5 \\ d_6 \end{bmatrix} = \begin{bmatrix} -73134 \\ 15626 \\ 1645 \\ 1148 \\ 2358 \\ 7500 \end{bmatrix}$$

Overall sensitivity vector for the mortgage is as follows:

$$D_{A7} = [d_{A7,IR} \quad d_{A7,LR} \quad d_{A7,PR} \quad d_{A7,WR} \quad d_{A7,ERR} \quad d_{A7,CR}]$$

$$= [-3761 \quad 820 \quad 369 \quad 0 \quad 1415 \quad 4100]$$

The covariance matrix is derived as follows:

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[17] The two key standards from by the Basel Accord II (1996) are: (a) the VaR for each risk factor must be calculated to a 99% confidence level, and (b) the resultant VaR is then multiplied by a factor of at least 3 to provide a "safety" buffer.

$$C=\begin{bmatrix} \delta_{IRR}\delta_{IRR} & \rho_{IRR,LR}\delta_{IRR}\delta_{LR} & \rho_{IRR,PR}\delta_{IRR}\delta_{PR} & \rho_{IRR,WR}\delta_{IRR}\delta_{WR} & \rho_{IRR,ERR}\delta_{IRR}\delta_{ERR} & \rho_{IRR,CR}\delta_{IRR}\delta_{CR} \\ \rho_{LR,IRR}\delta_{LR}\delta_{IRR} & \delta_{LR}\delta_{LR} & \rho_{LR,PR}\delta_{LR}\delta_{PR} & \rho_{LR,WR}\delta_{LR}\delta_{WR} & \rho_{LR,ERR}\delta_{LR}\delta_{ERR} & \rho_{LR,CR}\delta_{LR}\delta_{CR} \\ \rho_{PR,IRR}\delta_{PR}\delta_{IRR} & \rho_{PR,LR}\delta_{PR}\delta_{LR} & \delta_{PR}\delta_{PR} & \rho_{PR,WR}\delta_{PR}\delta_{WR} & \rho_{PR,ERR}\delta_{PR}\delta_{ERR} & \rho_{PR,CR}\delta_{PR}\delta_{CR} \\ \rho_{WR,IRR}\delta_{WR}\delta_{IRR} & \rho_{WR,LR}\delta_{WR}\delta_{LR} & \rho_{WR,PR}\delta_{WR}\delta_{PR} & \delta_{WR}\delta_{WR} & \rho_{WR,ERR}\delta_{WR}\delta_{ERR} & \rho_{WR,CR}\delta_{WR}\delta_{CR} \\ \rho_{ERR,IRR}\delta_{ERR}\delta_{IRR} & \rho_{ERR,LR}\delta_{ERR}\delta_{LR} & \rho_{ERR,PR}\delta_{ERR}\delta_{PR} & \rho_{ERR,WR}\delta_{ERR}\delta_{WR} & \delta_{ERR}\delta_{ERR} & \rho_{ERR,CR}\delta_{ERR}\delta_{CR} \\ \rho_{CR,IRR}\delta_{CR}\delta_{IRR} & \rho_{CR,LR}\delta_{CR}\delta_{LR} & \rho_{CR,PR}\delta_{CR}\delta_{PR} & \rho_{CR,WR}\delta_{CR}\delta_{WR} & \rho_{CR,ERR}\delta_{CR}\delta_{ERR} & \delta_{CR}\delta_{CR} \end{bmatrix}$$

$$= \begin{bmatrix} 0.00017 & 0.00000 & -0.00005 & 0.00012 & 0.00000 & 0.00020 \\ 0.00000 & 0.00000 & 0.00000 & 0.00001 & 0.00000 & 0.00005 \\ -0.00005 & 0.00000 & 0.00010 & 0.00000 & 0.00000 & 0.00000 \\ 0.00012 & 0.00001 & 0.00000 & 0.00023 & 0.00000 & 0.00000 \\ 0.00000 & 0.00000 & 0.00000 & 0.00000 & 0.00003 & 0.00023 \\ 0.00020 & 0.00005 & 0.00000 & 0.00000 & 0.00023 & 0.02250 \end{bmatrix}$$

$$CD^T = \begin{bmatrix} 0.00017 & 0.00000 & -0.00005 & 0.00012 & 0.00000 & 0.00020 \\ 0.00000 & 0.00000 & 0.00000 & 0.00001 & 0.00000 & 0.00005 \\ -0.00005 & 0.00000 & 0.00010 & 0.00000 & 0.00000 & 0.00000 \\ 0.00012 & 0.00001 & 0.00000 & 0.00023 & 0.00000 & 0.00000 \\ 0.00000 & 0.00000 & 0.00000 & 0.00000 & 0.00003 & 0.00023 \\ 0.00020 & 0.00005 & 0.00000 & 0.00000 & 0.00023 & 0.02250 \end{bmatrix} \times \begin{bmatrix} -73134 \\ 15626 \\ 1645 \\ 1148 \\ 2358 \\ 7500 \end{bmatrix} = \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix}$$

$$DCD^T = [-73134 \quad 15625 \quad 1645 \quad 1148 \quad 2358 \quad 7500] \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} = 3613650.68$$

$$\sqrt{DCD^T} = 1900.96$$

$$\text{VaR Contribution}_{A7} = \alpha \times \frac{D_{A7}CD^T}{\sqrt{DCD^T}}$$

$$= 3 \times [d_{A7,IR} \quad d_{A7,LR} \quad d_{A7,PR} \quad d_{A7,WR} \quad d_{A7,ERR} \quad d_{A7,CR}] \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} / 1900.96 \qquad (10.4)$$

VaR contribution for the six risk factors can be derived by breaking down the overall sensitivity vector into a series of the vectors with all the elements equal to zero other than the element corresponding to the risk factor of interest. The sensitivity vectors are:

Sensitivity Vector for IRR: $D_{A7,IRR}$ =[**-3761** 0 0 0 0 0]

Sensitivity Vector for LR: $D_{A7,LR}$ =[0 **820** 0 0 0 0]

Sensitivity Vector for PR: $D_{A7,PR}$ =[0 0 **369** 0 0 0]

Sensitivity Vector for WR: $D_{A7,WR}$ =[0 0 0 **0** 0 0]

Sensitivity Vector for ERR: $D_{A7,ERR}$=[0 0 0 0 **1415** 0]

Sensitivity Vector for CR: $D_{A7,CR}$ =[0 0 0 0 0 **4100**]

The VaR contributions for the risk variables are derived from Equation 10.4:

VaR Contribution $_{IRR}$=3×[(-3761) ×(-31.532)]/ 1900.96=187.18

VaR Contribution $_{LR}$ =3×(820×0.873)/ 1900.96=1.13

VaR Contribution $_{PR}$ =3×(369×0.082)/ 1900.96=0.05

VaR Contribution $_{WR}$ =3×(0×0.404)/ 1900.96=0.00

VaR Contribution $_{ERR}$ =3×(1415×0.590)/ 1900.96=1.32

VaR Contribution $_{CR}$ =3×(4100×172.266)/ 1900.96=1114.63

Step two: hurdle rate determination. The hurdle rate provided by Bank XYZ is LIBOR plus 3%.

Step three: opportunity cost of EC derivation. Since Bank XYZ can easily access funds in USD from the interbank market. Therefore, the EC is invested in the interbank market with the rate of return of LIBOR. The opportunity cost of EC is the difference between the hurdle rate and the LIBOR.

Opportunity Cost of Funds = (LIBOR+3%) - LIBOR=3%

In this case, it is assumed that LIBOR of 5% is the actual return for the EC. According to Equation 7.13, the amount of the opportunity cost for the EC

reserved for each risk is calculated as:

The Opportunity Cost of EC_{IRR} = VaR Contribution $_{IRR}$×3%/(1+LIBOR)

=187.18×3% /1.05=5.348

The Opportunity Cost of EC_{LR} = VaR Contribution $_{LR}$×3%/(1+LIBOR)

=1.13×3%/1.05=0.032

The Opportunity Cost of EC_{PR} = VaR Contribution $_{PR}$×3%/(1+LIBOR)

=0.05×3%/1.05=0.001

The Opportunity Cost of EC_{WR} = VaR Contribution $_{WR}$×3%/(1+LIBOR)

=0.00×3%/1.05=0.000

The Opportunity Cost of EC_{ERR} = VaR Contribution $_{ERR}$×3% /(1+LIBOR)

=1.32×3%/1.05=0.038

The Opportunity Cost of EC_{CR} = VaR Contribution $_{CR}$×3% /(1+LIBOR)

=1114.63×3%/1.05=31.847

Step Three: Adjusting Base Funds Transfer Price

Since it is determined that interest rate risk, liquidity risk, prepayment risk, withdrawal risk and exchange rate risk are all beyond the control of the business units that implement the mortgages, the risk premiums for these risks should be assigned to the ALCO who takes the responsibilities of managing these risks. The managers who implement the mortgages should not be allocated any returns generated from assuming these risks. However, the managers are rewarded for controlling the credit risks. The risk premium for each risk factor is calculated as:

