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O.R. Applications

Modeling international investment decisions for financial holding companies

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Abstract

This research analyzes the internationalization process model developed by Johanson and Vahlne and derives two integer programming investment decision models that consider the risk attitudes of investment firms. Johanson and Vahlne's model provides a starting point for building a model that suits the investment approach and decision making process of financial holding companies. In practice, when firms make an international investment decision, there is a need for a model that can generate outputs based on financial measures such as profit, investment returns, and tolerable levels of risk. Thus, in this paper, Johanson and Vahlne's concepts are studied and financial managers are interviewed to derive models that match the investment decision procedures of the firms. The model helps firms manage the risks of their investments and derive accurate investment strategies based on investment objectives and constraints.

Keywords: Market commitment; Market knowledge; Internationalization process model; Investment decision model; Integer programming; Financial holding companies

1. Introduction

Firms continuously search for opportunities and formulate strategies for profit development. Operational strategies such as product diversification, vertical or horizontal integration, and internationalization are commonly used by enterprises. Numerous researchers have provided conceptual frameworks and models of the internationalization process that have been adopted by multinational investment firms. Johanson and Vahlne [24] are among the first to discuss the internationalization process and state that understanding the marketplace or having market knowledge is essential for making new market commitments or redirecting business activities to exploit international opportunities. Strategic choices that continuously become available provide companies' with specific competitive advantages and directly affect their international performance. Further, risk and uncertainty are key factors impacting internationalization strategies. The accurate evaluation of multiple factors is required to enter and succeed in difficult markets. Mulvey and Shetty [34] indicated that the

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globalization of financial markets and the complexity of financial products have increased investment uncertainty and risks. Financial optimization models are frequently employed to weigh factors and are integrated with financial planning systems that use computer based mathematical models. This research provides two revised international investment models that expand the practical application of Johanson and Vahlne's early model to financial holding companies. The revised models consider the investment decision methods of financial managers and apply integer programming to incorporate the financial perspectives of experts. In order to demonstrate the practical applications of the model, interviews of investment advisors are conducted to provide case data and to create two investment decision models.

This study is organized as follows. Section 2 outlines the internationalization process model of Johanson and Vahlne. In Section 3, a literature review of international investment decision models is provided. Section 4 demonstrates the application of Johanson and Vahlne's original model and derives the integer programming model. Section 5 discusses the case study which includes data from two financial holding companies and the two investment decision models are defined. Finally, Section 6 presents the discussion and conclusion regarding the application of the model by financial holding companies.

2. The internationalization process model

Following the introduction of the internationalization process model offered by Johanson and Vahlne in 1977, numerous papers were published to discuss, revise, or challenge the model. This section discusses the early contributions of the authors and the research that has stimulated others to study internationalization process models.

2.1. Johanson and Vahlne's internationalization viewpoint

The internationalization process model developed by Johanson and Vahlne is based on an analysis of the firm's market knowledge, market commitment, commitment decision and current activities. The model emphasizes that a lack of knowledge about a foreign market of interest is a major obstacle to international investment operations. The accuracy of market knowledge leads to greater investment success whereas poor market knowledge increases the likelihood of a failed investment. Even though market knowledge can be purchased in the form of research reports or referenced from experience [21], the quality of knowledge underlies the success of firms entering international markets.

Market commitment [21] relates to activities of the firm that can restrict freedom of action. Commitment [24] has often been studied in terms of the resources applied by the firm to specific events or actions. The difficulty of transferring resources affects the degree of market commitment, and the more specialized the resource to the specific market, the greater the degree of commitment required [24]. According to Chetty and Eriksson [9], experiential knowledge and market commitment dependent on the structure of the business network surrounding the parties and cannot be transferred between countries or between units in a firm. Commitment decisions depend on the decision alternatives chosen and carried out [24]. For example, vertical integration means a higher market commitment degree than a miscellaneous foreign investment. Thus, as the commitment decisions become more serious, the investment costs increase. From the opposite view, if the commitment decisions are weakly supported, then the expected revenues from the decisions should be lower.

Finally, regarding the operational activities of firms, the internationalization behavior is often decided by a combination of learning through the experience and incorporation of members that have international knowledge [15]. Based on Johanson and Vahlne's viewpoint, the more differentiated the product, the larger the total commitment to current activities [24]. Further, the firms' commitment to current activities becomes greater when the product base is differentiated. Firms that are production oriented tend to invest in personnel to manage current activities. For customer-oriented products or services, the country features and cultures become more important for the firm to base their internationalization strategy. Finally, various operational activities, which come from different levels of market knowledge, market commitment, and commitment decisions, yield different investment costs and profits.