Mortgage RP_{IRR} = Opportunity Cost of EC_{IRR}/w_0 = 5.348/4100 = 0.13696%

Mortgage RP_{LR} = Opportunity Cost of EC_{LR}/w_0 = 0.032/4100 = 0.00083%

Mortgage RP_{PR} = Opportunity Cost of EC_{PR}/w_0 = 0.001/4100 = 0.00003%

Mortgage RP_{WR} = Opportunity Cost of EC_{WR}/w_0 = 0.000/4100 = 0.00000%

Mortgage RP_{ERR} = Opportunity Cost of $EC_{ERR}w_0$ = 31.847/4100=0.00096%

According to Equation 7.19, the funds transfer price for the mortgage is derived as:

$FTP_{mortgage}$ = Base $FTP_{mortgage}$ + Mortgage RP_{Uncon}

$$= \text{Base FTP}_{\text{mortgage}} + (\text{Mortgage RP}_{\text{IRR}} + \text{Mortgage RP}_{\text{LR}}$$

$$+ \text{Mortgage RP}_{\text{PR}} + \text{Mortgage RP}_{\text{WR}} + \text{Mortgage RP}_{\text{ERR}})$$

$$= 5.351\% + (0.13696\% + 0.00083\% + 0.00003\% + 0\% + 0.00096\%)$$

$$= 5.4895\%$$

10.3.3 Funds Transfer Prices Derivation at the Business Unit Level

A bank business unit or branch generally contains several bank instruments. The funds transfer price for each unit is determined based on the characteristics of each instrument in the unit. This section illustrates how funds transfer prices can be determined for Asset Unit 1, which implements three asset instruments, commercial loan A_1, A_2 and A_3. The characteristics of each instrument are provided in Table 10.3. According to Chapter Seven, three steps can be applied to derive the funds transfer price for the asset unit.

Step One: Determining Base Funds Transfer Price.

Table 10.3 shows that three bullet loans with different maturities and interest rates are included in the asset unit. It can be viewed as a series of three bullet loans, each equal to the principal paid at maturity. In other words, Bank XYZ makes one notional loan that includes three bullet loans. Having determined the time profile of cash flows for the notional loan, base funds transfer price is calculated as:

$$PV_{6\text{months}} + PV_{12\text{months}} + PV_{24\text{months}} = \frac{V_{6\text{months}}}{(1+r)^{0.5}} + \frac{V_{12\text{months}}}{(1+r)^{1}} + \frac{V_{24\text{months}}}{(1+r)^{2}}$$

$$PV_1 + PV_2 + PV_3 = \frac{1100}{(1+1.89\%)^{0.5}} + \frac{1300}{(1+1.98\%)^{1}} + \frac{2600}{(1+2.25\%)^{2}} = \frac{1100}{(1+r)^{0.5}} + \frac{1300}{(1+r)^{1}} + \frac{2600}{(1+r)^{2}} \quad (10.5)$$

Conducting the trial-and-error method with the data in Equation 10.5, the internal rate of return r is derived as 2.1704%.

Step Two: Deriving Risk Premiums

As previously defined, business units' managers cannot effectively manage interest

rate risk, liquidity risk, prepayment risk, withdrawal risk and exchange rate risk. Therefore, the risk premiums for taking these risks should be assigned to the ALCO. To derive the risk premiums, the overall sensitivity vector for the asset unit is broken down into three vectors. For each vector, the element for credit risk equal to zero other than the element corresponding to the risk that cannot be controlled by the unit. In this case, the elements corresponding to withdrawal risk and exchange rate risk are considered to be zero since the commercial loans denominated in RMB do not possess these two risks.

Sensitivity Vector for Unit 1: D_{Unit} =[-6831.61 1075.00 315.97 0 0 0]

Sensitivity Vector for Loan $\mathbf{A_1}$: D_{A1} =[-1041.86 165.00 61.38 0 0 0]

Sensitivity Vector for Loan $\mathbf{A_2}$: D_{A2} =[-1225.03 260.00 79.56 0 0 0]

Sensitivity Vector for Loan $\mathbf{A_3}$: D_{A3} =[-4564.72 650.00 175.03 0 0 0]

According to Equation 7.21, the VaR contribution for the asset unit is derived as:

$$\text{VaR Contribution}_{Unit} = \text{VaR Contribution}_{A1} + \text{VaR Contribution}_{A2} + \text{VaR Contribution}_{A3}$$

$$= \alpha \times \left(\frac{D_{A1}CD^T}{\sqrt{DCD^T}} + \frac{D_{A2}CD^T}{\sqrt{DCD^T}} + \frac{D_{A3}CD^T}{\sqrt{DCD^T}}\right)$$

$$= \alpha \times \frac{D_{AU1}CD^T}{\sqrt{DCD^T}}$$

$$= 3 \times [-6831.61 \quad 1075.00 \quad 315.97 \quad 0 \quad 0 \quad 0] \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} / 1900.96$$

$$= 341.64$$

In this case, SHIBOR of 3.0021% from Table 10.2 is assumed to be the actual return of the EC. With the hurdle rate of 6% and overnight SHIBOR of 1.5675%, the opportunity cost of funds, 4.4325%, is the difference between SHIBOR and hurdle rate. According to Equation 7.23, the risk premium for the asset unit is:

$$\text{Asset Unit RP} = [\text{VaR Contribution}_{Unit} \times 4.4325\% / (1+3.0021\%)] / 5000$$

$$= (341.64 \times 4.4325\% / 1.03) / 5000 = 0.2940\%$$

Step Three: Adjusting Base Funds Transfer Price.

According to Equation 7.24, the funds transfer price for the funds transferred from the ALCO to the asset unit is:

$$FTP_{Unit} = \text{Base } FTP_{Unit} + \text{Asset Unit } RP_{Uncon}$$
$$= 2.1704\% + 0.2940\% = 2.4644\%$$

The funds transfer price for the asset unit is 2.4644%, of which 0.2940% is the risk premiums for the interest rate risk, liquidity risk and prepayment risk.

10.4 Comparisons of Bank Performance Measurement: the FTP Model Vs. the Bank's Current FTP Method

The comparisons between the FTP model developed in this thesis and the pool based FTP methods have been discussed in Chapter Eight. As previously discussed Bank XYZ applies the single pool FTP method. Therefore, this section demonstrates the NIM derivations with the single pool FTP method and the FTP model developed in this thesis. The results from the performance measurements with each method are also compared.

As Bank XYZ only applies the single pool FTP method, data related to other pool based FTP methods are not available for this case study. Therefore, the contrasts of the FTP model developed in this thesis with other FTP methods are not made in this case study.

10.4.1 Net Interest Margin Measurement

As discussed in the Chapter Eight, the bank FTP model can be applied to identify the source of NIM profit contributions. In this case, the FTP model is applied to disaggregate the NIM components of the mortgage and the deposits funding the mortgage. The mortgage is from Business 3 and the deposits are from Business 6.

The NIM with the FTP Model

According to Chapter Eight, the NIM of the paired transactions, the mortgages and the deposits, can be disaggregated into three parts, (1) spread from deposits origination, (2) spread from the ALCO and (3) spread from mortgage origination.

(1) Spread from the deposits origination. To derive the spread from deposits origination, the market cost of the deposits supporting the mortgage and funds transfer price for the deposits need to be determined. According to the interview, the market cost of the 12-month deposits is 0.4% less than the LIBOR with the 12-month maturity. Table 10.2 shows that the 12-month LIBOR is 5.329%, thus the market cost of the deposit is:

$$\text{Market Cost of Deposits} = 5.329\% - 0.4\% = 4.929\% \quad (10.6)$$

As presented in Appendix 3, the funds transfer price for the 12-month deposits is 5.065%. The spread from deposits origination is calculated as the difference between the funds transfer price and the market cost for the deposits.

$$\text{Spread from Deposits Origination}_{\text{Unit6}} = \text{FTP}_{\text{Deposits}} - \text{Market Cost of Deposits}$$
$$= 5.065\% - 4.929\% = 0.136\%$$

(2) Spread from the ALCO. Business Unit 6 transfers the risks beyond its control to the ALCO, thus a part of the spread from liability origination is allocated to the ALCO. On the other hand, Business Unit 3, which generates the mortgage, also transfers the risks beyond its control to the ALCO. The spread for the ALCO is:

$$\text{Spread}_{\text{Unit 6 to ALCO}} = \text{Base FTP}_{\text{Deposits}} - \text{FTP}_{\text{Deposits}}$$
$$= 5.329\% - 5.065\% = 0.264\%$$

$$\text{Spread}_{\text{Unit 3 to ALCO}} = \text{FTP}_{\text{Mortgage}} - \text{Base FTP}_{\text{Mortgage}}$$
$$= 5.489\% - 5.352\% = 0.137\%$$

$$\text{Mismatch Spread} = \text{Base FTP}_{\text{Mortgage}} - \text{Base FTP}_{\text{Deposits}}$$

$$= 5.352\% - 5.329\% = 0.023\%$$

$$\text{Total Spread from ALCO} = \text{Spread}_{\text{Unit 6 to ALCO}} + \text{Spread}_{\text{Unit 3 to ALCO}} + \text{Mismatch Spread}$$

$$= 0.264\% + 0.137\% + 0.023\% = 0.424\%$$

(3) Spread from mortgage origination. The difference between market price and the funds transfer price for the mortgage is a part of the spread from the mortgage origination. The spread is for taking the risks under the control of Business Unit 3.

$$\text{Spread from Mortgage Origination}_{\text{Unit3}} = \text{Market Price}_{\text{Mortgage}} - \text{FTP}_{\text{Mortgage}}$$

$$= 9.000\% - 5.489\% = 3.511\%$$

The results from the NIM contribution calculations show that most NIM contributions come from the origination of mortgage. Deposits business makes the least contributions in generating the overall NIM contributions.