2.2. The application and challenge of Johanson and Vahlne's model

Numerous researchers have extended or modified the internationalization process model to include market selection, entry mode, foreign direct investment (FDI), location patterns, and

internationalization process factors [12]. For example, Sullivan and Bauerschmidt [42] conducted an empirical test of European forest product firms based on Johanson and Vahlne's model. However, the internationalization model did not hold for this case and the authors found that international involvement is influenced by competitive rivalry, government policies, and exogenous conditions. On the other hand, Erramilli et al. [16] applied the internationalization model to Asian multinationals and found significant support. Lamb and Liesch [30] re-framed the relationships between market knowledge, market commitment and market involvement. They proposed an iterative model of internationalization for small firms where market knowledge and market commitment were reciprocally caused. For instance, abundant market knowledge influenced the degree of the market commitment and the degree of market commitment influenced the abundance and accuracy of market knowledge. Furthermore, Forsgren [19] indicated that experiential learning positively influenced tacit knowledge. Abundant tacit knowledge tended to decrease perceived uncertainty and then increase the drive to internationalize. The research challenged firms to invest abroad even with low market knowledge if the perceived risk of investment was lower than the perceived risk of not investing. Thus, if the risks were well evaluated, then firms would tend to favor internationalization.

The eclectic paradigm provided by Dunning [13] challenged conventional internationalization models. Dunning [13] points out that ownership-specific advantages, transfer advantages, and location advantages play important roles in the internationalization process. Johanson and Vahlne [25] compared the eclectic paradigm to the internationalization model and offered a different viewpoint. That is, the eclectic paradigm is production oriented and assumes perfect information for the optimization decision. On the other hand, the internationalization model assumes market knowledge and experience is imperfect before entering a market and then uses a feedback loop to correct the market knowledge as experience is gained in the marketplace. Thus, Johanson views the eclectic paradigm as a static model but the internationalization model as dynamic. Dunning [12] concluded that a dynamic component would make the eclectic paradigm a more useful analytical framework for examining internationalization. This paper agrees with the importance of feedback and derives a revised international investment decision model based on Johanson and Vahlne's early research.

3. International investment decision model

Market uncertainty and risk require that firms utilize decision models to help analyze and evaluate international investment strategies. The risk attitudes of the decision-makers influence the international investment decision model differently. Accuracy, efficiency and flexibility of the decision model are common requirements for firms.

3.1. The international investment and decision model literature review

Successful internationalization of firms often depends on well-designed international investment strategies. Optimal investment and timing are achieved by managing the difference between the actual and expected rewards [15]. These differences vary depending on company characteristics, which include capital, wealth, scale, and human resources.

Investment decision-making under uncertainty is the method whereby investors forecast several different criteria values for each investment alternative without knowing which alternative will be selected. Jovanovic [26] demonstrated investment projects under uncertainty and risk using break-even analysis, sensitivity analysis, and game theory. Generally speaking, firms execute investment strategies based on various considerations. For example, if a firm wants to invest, three criteria are evaluated. The criteria are financial capabilities, management talent, and development strengths. Each company will have its own preferences and values placed on the criteria. Bacon [3] derived investment decision techniques using net present value (NPV) and internal rate of return (IRR). For the IRR method, if the discount rate equals the present value of cash inflows and the present value of cash outflows are better than the required return rate, then the investment is accepted.

Investment models are widely used for determining international investment strategies. Choi [10] indicated that there are two key factors that influence international diversification including barriers from the international capital market and the exchange rate on international investment. Therefore, for a typical decision formulation under uncertainty, the decision makers choose the action which maximizes their expected utility under the various evaluations [20]. For international investments, knowing how to define the countries' risk level is important. Fernandez et al. [17] used 27 factors

and classified countries into five risk categories. The risk factors included economic indicators, liquidity, performance, value, regulation, and efficiency. The five risk groups were listed as safe markets (e.g., USA, Canada, Sweden), developed markets (Austria, Hong Kong, Japan), mature emerging markets (Brazil, Philippines, Thailand), new emerging markets (China, India, Taiwan), and frontier markets (Egypt, Jordan). Doumpos and Zopounidis [11] applied multi-criteria decision models and used multi-group hierarchical discrimination to classify countries into four groups and obtained similar classification results. The risk factors focused on 12 economic indicators sourced from the World Bank. The countries were classified into four groups depending on income level – high-income economies (e.g., USA, Canada), upper middle economies (Europe), lower-middle income economies (Eastern Europe), and low-income economies (mostly Africa). These research results demonstrate that different techniques and risk evaluation models yield different classifications and different decision results. Thus, the modeling approach selected by decision makers will have a strong impact on the outcome. The validity and reliability of the model will be best when the accepted business decision processes of the firm are considered when formulating the models.

3.2. The impact of risk and risk attitude on decision-making

In classical theory, risk reflects variation in the distribution of achievable outcomes, their likelihoods, and their subjective values [32]. Pratt [38] indicated that risk is measured either by the nonlinear utility for money or by the variance of the probability distribution of possible gains and losses associated with a particular alternative. Expected value is supposed to be positively associated, and risk is assumed to be negatively associated, with the attractiveness of an alternative [32]. From a managerial perspective, managers see risk in ways that are both less precise and different from risk as it appears in decision theory. A risky choice is one with a wide range of possible outcomes or is one that contains a threat of a very poor outcome [32].

A number of risk measurement models have been proposed ([27,31,41,46]). Jianmin and Dyer [23] indicated that these risk models have two major problems. First, the validity of these risk models as measures of perceived risk has been called into question by empirical studies. Second, it is not clear how to incorporate risk measures into decision models because they were developed separately from the preference models. Dyer [14] proposed two general frameworks for risk-value models; an additive one and a multiplicative one, and showed that many decision models express the intuitive idea of risk and value tradeoffs. Bell [4] derived a utility-compatible measure of risk for the purpose of trading off risks against returns and explored risk-return structures for typical utility models [5]. Sarin and Weber [40] provided a synthesis of the research on risk measurement and decision models based on expected utility and non-expected utility. In their research, risk is measured by the variance and value by expected returns. From another aspect, risk has become increasingly a term referring not only to the unpredictability of outcomes but to their costs [18]. Market knowledge, information and experience cause different levels of market commitment and influence the investment costs for firms entering the international market.

Early research assumed that most decision makers are risk averse. Decision makers study the variability of possible outcomes and the greater the return on investment then the greater the variance [38,39]. March and Shapira [32] indicated that variation in the ways individuals perceive risk results from incentives and experience. They showed the necessity and the excitement of risk taking in management, but noted that risk taking in organizations is sustained more by personal than by organizational incentives. The attitude toward risk is important to consider in the corporate internationalization process. Although risk can be defined as an exposure to uncertainty, people judge uncertainty differently [22]. Aloysius [1] expressed that the impact of risk attitudes on the optimal allocation of members' restricted budgets on funding for profitable projects is important.

There are several methods developed to measure risk attitudes. For example, Wakker [44] showed that under the methodology of expected utility, risk attitudes could be modeled using utility and outcome sensitivity. In a rank dependent model, risk attitudes consist of two independent components including a measure of sensitivity towards outcomes. Studying managerial attitudes to risk, March and Shapira [32] indicated that the definition of risk employed by executives who were responsible for organizational decisions differed radically from the variance measure used in the financial management field. Risk attitude varies according to individual's age and seniority in the firm, the division's

performance in relation to the company budget, and whether the company possesses expert knowledge of the decision context [21].

Wu and Gonzalez [47] indicated that previous studies of weighting functions for risk attitude have suggested an inverse S-shaped function, first concave and then convex. However, these studies faced a methodological shortcoming since estimation procedures have required assumptions about the functional form of the weighting functions. Thus, they use prospect theory to confirm their studies and found three results. First, the data-fitting exercise indicates that a weighting function that is strictly non-linear within the boundaries generally outperforms a linear weighting function with discontinuities at 0 and 1. Second, these common-consequence (concavity and convexity) conditions permit non-parametric tests of the curvature properties of the weighting function. Third, a more refined set of probabilities, namely concavity for small probabilities and convexity for large probabilities should be used.

In conclusion, because of the different tolerances of risk and the different risk attitudes, various industries or companies will set different risk coefficients or use different evaluation models. In the banking industry, for example, the variability of bank stock returns reflects the risks associated with all aspects of bank holding company activities [35]. These risks include asset risk, default risk, and charter value risks. Financial institutions face five generic risks, namely systematic, credit, counter party, operational, and legal risk [37]. Nickel and Rodriguez [36] indicated that helping managers understand the evolution of the risk relationship over time is important, and it is also important to examine whether the risk-return relationship depends on the managers' attitude towards risk or the operation differences among companies. Johanson and Vahlne's model incorporates perceived risk and tolerable risk. Based on their model and other author's international investment viewpoints, this paper develops a decision model considering risk attitude, expected revenue, and cost variables for financial holding companies.

4. Methodology

4.1. Johanson and Vahlne's model

Johanson and Vahlne's model emphasizes the gradual acquisition, integration and use of knowledge about foreign markets and operations, and then recommends incrementally increasing commitments to foreign markets as confidence in the market increases. There are four key items underlying Johanson and Vahlne's model [24] – market knowledge, market commitment, commitment decision, and current activities. The factors for market commitment include two state factors, the amount of resources committed and the degree of commitment. The higher the degree of commitment, the more the resources in question are integrated with other parts of the firm and their value is derived from these integrated activities. The amount of resources committed is indirectly related to the size of the investment in the market. In order to clarify the roles of integrating the experience of the firm into the internationalization process, the authors distinguish between firm experience and market experience. Because of the performance of current activities, both experiences are necessary. For the commitment decision, the authors distinguish between an economic effect and an uncertainty effect for each additional commitment. They note that the economic effect is associated primarily with increases in the scale of operations in the market. Further, market uncertainty is reduced through increased interaction and integration with the market environment.