According to Table 8.1, the FTP model can also be applied to derive the NIM contributions for each risk incurred by the mortgage and the deposits. The derivation of the NIM contributions by the risk factors is based on Equation 7.15.

$$\text{NIM}_{\text{Overall Risk}} = \text{NIM Contribution}_{\text{Overall Risk, Mortgage}} + \text{NIM Contribution}_{\text{Overall Risk, Deposits}}$$

$$= [\text{VaR Contribution}_{\text{Unit 3}} \times (\text{H-LIBOR})/(1+\text{LIBOR})]/w_{\text{Mortgage}}$$

$$+ [\text{VaR Contribution}_{\text{Unit 6}} \times (\text{H-LIBOR})/(1+\text{LIBOR})]/w_{\text{Deposits}}$$

$$= 1304.3 \times 3\%/(4100 \times 1.05\%) + 278760 \times 3\%/(5000 \times 1.05\%) = 1.16030\%$$

$$\text{NIM Contribution}_{\text{IRR}} = \text{NIM Contribution}_{\text{IRR, Mortgage}} + \text{NIM Contribution}_{\text{IRR, Deposits}}$$

$$= [\text{VaR Contribution}_{\text{IRR,Mortgage}} \times (\text{H-LIBOR})/(1+\text{LIBOR})]/w_{\text{Mortgage}}$$

$$+ [\text{VaR Contribution}_{\text{IRR,Deposits}} \times (\text{H-LIBOR})/(1+\text{LIBOR})]/w_{\text{Deposits}}$$

$$= 187.18 \times 3\%/(4100 \times 1.05) + 437.31 \times 3\%/(5000 \times 1.05\%)$$

$$= 0.13044\% + 0.24989\% = 0.38033\%$$

Along a similar vein to the NIM contribution calculation for the interest rate risk,

the NIM contributions for other risks are derived and presented in Table 10.8.

Table 10.8: NIM Contributions for the Risks from the Mortgage and the Deposits

	IRR	LR	PR	WR	ERR	CR	Sum of NIM Contributions
Mortgage	0.13044%	0.00079%	0.00003%	0.00000%	0.00092%	0.77675%	0.90892%
Deposits	0.24989%	0.00098%	0.00000%	0.00009%	0.00042%	0.00000%	0.25139%
Sum of NIM Contributions	0.38033%	0.00177%	0.00003%	0.00009%	0.00134%	0.77675%	1.16030%

In this case, the NIM contributions from the credit risk provide the most profit contributions to the overall NIM. Profit contributions from taking the interest rate risk ranks second. It is least profitable from taking prepayment risk. It is noticed that the total NIM contributions from all the risks, 1.160%, is not equal to the total NIM from the business units, 4.048%. As discussed in Chapter Seven, the difference between these two NIM contributions, 2.888% (4.048% - 1.160% = 2.888%), is due to the overhead cost and the business mark-up. After the identifications of the sources of profits, the FTP model is used to allocate the profits to the bank business units. Based on Table 10.8, the NIM contribution allocation among the business units is calculated and presented in Table 10.9.

Table 10.9: NIM contribution Allocation among the Business Units by the FTP Model

	IRR	LR	PR	WR	ERR	CR	NIM for Unit 3	NIM for Unit6	NIM for ALCO
Mortgage	0.13044%	0.00079%	0.00003%	0.00000%	0.00092%	0.77675%	**0.77675%**	**0%**	**0.13217%**
12-Month Deposits	0.24989%	0.00098%	0.00000%	0.00009%	0.00042%	0.00000%	**0%**	**0%**	**0.25139%**
Sum of NIM Contributions	0.38033%	0.00177%	0.00003%	0.00009%	0.00134%	0.77675%	**0.77675%**	**0%**	**0.38356%**

As business units within Bank XYZ cannot control interest rate risk, liquidity risk, prepayment risk, withdrawal risk and exchange rate risk, the NIM contributions from managing these risks need to be allocated to the ALCO.

$$\text{NIM}_{\text{Mortgage to ALCO}} = \text{FTP}_{\text{Mortgage}} - \text{Base FTP}_{\text{Mortgage}}$$

$$= \text{Base FTP}_{\text{Mortgage}} + \text{Mortgage RP}_{\text{Uncon}} - \text{Base FTP}_{\text{Mortgage}}$$

$$= \text{Mortgage RP}_{\text{Uncon}}$$

$$= \text{Mortgage RP}_{IRR} + \text{Mortgage RP}_{LR}$$

$$+ \text{Mortgage RP}_{PR} + \text{Mortgage RP}_{ERR}$$

$$= 0.13044\% + 0.00079\% + 0.00003\% + 0.00092\% = 0.13217\%$$

In the above calculation, the FTP model ensures that all the NIM contributions from the risks beyond the control of Business Unit 6 are allocated to the ALCO. Similarly, the deposit NIM contributions allocated to the ALCO are calculated and presented in Table 10.9. The NIM contribution for Unit 6 is 0 since the deposit taking units within the bank cannot control any of risks listed in Table 10.9.

In Table 10.9, the NIM from managing the credit risk, 0.77675%, are allocated to Unit 3 since Unit 3 is assumed to control the credit risk. The NIM contribution allocation process by the FTP model ensures that business units' managers are only rewarded for taking the risks under their control. Thus, the effects of NIM fluctuation caused by the business unit uncontrollable risks are identified and separated from the results of individual business unit. This process enables bank managers to properly evaluate the risk-adjusted performance of business units or instruments.

The NIM with the Bank's FTP Method

Bank XYZ currently applies the single pool FTP method. As previously discussed, Bank XYZ applies 5% as the funds transfer price for all the banking business denominated in USD. The NIM contributions for the mortgage and deposits are calculated as follows:

$$\text{NIM contributions}_{\text{Mortgage}} = \text{Market Price}_{\text{Mortgage}} - \text{FTP}_{\text{Mortgage}}$$

$$= 9\% - 5\% = 4\%$$

$$\text{NIM Contributions}_{\text{Deposits}} = \text{FTP}_{\text{Deposits}} - \text{Market Price}_{\text{Deposits}}$$

$$= 5\% - 4.929\% = 0.071\%$$

$$\text{Total NIM}_{\text{Mortgage and Deposits}} = \text{NIM Contributions}_{\text{Mortgage}} + \text{NIM Contributions}_{\text{Deposits}}$$

$$= 4\% + 0.048\%$$

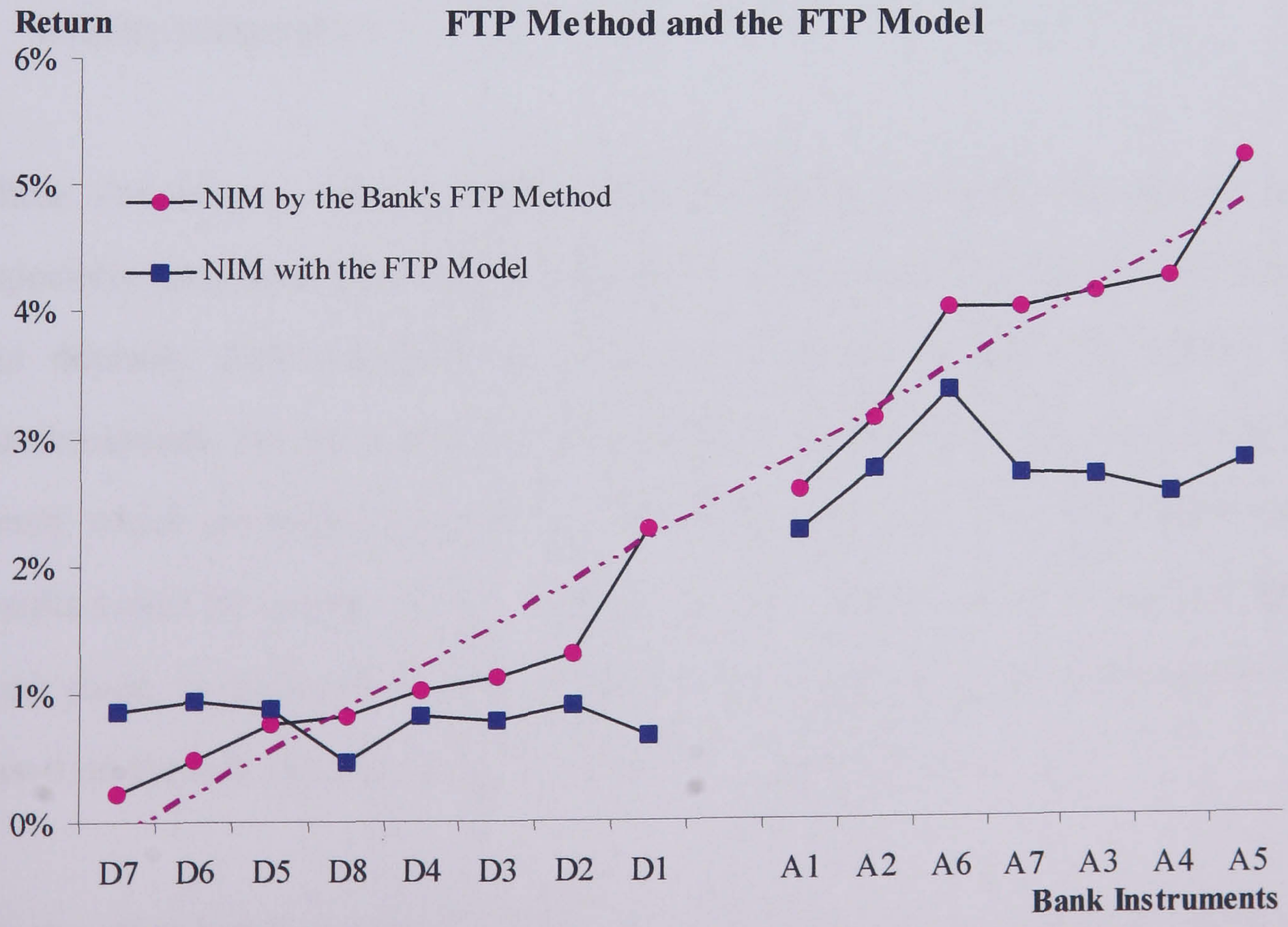
$$= 4.048\%$$

In the above calculation, 4.929% is the market cost of the deposits. The bank's FTP method can identify that the sources of NIM are from mortgages and deposits. However, this method cannot identify how the NIM contributions are generated from taking the risks incurred by the mortgage and the deposits. This is because the bank's FTP method cannot be applied to decompose the risks involved in the banking businesses.

Comparisons of the NIM from the Bank's FTP Method and the FTP Model

To examine the profitability measurement function of the bank's FTP method and that of the FTP model derived by this thesis, the NIM derived with the bank's FTP method and the FTP model are compared and depicted in Figure 10.1.

Figure 10.1: Comparisons of NIM Measured with the Bank's FTP Method and the FTP Model



In Figure 10.1, bank instruments from D7 to A5 are depicted in the X-axis. For the deposits instruments, the maturities of the instruments decrease from D7 to D1, for the loan instruments, the maturities of the instruments increase from A1 to A5. Instruments D8 is depicted between D5 and D4 since the maturity of the D8 is between that of D5 and D4. Instrument A6 and A7 are depicted between A2 and A3 since the maturities of A6 and A7 are between that of A2 and A3.

As shown in Figure 10.1, the NIM derived with the bank's FTP method shows a consistently increasing tendency from D7 to A5. This tendency gives the following conclusions:

- Liability instruments with longer maturities always make less profit contributions than the liability instruments with shorter maturities.

- Asset instruments with longer maturities always make more profit contributions than the asset instruments with shorter maturities.

- All the bank asset instruments always make more profit contributions than liability instruments.

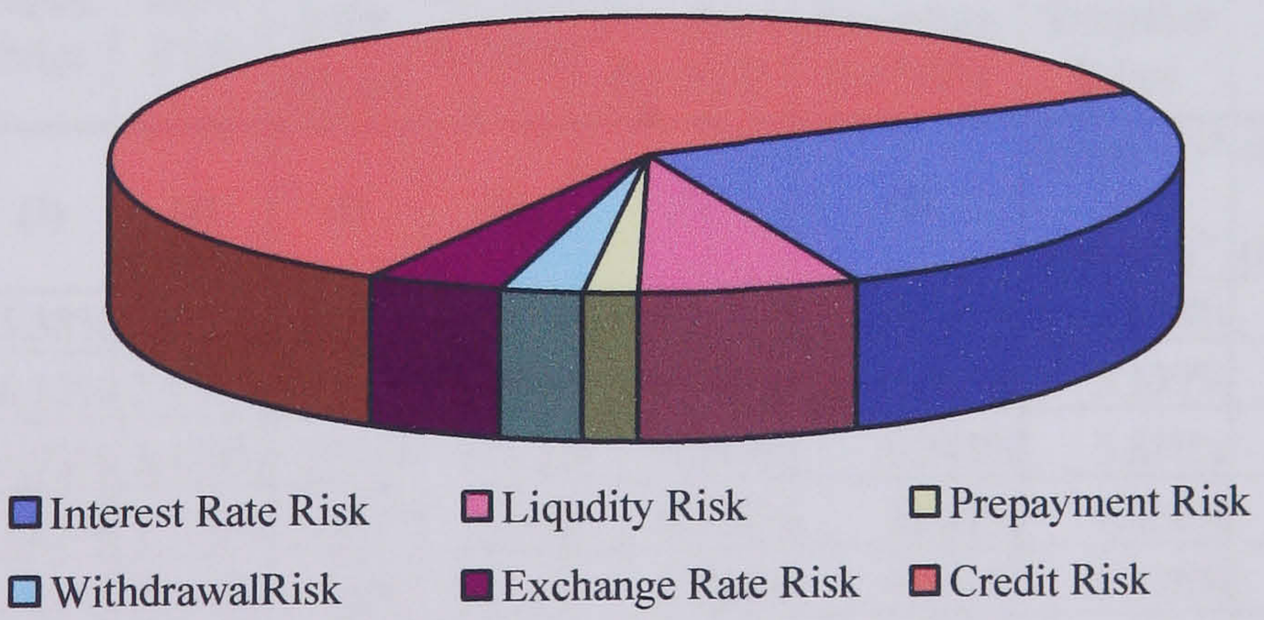
These conclusions may encourage bank managers to focus on making loans, especially long-term loans. Some efforts may be put on pursing short-term deposits but deposits with long-term maturities may not be of interest. Under these circumstances, the mismatch risk increases due to the large amount of long-term loans, which are mostly supported by the short-term deposits. These unfavorable results could be caused by the application of the single pool FTP method by the bank since, as discussed in Chapter Three, this method does not differentiate value based on the risk characteristics of the underlying instruments.

On the other hand, in Figure 10.1 the NIM derived with the FTP model developed in this thesis does not show any consistent tendency. Some long-term deposits,

such as D6, makes more profit contribution than short-term deposits, such as D1. Some short-term loans, such as A2, makes more profit contributions than long-term loans, such as A3. Under these circumstances, mismatch risks could be properly managed, and business units' managers would only pursue the instruments that bring favorable NIM. For Bank XYZ, the NIM with the FTP model shows that all commercial loans make more profit contributions than deposits. This is due to the fact that in Bank XYZ commercial loans involve a great amount of the credit risk, which enables the bank to achieve higher returns. Bank deposits involve fewer risks, which bring the bank fewer returns. Therefore, the absolute values of the NIM for the asset instruments are larger than those for the liability instruments.

The FTP model developed in this thesis not only direct bank managers to pursue profitable businesses, but also would help properly measure what contributions they make from taking each risk involved in its banking businesses. The data for profit contributions from taking each risk are depicted in Figure 10.2. The data applied for Figure 10.2 are taken from Table 10.8.

Figure 10.2: Profit Contributions from Taking Each Type of the Bank Risks



As shown in Figure 10.2, with the bank FTP model developed in this thesis, bank managers can understand that the bank's profit contributions come mostly from taking credit risk and interest rate risk. However, as the bank's FTP method cannot identify profit contributions by the risk factors, this makes its FTP method unable to achieve the function of allocating the NIM contributions by risk factors.

Therefore, some business units may be rewarded from taking the risks beyond their control. This indicates that the performance of business units or instruments may not be properly measured.

The comparisons of the NIM measurements with the bank's FTP method and the FTP model developed in this thesis show that the FTP model gives more accurate results and are effective in providing information for bank risk management. On the other hand, the bank's FTP method may deteriorate the bank's financial risk positions.

10.4.2 Risk Adjusted Return on Capital Measurement

As the bank's FTP method cannot decompose bank risks, the RAROC cannot be calculated with the method. However, as discussed in Chapter Eight, the FTP model developed in this thesis produces all the data for calculating the RAROC. The RAROC for the bank instruments are derived with Equation 8.18 and 8.19, and are presented in Table 10.10.

Table 10.10: The Derivation of the RAROC for Bank XYZ Instruments

Bank Product	Total Amount	Bank Price	Base FTP	EC for FTP Model	EC for RAROC	Risk Premium for FTP	Risk Premium for NIM	Funds Transfer Price	Risk Adjusted NIM	RAROC
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)=(4)+(7) [a] or (9)=(4)-(7) [b]	(10)=(3)-(9)-(8) [c] or (10)=(9)-(3)-(8) [d]	(11)=(10)/[(5)+(6)]
A1	1100	5.58%	2.869%	52.08	59.81	0.210%	0.241%	3.078%	2.261%	22.22%
A2	1300	6.12%	2.930%	61.33	70.68	0.209%	0.241%	3.139%	2.740%	26.98%
A3	2600	6.73%	3.430%	228.06	141.37	0.389%	0.241%	3.819%	2.672%	18.81%
A4	3300	7.25%	3.930%	400.78	179.43	0.538%	0.241%	4.468%	2.536%	14.42%
A5	7800	8.21%	4.430%	1312.00	424.10	0.746%	0.241%	5.176%	2.791%	12.54%
A6	900	9.00%	5.351%	41.49	48.93	0.138%	0.163%	5.489%	3.348%	33.32%
A7	4100	9.00%	5.351%	189.67	1114.63	0.139%	0.816%	5.489%	2.695%	8.47%
D1	5600	0.72%	1.568%	250.66	0.00	0.198%	0.000%	1.369%	0.649%	14.50%
D2	3100	1.71%	2.808%	141.33	0.00	0.202%	0.000%	2.606%	0.896%	19.66%
D3	2500	1.89%	2.869%	114.35	0.00	0.203%	0.000%	2.666%	0.776%	16.96%
D4	2200	1.98%	3.002%	100.80	0.00	0.203%	0.000%	2.799%	0.819%	17.88%
D5	1200	2.25%	3.502%	103.72	0.00	0.383%	0.000%	3.119%	0.869%	10.05%
D6	900	2.52%	4.002%	112.22	0.00	0.553%	0.000%	3.449%	0.929%	7.45%
D7	600	2.79%	4.502%	115.50	0.00	0.853%	0.000%	3.649%	0.859%	4.46%
D8	5000	4.60%	5.351%	439.92	0.00	0.264%	0.000%	5.088%	0.488%	5.30%

The results in Table 10.10 are illustrated as follows:

Column (1): items in this column are for the name of bank instruments and taken from Table 10.3.