The following equation describes the systems of relationships underlying Johanson and Vahlne's commitment decision strategy.

$$\begin{aligned} R_i^* &= \text{Maximum tolerable market } i \text{ risk} \\ &= f\,(\text{firm's resource position, firm's risk approach}) \\ R_i &= \text{Market } i \text{ risk situation} \\ &= C_i * U_i \end{aligned}$$

where

C_i Market i commitment
U_i Market i uncertainty

According to the above equations, companies should increase their investment scale when $R_i \leqq R_i^*$ and implement an uncertainty-reducing strategy seeking opportunities to invest in the market but withdraw from the market when $R_i > R_i^*$. Table 1 provides an example application of Johanson and Vahlne's model.

4.2. Revised international investment decision model

Andersen and Buvik [2] adopted the decision-making process in relation to international market

Table 1
An example application of Johanson and Vahlne's model

Firm no.	Risk attitude	R_i^*	C_i	U_i	$R_i = C_i * U_i$	Decision	
Firm 1	Risk wary	0.3	0.8	0.8	0.64		Withdraw
				0.4	0.32		Withdraw
			0.4	0.8	0.32		Withdraw
				0.4	0.16	Invest	
Firm 2	Risk neutral	0.5	0.8	0.8	0.64		Withdraw
				0.4	0.32	Invest	
			0.4	0.8	0.32	Invest	
				0.4	0.16	Invest	
Firm 3	Risk lover	0.7	0.8	0.8	0.64	Invest	
				0.4	0.32	Invest	
			0.4	0.8	0.32	Invest	
				0.4	0.16	Invest	

Note: The values of R_i^*, C_i, and U_i are assumed values describing various risk attitudes of firms.

selection. The steps include problem definition, identifying choice criteria, criteria weighing, generation of alternatives, rating alternatives based on the criterion, and finally calculating the optimal decision. Chen, Fine and Huberman [8] indicated that rational expectation theory shows that markets have the capacity not only to aggregate information held by individuals, but also to convey it via the price and volume of assets associated with that information. March and Shapira [32] expressed that in conventional decision theory formulations, choice involves a trade-off between risk and expected return. Risk wary decision makers prefer relatively low risks and are willing to sacrifice some expected return in order to reduce the variation in possible outcomes. Risk seeking decision makers prefer relatively high risks and are willing to sacrifice some expected returns in order to increase the variation of outcomes. Wu and Gonzalez [47] also indicated that risk aversion for most gains and low probability losses are asymmetrical and that individuals treat losses and gains differently.

According to the discussion about risk averse and risks seeking behavior and the relationship between risk and expected returns, this research formulates an example to describe the revised Johanson and Vahlne investment decision model. Basically, the revised international investment model adopts ER_j ($P_{ij} * \mathrm{Outcome}_{ij}$), Cost_j and PR_j as the model parameters to replace market risk (market uncertainty U_i and market commitment C_i) and firm's risk tolerance degree (R_i^*) from Johanson's model. The replacements are justified as follows. In practice, the sources of market information are varied, which causes difficulties for firms to precisely quantify the market risk. Further, the risk tolerance depends on the firm's investment decision experience, capital scale, and manager's subjective judgment. Therefore, the comparison between market risk (R_i) and risk tolerance (R_i^*) is difficult to quantify in practice. However, it is fairly easy to estimate the expect revenue of projects under market uncertainty (U_i). ER_j is defined as the expected revenue under the jth market. When a firm can define or estimate the market knowledge needed for market entry decisions, then the task is to compute the expected revenue (ER_j) to be derived from the estimated sales volume given the product price in the target market. The firm further evaluates the possibilities PR_j of achieving the revenue in terms of the company's risk attitude (which replaces the measure of the firm's risk tolerance degree R_i^*). The risk attitude is used to weigh the risk factors after evaluating the market uncertainty using market knowledge and the firm's experience. In the revised investment decision example, the authors model and compare two firms with different risk attitudes (risk wary and risk taker).

Market commitment defines the firm's involvement level and willingness to invest in a market and is quantified by evaluating Cost_j, the investment cost of the jth market. The higher the market commitment degree (C_i), the higher the investment cost (Cost_j) to enter a market. Investment cost may include factors such as transaction cost, management cost, operating cost, production cost, labour cost, coordination cost [7,48], and other costs. Therefore, the cost variables can be numerous various and may be expressed by a linear or non-linear function on the basis of firm's demands. Hence, when the expected revenue, multiplied by the

Table 2
An example of revised investment decision model (unit: NT$)

Firm no.	Market no. $j=3$	P_{ij} $i=2$	Outcome_{ij}	ER_j	Variance	PR_j	Cost_j	$\text{Profit}_j = \text{PR}_j * \text{ER}_j - \text{Cost}_j$
Firm 1 (risk wary)	Market 1 (high risk)	0.3	9,000,000	600,000	3.024E+13	0.5	250,000	$0.5 * 600{,}000 - 250{,}000 = 50{,}000$
		0.7	−3,000,000					
	Market 2 (mid risk)	0.5	2,000,000	500,000	2.25E+12	0.7	250,000	$0.7 * 500{,}000 - 250{,}000 = 100{,}000$
		0.5	−1,000,000					
	Market 3 (low risk)	0.7	600,000	435,000	6.35E+10	0.9	250,000	$0.9 * 435{,}000 - 250{,}000 = 141{,}500$
		0.3	50,000					
Firm 2 (risk taker)	Market 1 (high risk)	0.3	9,000,000	600,000	3.024E+13	0.9	250,000	$0.9 * 600{,}000 - 250{,}000 = 290{,}000$
		0.7	−3,000,000					
	Market 2 (mid risk)	0.5	2,000,000	500,000	2.25E+12	0.8	250,000	$0.8 * 500{,}000 - 250{,}000 = 150{,}000$
		0.5	−1,000,000					
	Market 3 (low risk)	0.7	600,000	435,000	6.35E+10	0.7	250,000	$0.7 * 435{,}000 - 250{,}000 = 54{,}500$
		0.3	50,000					

Note: Data show the relationship between risk tolerance and the degree of market commitment. The higher the Variance_j, the higher the market risk. P_{ij} means the prior possibility of Outcome_{ij} depends on the market information and market knowledge. In order to simplify the model, the study assumed that the market information, market knowledge, and market commitment between the two firms are the same. PR_j is assumed based on the firms' risk attitude. The risk wary firm prefers a low risk market with a lower variance of outcomes and the risk-seeking firm prefers a higher risk market with a higher variance of outcomes.

probability of achieving the revenue is greater than the investment cost, then the firm should invest in the market. The rule for deciding when to invest in a market is $\text{PR}_j * \text{ER}_j \geqq \text{Cost}_j$.

Thus, this paper proposes a revised integer-programming model based on Johanson and Vahlne's early research. The revised investment decision model is derived as follows. In Table 2, the examples of two firms' investment profiles (with distinct attitudes toward market risks) are listed.

$$\text{Maximize} \quad \pi = \sum_{j=1}^{n} \left[PR_j * \left(\sum_{i=1}^{m} (\text{Outcome}_{ij} * P_{ij}) \right) - \text{Cost}_j \right] * \text{Iv}_j$$

$$\text{Subject to} \quad \sum_{j=1}^{n} (\text{Cost}_j * \text{Iv}_j) \leqslant \text{Cost}_F,$$

$$\text{Iv}_j = (0, 1),$$

$$\sum_{i=1}^{m} P_i = 1,$$

$$0 \leqslant P_{ij} \leqslant 1,$$

$$0 \leqslant PR_j \leqslant 1,$$

$$i = 1, 2, 3, \ldots, m,$$

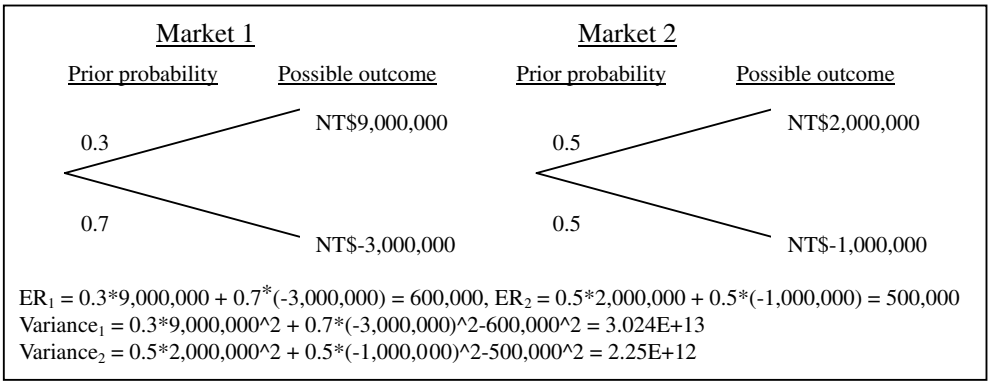
$$j = 1, 2, 3, \ldots, n,$$

where

Cost_j the investment costs for a given market [48]
Cost_F the total restricted investment cost for all the markets considered by firm
Iv_j the decision to invest ($\text{Iv}_j = 1$) or withdraw ($\text{Iv}_j = 0$) from a market
i the number of different types of risk in a given market
j the number of different markets
Outcome_{ij} the possible outcome under condition i and j market
$P_{i.}$ the sum of probabilities under the Outcome_{ij} condition when market j is fixed
P_{ij} the prior probabilities of Outcome_{ij} vary with market information and market knowledge
PR_j the achievable probabilities of ER_j vary with the investors' risk attitudes.