Column (2): items in this column are for the total amount of funds for the instruments and taken from Table 10.3.

Column (3): items in this column are for the interest rates that offered to customers by the bank. According to the bank's pricing policies, interest rates for asset instruments are derived by upward adjusting the prime interest rate. Interest rates for liability instruments are simply the prime rates.

Column (4): Base FTP are weighted cost of interbank market rate and derived by following the steps designed in Chapter Seven.

Column (5): EC in this column are used for producing the funds transfer prices. The EC are for the risks, which consist of interest rate risk, liquidity risk, prepayment risk, withdrawal risk and exchange rate risk.

Column (6): EC in this column are applied for calculating the RAROC. The EC is only for the credit risk.

Column (7): risk premiums in this column are for the funds transfer prices derivation. The risk premiums are for risks beyond the control of business units' managers and are derived by following the steps designed in Chapter Seven.

Column (8): risk premiums in this column are for the risks under the control of business units' managers and derived by following the steps designed in Chapter Seven.

Column (9): in this column, the funds transfer prices derived from (9)=(4)+(7)[a] are for the asset instruments; the funds transfer prices derived from (9)=(4)-(7)[b] are for the liability instruments.

Column (10): in this column, the risk adjusted NIM from (10)=(3)-(9)-(8)[c] is for the asset instruments. The results from (10)=(3)-(9)-(8)[d] are for the liability instruments.

Column (11):the RAROC for bank instruments is derived from Equation 8.18 and

Equation 8.19.

To derive the risk premiums presented in Table 10.10, hurdle rates and overnight interbank market rates for the businesses denominated in RMB and USD are needed. The hurdle rate provided by Bank XYZ is 6% for the instruments denominated in RMB and LIBOR plus 3% for the instruments in USD. The overnight rates are from Table 10.2.

To illustrate the profitability measurement function of the bank FTP model developed in this thesis, the RAROC derived with the FTP model are depicted in Figure 10.3.

Figure 10.3: The RAROC and EC Derivation with the FTP Model

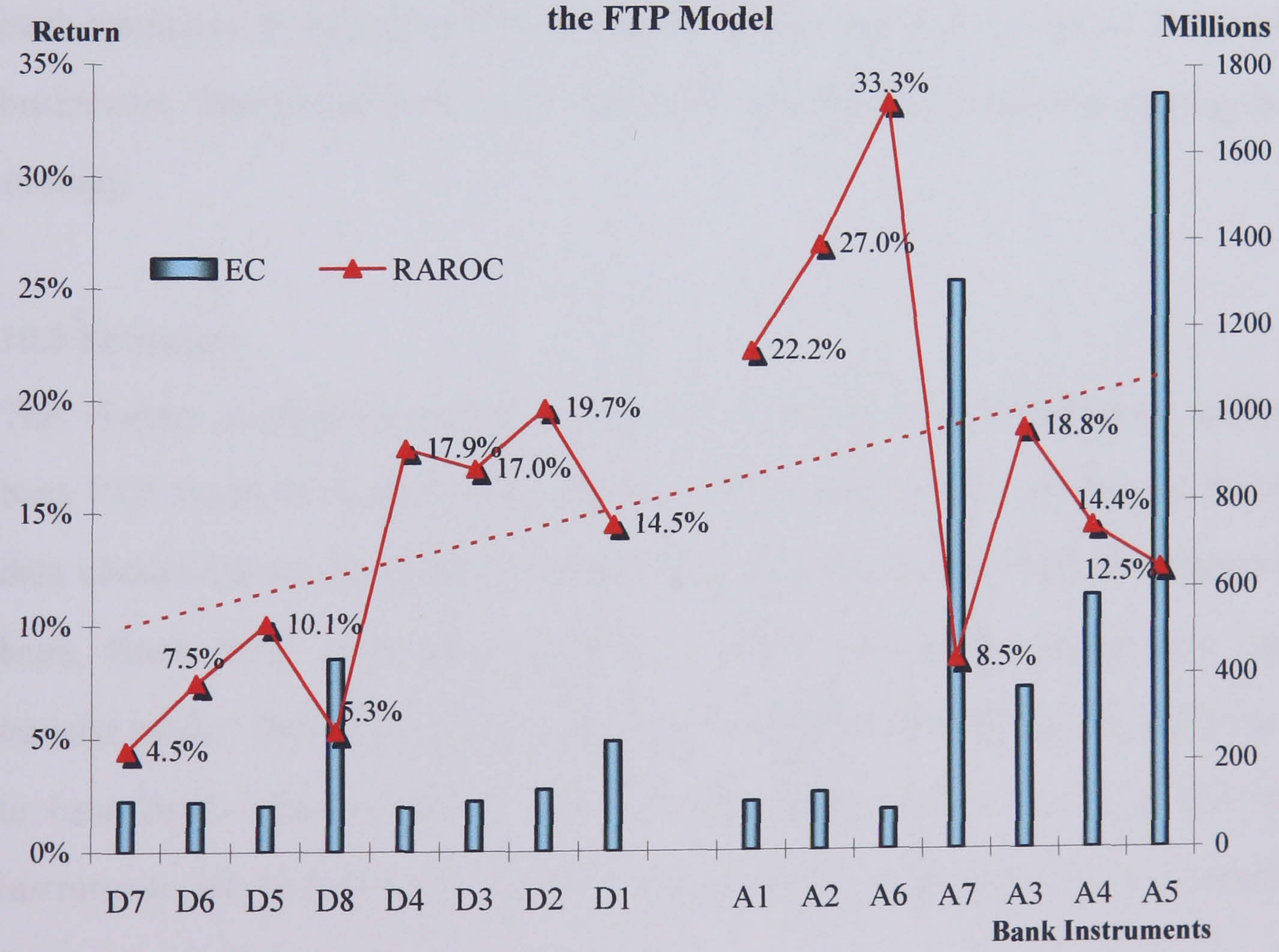


Figure 10.3 shows that the tendency line for RAROC is upward sloping, however, not all the RAROC for the asset instruments are larger than those for the liability instruments. For example, the RAROC for the D2, 19.7%, is larger than A5, 12.5%. This is due to the fact that the EC for A5 is almost ten times larger than that for D2.

However, the risk adjusted NIM for A5 is only about three times larger than that for D2. The results from the comparisons indicate that the risk capitals for the D2 are efficiently used. This means that the bank managers who implemented the D2 have effectively managed the risks associated with the instrument. On the other hand, it shows that Bank XYZ reserved great amount of the EC for A5; however, the return from taking the risks associated with the instrument is quite low. This means that the bank managers who implemented the A5 instrument cannot effectively manage the risks associated with the instruments. This is confirmed from the interview that A5 are long-term commercial loans for Bank XYZ and much credit risks have accumulated in this type of loans. The interviewee confirmed that the bank has suffered greatly from the long-term loan defaults. Therefore, integrating the bank FTP model with the RAROC measurement enables bank managers to understand that credit risk management is crucial for its banking businesses. This would help bank managers determine its credit risk management strategy.

10.5 Summary

This chapter conducts a case study analysis of funds transfer derivation with the bank FTP model developed in this thesis. Funds transfer prices are derived with the data obtained from the public resources and provided by the Chinese commercial bank, Bank XYZ. Data from interbank market are used to derive base funds transfer prices. Data provided by the bank are applied to derived risk adjustments to base funds transfer prices. Funds transfer prices are developed at the bank instrument and business unit levels for the purposes of performance evaluation at the corresponding levels.

This chapter also presents the NIM measurement with the FTP model developed in this thesis and the bank's FTP method. Although the bank's FTP method can identify the source of NIM by instruments, the method cannot be used to derive NIM contributions by risk factors. The case study shows that the bank's FTP

method may deteriorate its financial risk positions. This case study also shows that the FTP model developed in this thesis enables bank managers to identify the sources of bank profits by bank risk factors and provide more information on bank risk management. Therefore, the FTP model developed in this thesis is more effective in bank risk management than the bank's FTP method.

This chapter also presents how the FTP model developed in this thesis is applied to measure bank RAROC. The case study shows that the FTP model helps bank managers compare the economic profitability of different instruments on a risk-adjusted basis across different sources of risk. This would help bank managers determine their risk management strategies.