The integer-programming problem is solved using Lingo and Excel software. The example sets all variables except for Iv_j. The value of Iv_j determines whether or not to invest in the project. After confirming Iv_j, the company derives the maximum values π and the total cost. Table 2 shows two firms with two different risk profiles. In order to simplify the example, the authors fixed Outcome_{ij}, Cost_j, and P_{ij}. Fig. 1 shows that the firms derive two Outcome_{ij} values and the two prior probabilities from the market. The firms then compute the expected return and variance (the variance value represents the degree of risk). The sum of prior probabilities under one market must be 1. Furthermore, in order to simplify the model comparing two firms facing the same market, the P_{ij} are assumed to be equal (Table 2).

Risk wary investors prefer low risks and are willing to sacrifice some expected return in order to reduce the variation in possible outcomes. There-



Note. Data show the possible outcomes and prior probability under market 1 and market 2.

Fig. 1. The computation of ER_j and $Variance_j$ for Market 1 and Market 2 in Table 2.

fore, in this model, the values of PR_j vary depending on the firms' risk attitudes. The risk wary investor, when facing a high risk market, sets a lower value for PR_1 to evaluate the market 1 investment decision and expects stable investment returns. On the contrary, the risk taker sets a higher PR_1 and expects a higher investment return. Even though the prior probability and the possible outcomes are equal for the same market situation, the investment decisions vary based on the firm's risk attitudes. Furthermore, if the firms assign more $Cost_F$ to their investment project, their investment decisions change accordingly.

Table 3 shows the optimal solutions of the two firms using Lingo and Excel software (Figs. 2 and 3). The resulting matrix enables the firm to execute its strategic plan quantitatively and objectively. From Table 3, the risk wary firm invests in market 2 (mid risk) and market 3 (low risk) under the $Cost_{F1}$ restriction. The same firm will choose all markets to invest in under the $Cost_{F2}$ restriction. The risk taker firm chooses market 1 (high risk) and market 2 (mid risk) to invest in under the $Cost_{F1}$ restriction and all markets under the $Cost_{F2}$ restriction. Comparing the two firms' investment decisions, firm 2 receives a higher estimated investment profit.

5. Case study

The history of Taiwan's banking market can be divided into three stages. Before 1992, most banks were public banks and controlled by the government. As the Legislature Yuan revised the banking laws, many new banks were established after 1992. After Taiwan became a member of WTO in 2002, the number of foreign banks in the Taiwan market began to increase. Taiwan banks cannot avoid the transformation from being local to acting global. In 2003, 14 financial holding companies were established after several mergers and ventures with local financial institutions [43].

Furthermore, the Basel II Accord will be implemented in Taiwan at the end of 2006. In order to help banks adopt the new rules of Basel II and boost

Table 3
Optimal solutions derived for Firm 1 and Firm 2 using Lingo and Excel software (unit: NT$)

	$Cost_{F1} = 600{,}000$				$Cost_{F2} = 800{,}000$			
	Market no.	Iv_j	Max π	Total cost	Market no.	Iv_j	Max π	Total cost
Firm 1 (risk wary)	Market 1 (high risk)	0	241,500	500,000	Market 1 (high risk)	1	291,500	750,000
	Market 2 (mid risk)	1			Market 2 (mid risk)	1		
	Market 3 (low risk)	1			Market 3 (low risk)	1		
Firm 2 (risk taker)	Market 1 (high risk)	1	440,000	500,000	Market 1 (high risk)	1	494,500	750,000
	Market 2 (mid risk)	1			Market 2 (mid risk)	1		
	Market 3 (low risk)	0			Market 3 (low risk)	1		

Note: Investment in a market when $Iv_j = 1$ or withdraw from a market when $Iv_j = 0$. The max π and total costs are computed using values for Iv_j, $Cost_j$, and $profit_j$.