Chapter Eleven: Conclusions, Limitations and Future Research

11.1 Introduction

The primary objective of this research is to develop the bank FTP model for the purpose of effectively managing bank risks and accurately measuring the economic performance of banking businesses. As the six-factor bank FTP framework determines the process of generating funds transfer prices, the second objective of this research is to design the six factors. The bank FTP model developed and the six-factor bank FTP framework designed are expected to contribute and improve the understanding of FTP for commercial banks. This chapter presents a summary of the conclusions of the thesis, discusses the limitations of the research, and provides further research on the bank FTP model development.

The first section of this chapter is a summary of the conclusions. In the second section, the implications and the contributions of this research to both FTP theories and practical uses are provided. The third section identifies the limitations of this research followed by the fourth section, suggestions on the directions for the future research. The final section is the summary.

11.2 Conclusions of This Research

In this thesis, Chapter One introduces the focuses of this research. Chapter Two presents the literature review on TP theories. Chapter two reviews various definitions for TP and a six-factor TP framework. This chapter also discusses the motives for FTP, and examines TP in terms of transaction cost economics theory.

Chapter Three reviews TP methods from both the economist's and the accountant's perception. In this chapter, the advantages and disadvantages of the various TP and FTP methods are discussed.

To design the six-factor bank FTP framework and develop the bank FTP model, Chapter Four introduces the research methodologies. The empirical investigations on bank FTP consist of questionnaire survey, email contacts and telephone interview. The aim of conducting multiple empirical investigation methods is to to check the validity of the findings of each method and to explore FTP in-depth. This chapter also provides various financial risk management concepts and techniques for the bank FTP model development.

Chapter Five conducts the empirical investigations on bank FTP. The results of the empirical investigations provide evidences for the six-factor bank FTP framework design. The investigations show that commercial banks concern how to use FTP to manage bank risks and evaluate bank performances. The investigations indicate that a special bank unit should be established to centrally mange bank risks. The survey shows that the bank FTP model should be developed at both the business unit and instrument levels. Both the original term and remaining term FTP model should also be developed. The telephone interview in this chapter provides the data for the case study, which is presented in Chapter Ten.

Chapter Six designs the six-factor bank FTP framework. The findings from the empirical investigations and financial theories are applied to design the six factors. The WHAT, the WHO, the WHERE, the WHEN and the HOW factors are designed for the purpose of achieving the objectives set by the WHY factor. The following outlines the six factors designed for the commercial banks:

(1) The WHY factor defines that the main objectives of the bank FTP model are to effectively manage bank risks and accurately measure the economic performance of banking businesses.

(2) To achieve the objectives set by the WHY factor, the WHAT factor should concern funds transactions and the associated risk management responsibility.

(3) To achieve effective bank risk management, the WHO factor requires that the ALCO should be established and be assigned the responsibility of managing the risks beyond the control of the business units.

(4) To identify the sources of bank profit contributions, the WHERE factor determines that the bank FTP model should be developed at the business unit and instrument levels.

(5) To accurately measure the performances of bank business units or instruments, the WHEN factor requires that the FTP model should enable bank managers to measure their business performances at any point of time over the life of the business transaction period. Thus both the original term and remaining term FTP models should be developed.

(6) To assign the responsibility of managing the risks among bank units, the HOW determines that some financial techniques, such as the GFT pattern, risk decomposition and the MMFTP method, are applied.

Chapter Seven develops the bank FTP model for the purposes of effective bank risk management and accurate bank performance measurements. The FTP model is developed with financial risk management techniques, such as VaR, VaR contribution, EC and hurdle rate, and methods, such as, notional funding solution, strip balance weighted method and the MMFTP method.

Chapter Eight of this research examines the implications of the bank FTP model. Five important functions are found from integrating the FTP model with bank performance evaluation metrics. Application of both the original term and remaining term FTP models enables bank top management to properly appraise the performance of business units and the ALCO.

Chapter Nine applies the bank FTP model in various types of the banks. The primary aim of this chapter is to testify the effectiveness of the FTP model for the internal and external funds transfer within each type of the banks. The FTP model is found to be effective for the internal funds transfer within the partially decentralized banks.

Chapter Ten conducts a case study analysis of applying the bank FTP model in a Chinese commercial bank. The case study demonstrates the derivation of the funds transfer prices for the bank business units and instruments. The case study finds that the FTP model developed in this thesis is more effective in bank risk management than the bank's FTP method.

11.3 Implications of This Research

Three contributions are made by this research and summarized as follows:

(1) This research develops the bank FTP model based on the responsibility accounting principles and financial risk management techniques. As far as the author is aware, no studies have addressed a specific bank FTP model that can be established to produce funds transfer prices in the context of both responsibility accounting principles and financial risk management techniques. Some financial concepts and methodologies, such as VaR, VaR contribution, EC, hurdle rate, shadow asset and liability, notional funding solution, strip balance weighted method and the MMFTP method, are applied for developing the bank FTP model. Incorporating these concepts, methodologies and techniques in the FTP model development enables the model to achieve the following five important functions:

(a) Identification of the sources of bank profits.

(b) Proper allocation of the bank profits among business units.

(c) Solution for the FTP double counting issues.

(d) Keeping the consistency of analytical bank income statements.

(e) Effective bank risk management.

The application of the original term and remaining term FTP models in bank performance evaluation shows that the models identify the historical and current profit contributions from managing bank risks. Clear identifications of the historical and current amount of the risks would help bank managers evaluate how effective their risk management strategies were, and facilitate the top management to determine appropriate risk management strategies for current bank risks.

The application of the FTP model in the partially decentralized banks shows that the model achieves the function of effective bank risk management and accurate bank performance evaluation. The FTP model is also found to be more effective for managing the funds transferred internally than those transferred externally. As current banks tend to transfer funds internally within a bank, the bank FTP model developed in this thesis has great practical value.

(2) This thesis applies various financial risk management techniques and methodologies to design the HOW factor for the bank FTP process administration. The HOW factor designed in this thesis would provide bank managers a good understanding on how bank funds and associated risks are effectively controlled with bank FTP.

(3) This thesis designs a questionnaire survey to investigate bank FTP process. Despite the ever-growing importance of the financial services sector to the economy, TP practices in this sector have received little research attention. There are few surveys on bank FTP issues and the surveys are not generally available to the public. The questions designed for the bank FTP investigations might pave the road for the further research on the bank FTP issues.

The implications of the results from the bank FTP model are obvious. Studies such as this one are providing a theoretical and empirical foundation that will ultimately enable bank managers to effectively manage bank risks, to identify the resources of profits and to evaluate the risk adjusted performance of bank business units and instruments. It is expected that the results reported in this study will be of interest not only to academic FTP researchers but also to commercial bank managers whose tasks are to administer internal funds transactions.

11.4 Research Limitations

As is the case with all research of this nature, certain limitations may apply. Various financial techniques are applied in the bank FTP model development. The limitations associated with the techniques themselves will inevitably affect the FTP model. VaR is used for the purposes of measuring risks. There are some limitations for the VaR method. For example, VaR does not consider the effects of catastrophic events. To fully understand the risks associated with financial instruments, the effect of large, infrequent swings in the market values of the instruments must also be considered. Although VaR has some limitations, the method is applied in the FTP model since it is considered to be the financial service industry's premier risk management technique.

One potential limitation of this research is the lack of responses to the questionnaire survey. Questionnaire survey response rate is low due to the sensitivity of the FTP issue. Low responses may affect the investigations on the six factors for the bank FTP process. However, the aim of this research is not to do rigorous statistical analysis, but to find evidences for designing the six factors.

Another limitation is that it is difficult to obtain sufficient and reliable information for the case study due to the sensitivity of the subject and restricted access. The complete reliance on the data supplied by the bank may affect the accuracy of the results produced with the bank FTP model. However, the data will not affect the

feasibility of the model since the data is used for the purpose of illustrating the process of generating funds transfer prices.

The bank FTP model developed in this research focuses on domestic internal FTP issues, thus tax risk issues are not included in the model development. However, tax issues must be considered when it is determined that the FTP model is used in the international setting.

11.5 Further Research

Further research remains necessary for eliminating some of the limitations of this study. Further research could consider the following points:

(1) To eliminate the limitation of the VaR, financial techniques, such as stress testing and scenario analysis, may be used to assess the impacts incurred by the catastrophic events.

(2) Surveys on the FTP issues may be extended to cover commercial banks in several countries other than the UK and Chinese commercial bank. The enlarged sample size may improve the number of responses. This may eliminate some of the limitations of this research. For example, statistical analysis, which due to time and resource limitations was not conducted by this research, may be made to enhance the six-factor bank FTP framework designed.

(3) This research has designed the six factors FTP framework for banks. Future research may redesign the factors according to the financial situations that commercial banks face. For example, the WHY factor may be redesigned. In this research, the WHY factor defines that the FTP model should be developed as a managerial tool in bank risk management. However, FTP may also be used as a behavioural tool in bank management; this will accordingly change the design of the WHY factor, thereby change the bank FTP model development.

(4) Further research may include tax issues in the bank FTP model development. In this circumstance, risk variables related to the tax issues should be incorporated in the bank FTP model.

11.6 Summary

This research designs the six-factor bank FTP framework and develops the bank FTP model. The six factors designed give a good understanding of the bank FTP administration process. With the bank FTP model, bank managers can effectively manage risks and accurately measure the performance of bank instruments and business units.

The bank FTP model development requires various financial concepts and techniques that can be applied to achieve the objectives set by the WHY factor. Integrating the FTP model with bank performance evaluation metrics and organization forms shows that the FTP model achieve the important functions of effective bank risk management and accurate bank performance evaluation. The application of the case study with the FTP model highlights the fact that the FTP model developed in this research produces more effective risk management and more accurate performance measurements than those produced by the bank's FTP method.

Through the knowledge gained from this study, the six-factor bank FTP framework can be used as a starting point for the empirical research on the bank FTP process. It is expected that this research will provide a theoretical and empirical foundation for the future bank FTP studies.

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Appendices

Appendix 1: The Double Counting Issue for the Double Pool FTP Method

To examine the double counting issues caused by the double pool FTP method, a paired funds transaction is assumed. The data for the funds transaction are assumed and presented in Table 1.

Table 1: Data for the Paired Funds Transaction (in £ millions)

Item	Mortgage	Deposit	Overall NIM
Balances	100	100	40
Market Price	10.0%	6.0%	4.0%

In this paired transaction, the mortgage is supported by the deposit. The overall NIM shown in Table 1 is derived as follows:

Overall NIM = 10.0% - 6.0% = 4.0%

The following examines the circumstance in which the double counting issue arises. The funds transfer prices for the mortgage and deposit in Table 2, Table 3 and Table 4 are assumed.

(1) Funds transfer price for the mortgage is less than that for the deposit.

Table 2: FTP_{charge} Less than FTP_{credit} in the Double Pool FTP Method (in £ millions)

Item	Mortgage	Deposit	Total NIM Allocated
Balances	100	100	
Market Price	10.0%	6.0%	
Funds Transfer Price	7.5%	8.0%	
NIM for Products	2.5%	2.0%	4.5%

In Table 2, the funds transfer price for the mortgage, 7.5%, is less than that for the deposit, 8.0%. The NIM for the Mortgage and Depost can be derived as:

$NIM_{Mortgage}$ = 10.0% - 7.5% = 2.5%

$NIM_{Deposit}$ = 8.0% - 6.0% = 2.0%

Therefore, the total NIM allocated to the mortgage and the deposit is:

The Total NIM for the Mortgage and Deposit = $NIM_{Mortgage}$ + $NIM_{Deposit}$

$$= 2.5\% + 2.0\% = 4.5\%$$

The total NIM allocated to the mortgage and the deposit, 4.5%, is larger than the overall NIM, 4.0% . Thus double counting issue occurs.

(2) Funds transfer price for the mortgage equals to that for the deposit.

Table 3: FTP_{charge} Equals FTP_{credit} in the Double Pool FTP Method (in £ millions)

Item	Mortgage	Deposit	Total NIM Allocated
Balances	100	100	
Market Price	10.0%	6.0%	
Funds Transfer Price	7.5%	7.5%	
NIM for Products	2.5%	1.5%	4.0%

In Table 3, the funds transfer price for the mortgage, 7.5%, equals to that for the deposit, 7.5%. The NIM for the Mortgage and Depost can be derived as:

$$NIM_{Mortgage} = 10.0\% - 7.5\% = 2.5\%$$

$$NIM_{Deposit} = 7.5\% - 6.0\% = 1.5\%$$

Therefore, the total NIM allocated to the mortgage and the deposit is:

$$\text{The Total NIM for the Mortgage and Deposit} = NIM_{Mortgage} + NIM_{Deposit}$$
$$= 2.5\% + 1.5\% = 4.0\%$$

The total NIM allocated to the mortgage and the deposit, 4.0%, is equal to the overall NIM, 4.0% . Thus no double counting issue occurs.

(3) Funds transfer price for the mortgage is larger than that for the deposit.

Table 4: FTP_{charge} Larger than FTP_{credit} in the Double Pool FTP Method (in £millions)

Item	Mortgages	Deposits	Total NIM Allocated
Balances	100	100	
Market Price	10.0%	6.0%	
Funds Transfer Price	7.5%	7.0%	
NIM for Products	2.5%	1.0%	3.5%

In Table 3, the funds transfer price for the mortgage, 7.5%, is larger than that for the deposit, 7.0%. The NIM for the Mortgage and Depost can be derived as:

$$NIM_{Mortgage} = 10.0\% - 7.5\% = 2.5\%$$

$$NIM_{Deposit} = 7.0\% - 6.0\% = 1.0\%$$

Therefore, the total NIM allocated to the mortgage and the deposit is:

$$\text{The Total NIM for the Mortgage and Deposit} = NIM_{Mortgage} + NIM_{Deposit}$$
$$= 2.5\% + 1.0\% = 3.5\%$$

The total NIM allocated to the mortgage and the deposit, 3.5%, is less than the overall NIM, 4.0% . Thus no double counting issue occurs.

UNIVERSITY OF WALES, BANGOR

BANGOR BUSINESS SCHOOL

QUESTIONNAIRE ON FUNDS TRANSFER PRICING AND PERFORMANCE EVALUATION IN THE UK BANKS

SPONSOR: ORSAS, BRITISH COUNCIL
CENTRE FOR BANKING & FINANCE
UNIVERSITY OF WALES, BANGOR
PROFESSOR PHILIP MOLYNEUX,
DIRECTOR

DIRECTOR: PROFESSOR LYNN HODGKINSON
DIRECTOR OF BANKING& FINANCE
TEACHING DIVISION
UNIVERSITY OF WALES, BANGOR

ASSOCIATE: LIANFENG QUAN
PHD RESEARCHER
DIVISION OF FINANCIAL STUDIES
UNIVERSITY OF WALES, BANGOR

QUESTIONNAIRE ON FUNDS TRANSFER PRICING AND PERFORMANCE EVALUATION IN THE UK BANKS

To the Respondent:

Thank you for your consideration in filling out this form. All responses are considered strictly confidential: the completed forms will be destroyed after general statistics are obtained.

If you desire a summary of the report based on this survey, check the box below:

☐ PLEASE SEND A SUMMARY REPORT
(If checked, identify company below)

Person completing form (optional)

Name and Position: _____

Name of Company (optional): _____

Headquarters Address (optional): _____

_____

Alternatively, you may send a request for the report to the following email box (optional):

xyz@bangor.ac.uk

A. Company Characteristics

(Please give estimates if exact figures are unknown or difficult to ascertain.)

Number of branches:_____ Number of profit centre subsidiaries: _____

Number of investment centres: __ Number of cost centre subsidiaries: _____

Current main businesses: How important are the following business in your bank?
(Please check the best response: one check in each line)

Type of Businesses	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Acceptance of short term deposits							
Acceptance of long term deposits							
Provision of short term loan							
Provision of long term loan							
Provision of mortgage loan							
Selling securities							
Interbank funding transaction							
Other (please specify):							

PLEASE CHECK THE BEST RESPONSE

Current Business Orientation: How important are the following objectives in your current business planning?

Objective	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Short run profit							
Long run profit							
Increase in market share							
Effective bank risk management							
New financial product development							
Maintain a strong liquidity position							
Ensure a satisfactory funding mix							
Other (please specify):							

B. Transfer Pricing for Internal Bank Funds Transfer

1. **General Objectives**: How important are the following objectives in your internal funds transfer pricing system?

General Objective	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Achievement of overall corporate goals							
Identify and manage bank risks							
Assign responsibilities to branch managers to mange resources							
Motive branch managers desired behaviour							
Determination of profit-related pay for branch managers							
Facilitate performance evaluation of products							
Facilitate performance evaluation of managers							
Facilitate performance evaluation of branches							
Preserve branch autonomy							
Fairness and neutrality							
Simplicity and ease of application							
Other (please specify):							

2. **General Policy:**

(1) How many funding pools are there for your subsidiaries to buy and sell funds from?

☐ Single pool ☐Double Pools ☐Multiple Pools

PLEASE CHECK THE BEST RESPONSE

(2) How many funds transfer prices do you use within your bank?

☐Single Price ☐Double Prices ☐Multiple Prices

(3) What types of funds transfer prices do you generally use?

☐Fixed Price ☐Floating Price

(4) Do you set different funds transfer prices for funds providers and funds users within your bank?

☐Yes ☐No

(5) Do subsidiaries within your bank funds themselves first, and then sell excess funds or buy funds to cover excess assets?

☐Yes ☐No

(6) Are funds users in you bank permitted to borrow funds directly from outside money market without buying funds from your funds management centre?

☐Yes ☐No

(7) Are funds providers in you bank permitted to sell funds to outside money market without selling funds to your funds management centre?

☐Yes ☐No

(8) Which department or centre is responsible for your funds transfer pricing process?

☐Treasury ☐Asset/Liability Management Committee ☐Financial Control Department ☐Others (please specify) _____

(9) Approximately how many people are employed in the funds management centre described in the question ***(8)*** above?

☐ 1-5 ☐ 6-10 ☐ 11-20 ☐ 21-30 ☐ over 30

(10) In your opinion, do you view your funds transfer pricing system successful?

☐Yes ☐No

(11) How often are the following specific transfer pricing methods utilized for your internal funds transfers?