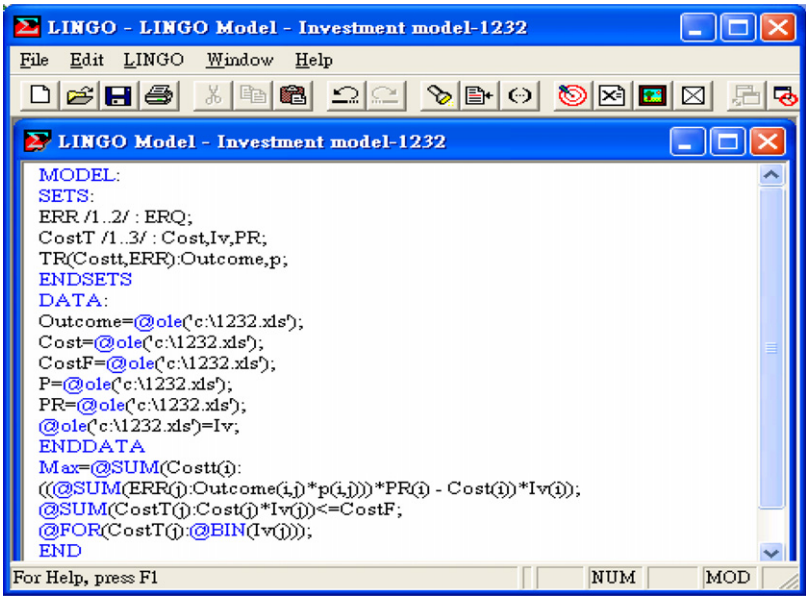


Fig. 2. The Lingo integer programming example for FHC A in Table 2.

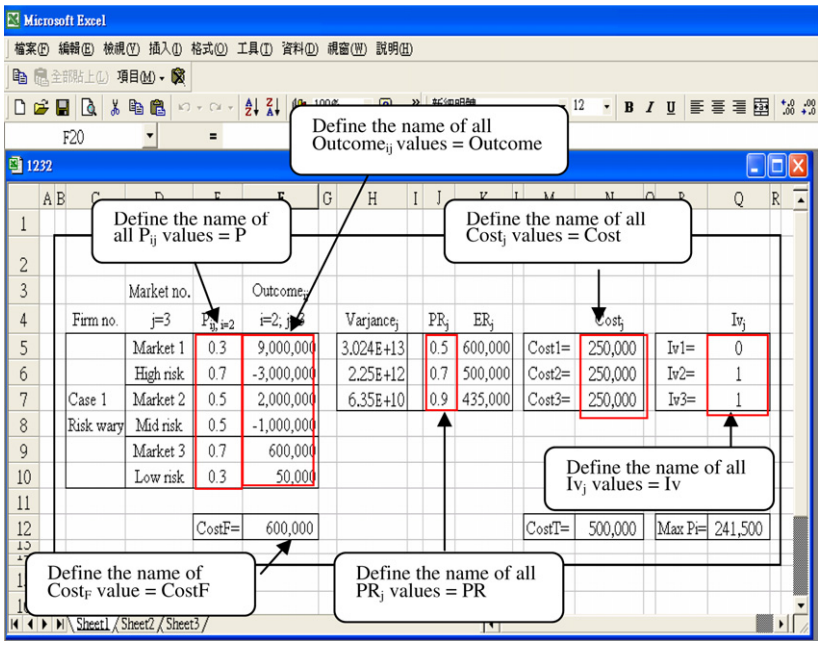


Fig. 3. The example Excel data input for FHC A in Table 2.

their risk management capability, the Financial Supervisory Commission and the Bankers Association set up joint research taskforce to study the rules and propose action plans for promoting compliance. Taiwan's government hopes that in the process of promotion, banks will face fewer obstacles in implementing the Accord through experience sharing while supervisor-bank collaboration mechanism is established [6].

The current objective of Taiwan government is to build worldwide financial institutions for investment and develop large scale and internationally recognized firms across all economic sectors. The investment decision-making processes of Taiwan's

financial institutions are frequently managed by the risk management department, the investment decision department, and then approved by the chiefs of financial holding companies. Therefore, even though the market information and market knowledge comes from the internal sources, the different risk attitudes and market experiences of the chiefs heavily influence final decisions. To confirm the revised international investment decision model, interviews were conducted with two international financial holding company managers. The interviews are used to confirm the revised international investment decision model and to derive actual values for the investment decision tables.

5.1. Financial holding company A

Financial holding company A promotes the business philosophy of "trustworthiness, sincerity, professionalism and innovativeness," and continuously upgrades its services with new products. Financial holding company A (FHC A) is a conglomerate that includes insurance, commercial banking, securities, asset management, venture capital, land and property management, construction, leisure and entertainment services, charitable foundations, art foundations, futures, bills finance, and investment services.