Method	Always used	Often used	Sometimes used	Rarely used	Never used
Average cost of raising funds					
Average cost of funds plus fixed markup					
Marginal funding cost (incremental cost)					
Market price (for example, LIBOR)					
Adjusted market price					
Negotiated price					
*Matched Maturity Funds Transfer Pricing Method (see below for definition)					
Mathematical programming optimal price					
No transfer price (free transfers)					
Others (please specify):					

PLEASE CHECK THE BEST RESPONSE

3. ***Matched Maturity Funds Transfer Pricing Method:** *This method requires that every incremental customer transaction should be matched with a corresponding hypothetical internal funds transfer. The method assigns unique transfer price to each source and use of funds at the time of origination..*

In those cases when **Matched Maturity Funds Transfer Pricing Method** is used, relatively how important are the following specific objectives in your internal funds transfer pricing system?

Specific objective	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Transfer bank risks to a special unit that effectively controls them							
Assign responsibilities to unit managers to mange bank risks							
Manage the liquidity profile of bank assets and liabilities							
Reduce interest rate fluctuation losses							
Reduce market prices fluctuation losses							
Reduce asset and liability mismatch risks							
Reduce prepayment (option) risks							
Reduce credit risks							
Reduce basis risks							
Other (please specify):							

C. Funds Transfer Pricing Model and Bank Financial Risk Management

1. How important are the following risk management processes to your business?

Specific objective	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Interest rate risk management							
Liquidity risk management							
Credit risk management							
Basis risk management							
Prepayment/option risk management							
Market price risk management							
Other (please specify):							

2. Among the following bank risks, which risk is within the control of your branch managers?
(Please check any items that are applicable)

☐Interest Rate Risk ☐Liquidity Risk ☐Credit Risk ☐Prepayment Risk

☐Price Risk ☐Other risks (please specify) _____

PLEASE CHECK THE BEST RESPONSE

3. What bank risk factors are incorporated in your current funds transfer pricing model?
(Please check any items that are applicable)

☐Interest Rate Risk ☐Liquidity Risk ☐Credit Risk ☐Prepayment Risk

☐Price Risk ☐Other risks (please specify) _____

4. In your opinion, what risk factors should be incorporated into a funds transfer pricing model to effectively manage various bank risks? (Please check any items that are applicable)

☐Interest Rate Risk ☐Liquidity Risk ☐Credit Risk ☐Prepayment Risk

☐Price Risk ☐Other risks (please specify) _____

5. Is your bank likely to make any changes to your funds transfer pricing system within the next two years?

☐ Changes likely ☐ Changes not likely ☐ Don't know

D. Funds Transfer Pricing and Performance Evaluation

1. How important are the following measures for performance evaluation in your bank?

Measures	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Net Interest Income (NII)							
Return on Equity (ROE)							
Risk Adjusted Return on Capital (RAROC)							
Return on Risk Adjusted Capital (RORAC)							
Economic Value Added (EVA)							
Other (please specify):							

2. How important are the following factors on introducing risk adjusted performance measurements to your bank?

Factors	Degree of Importance						
	Extremely High	Very High	High	Moderately	Low	Very Low	Extremely Low
Better management of bank risk							
Better management of capital							
Better assessment of business profitability							
Compliance with regulations							
Other (please specify):							

3. Which performance measurement ratio is calculated with your current funds transfer prices?

☐Risk Adjusted Return on Capital (RAROC) ☐Return on Equity (ROE)

☐Net Interest Income (NII) ☐Return on Risk Adjusted Capital (RORAC)

☐Economic Value Added (EVA) ☐Other (please specify) _____

4. Which risks factors are considered in your risk adjusted performance measurements?

☐Interest Rate Risk ☐Liquidity Risk ☐Credit Risk ☐Prepayment Risk

☐Price Risk ☐Other risks (please specify) _____

5. How frequently does your bank prepare profit statements for the internal profitability analysis purposes?

☐ Monthly or more frequently ☐ Quarterly ☐ Six-monthly ☐ Annually

Would you like to attend our interviews on this survey in the future?

☐Yes ☐No

If yes, what types of interview would you prefer?

☐Fact-to-face Interview ☐Telephone Interview

MANY THANKS FOR YOUR COOPERATION!

Appendix 3: The Derivation of the Funds Transfer Price for the 12-month Deposits

The funds transfer price for the 12-month deposits is derived based on the three steps designed in Chapter Seven.

Step One: Determining Base Funds Transfer Price

Table 10.3 shows that the deposits are repaid only at maturity. Thus the base funds transfer price for the 12-month deposits equals to the 12-month LIBOR. According to Table 10.2, the base funds transfer price for the 12-month deposits is 5.329%.

Step Two: Deriving Risk Premiums

The funds supporting the mortgage denominated in USD are taken from Unit 6 since Unit 6 is the only one that raises deposits in USD. The sensitivity vectors for interest rate risk, liquidity risk, withdrawal risk and foreign exchange rate risk are:

Overall Sensitivity Vector for Unit 6: $D_{Unit\ 6}$ = [-8788.17 1250 0 250 786.29 0]

Sensitivity Vector for IRR in Unit 6: $D_{Unit\ 6,\ IRR}$ = [-8788.17 0 0 0 0 0]

Sensitivity Vector for LR in Unit 6: $D_{Unit\ 6,\ LR}$ = [0 1250 0 0 0 0]

Sensitivity Vector for WR in Unit 6: $D_{Unit\ 6,WR}$ = [0 0 0 250 0 0]

Sensitivity Vector for ERR in Unit 6: $D_{Unit\ 6,\ ERR}$ = [0 0 0 0 786.29 0]

According to Equation 7.16 and 7.17, the VaR contribution is derived as follows:

$$\text{VaR Contribution}_{\text{Unit 6}} = \alpha \times \frac{D_{\text{Unit6}} C D^{T}}{\sqrt{D C D^{T}}}$$

$$= 3 \times \begin{bmatrix} -8788.17 & 0 & 0 & 250.00 & 786.29 & 0 \end{bmatrix} \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} / 1900.96$$

$$= 439.92$$

$$\text{VaR Contribution}_{\text{Unit 6, IRR}} = \alpha \times \frac{D_{\text{Unit6, IRR}} CD^{T}}{\sqrt{DCD^{T}}}$$

$$= 3 \times \begin{bmatrix} -8788.17 & 0 & 0 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} / 1900.96$$

$$= 437.31$$

$$\text{VaR Contribution}_{\text{Unit 6, LR}} = \alpha \times \frac{D_{\text{Unit6, LR}} CD^{T}}{\sqrt{DCD^{T}}}$$

$$= 3 \times \begin{bmatrix} 0 & 1250.00 & 0 & 0 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} / 1900.96$$

$$= 1.72$$

$$\text{VaR Contribution}_{\text{Unit 6, WR}} = \alpha \times \frac{D_{\text{Unit6, WR}} CD^{T}}{\sqrt{DCD^{T}}}$$

$$= 3 \times \begin{bmatrix} 0 & 0 & 0 & 250.00 & 0 & 0 \end{bmatrix} \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} / 1900.96$$

$$= 0.16$$

$$\text{VaR Contribution}_{\text{Unit 6, ERR}} = \alpha \times \frac{D_{\text{Unit6, ERR}} CD^{T}}{\sqrt{DCD^{T}}}$$

$$= 3 \times \begin{bmatrix} 0 & 0 & 0 & 0 & 786.29 & 0 \end{bmatrix} \times \begin{bmatrix} -31.532 \\ 0.873 \\ 0.082 \\ 0.404 \\ 0.590 \\ 172.266 \end{bmatrix} / 1900.96$$

$$= 0.73$$

According to Equation 7.15, the risk premiums are derived as follows:

$$RP_{\text{Unit 6}} = (\text{VaR Contribution}_{\text{Unit 6}} \times 3\%)/(5000 \times 1.05)$$

$$= (439.92 \times 3\%)/(5000 \times 1.05) = 0.2640\%$$

$$RP_{\text{Unit 6, IRR}} = (\text{VaR Contribution}_{\text{Unit 6, IRR}} \times 3\%)/(5000 \times 1.05)$$

$$= (437.31 \times 3\%)/(5000 \times 1.05) = 0.2624\%$$

$$RP_{\text{Unit 6, LR}} = (\text{VaR Contribution}_{\text{Unit 6, LR}} \times 3\%)/(5000 \times 1.05)$$

$$= (1.72 \times 3\%)/(5000 \times 1.05\%) = 0.0011\%$$

$$RP_{\text{Unit 6, WR}} = (\text{VaR Contribution}_{\text{Unit 6, WR}} \times 3\%)/(5000 \times 1.05)$$

$$= 0.16 \times 3\%/(5000 \times 1.05) = 0.001\%$$

$$RP_{\text{Unit 6, ERR}} = (\text{VaR Contribution}_{\text{Unit 6, ERR}} \times 3\%)/(5000 \times 1.05)$$

$$= (0.73 \times 3\%)/(5000 \times 1.05) = 0.0004\%$$

Step Three: Adjusting Base Funds Transfer Price

As it is assumed that Unit 6 cannot control interest rate risk, liquidity risk, withdrawal risk and foreign exchange rate risk, these risks should be transferred to the ALCO. Therefore, Unit 6 should not be credited for incurring these risks. After deriving base funds transfer price and risk premiums for the 12-month deposits, the funds transfer price for the deposits is obtained with Equation 7.19 as shown below:

$$FTP_{\text{Deposits}} = \text{Base FTP} - \text{Deposit } RP_{\text{Unit 6}}$$

$$= 5.329\% - 0.2640\%$$

$$= 5.065\%$$