To confirm the revised model, the authors interviewed the vice president and director of the group risk management office at FHC A. The authors summarized his views regarding the Taiwan banking market and revised the model according to his suggestions. First, the products and services of Taiwan banks differ depending on the operating objectives. For example, the products and services of commercial banks include deposits and credit. Investment banks are currently seeking opportunities to invest in industry or business and this strategy entails a high probability of losses. Moreover, industrial banks target industrial customers but are suffering from a declining number of customers and are exploring alternative methods of raising capital. FHC A was originally an insurance company and maintains a risk wary investment attitude. Market knowledge and market information used for risk analysis is often purchased from professional research and consulting organizations. The company ranks the investment risk of various countries from high degree to low degree as follows: Indonesia, Malaysia, China, Vietnam, Hong Kong, Thailand, Singapore, Taiwan and America. FHC A has established a risk management department to help the company evaluate investment projects. Although there are numerous risk factors that can be considered, this research focuses on the critical risk factors chosen by experienced investment bankers [45]. The head of FHC A's risk management department indicated that the risk factors considered for their investment projects include country risk, industry risk, product life cycle risk, and operation risk. Concerning Basel II, the vice president is a member of the joint research taskforce in Taiwan. He believes that Basel II will strengthen Taiwan's financial operating environment by enabling financial institutions to perform more prudent risk evaluations and simultaneously reduce the risk of financial crisis. FHC A has incorporated Basel II process into their risk management system. FHC A has built an electronic risk management system to help evaluate market risk and investment risk. However, the final investment decision depends on the chief of FHC A. Whether to investment in a project or not depends on the estimated loss rate. Therefore, regarding the PR_j in the revised model, the manager suggested that the value be changed to 1-$Loss_j$. The other variables stay the same as proposed in Section 4.2. According to the vice president's opinions, the revised model should be stated as:

$$\text{Maximize} \quad \pi = \sum_{j=1}^{n} [ER_j * (1 - Loss_j) - Cost_j] * Iv_j$$

$$\text{Subject to} \quad \sum_{j=1}^{n} (Cost_j * Iv_j) \leqslant Cost_F$$

$$Iv_j = (0, 1)$$

$$ER_j \geqslant 0$$

$$0 \leqslant Loss_j \leqslant 1$$

$$j = 1, 2, 3, \ldots, n$$

where

ER_j the expected value of total revenue under j market condition.

$Loss_j$ the probability of ER_j loss under j market.

$Loss_j$ $W_1 *$ country risk $+ W_2 *$ industry risk $+ W_3 *$ product life cycle risk $+ W_4 *$ operation risk; where $W_v =$ Weight value on various risk variables. $0 \leqq W_v \leqq 1$, $\sum_v W_v = 1$.

Next, the authors listed five countries and invited the department head to estimate the different values of 1-$Loss_j$, ER_j, and $Cost_j$. Therefore, the authors

Table 4
Financial holdings company A's application of the revised investment decision model (unit: NT$ thousands)

Investment plans	Market no. $j = 5$	$1 - \text{Loss}_j$	ER_j	Cost_j	$\text{Profit}_j = \text{ER}_j * (1 - \text{Loss}_j) - \text{Cost}_j$
1	Indonesia	0.3	500,000	250,000	$500{,}000 * 0.3 - 250{,}000 = -100{,}000$
2	China	0.4	850,000	330,000	$850{,}000 * 0.4 - 330{,}000 = 10{,}000$
3	Hong Kong	0.5	1,000,000	448,226	$1{,}000{,}000 * 0.5 - 448{,}226 = 51{,}774$
4	USA	0.7	450,000	320,000	$450{,}000 * 0.7 - 320{,}000 = -5000$
5	Taiwan	0.9	400,000	300,444	$400{,}000 * 0.9 - 300{,}444 = 59{,}556$

Note: Data collected from financial holding company A's 2002 year book and interviews with the vice president of risk management.

Table 5
Optimal solutions for FHC A's example using Lingo and Excel software (unit: NT$ thousands)

Investment plans	$\text{Cost}_{F1} = 800{,}000$				$\text{Cost}_{F2} = 1{,}200{,}000$			
	Market no. $j = 5$	Iv_j	Max π	Total cost	Market no. $j = 5$	Iv_j	Max π	Total cost
1	Indonesia	0	111,330	748,670	Indonesia	0	121,330	1,078,670
2	China	0			China	1		
3	Hong Kong	1			Hong Kong	1		
4	USA	0			USA	0		
5	Taiwan	1			Taiwan	1		

Note: Investment in a market occurs when $\text{Iv}_j = 1$ and withdrawal from a market occurs when $\text{Iv}_j = 0$. The max π and total costs were computed using the value of Iv_j, Cost_j, and profit_j.

completed Table 4 based on FHC A's investment plans and the recommendations from the vice president. In Table 5, the results generated using Lingo and Excel software are shown. Given the risk wary attitude of FHC A, there is a higher loss rate for various markets. In this example, owing to the established business operation guidelines, international competitive pressure, and lack of American market experience, FHC A assigns a lower loss rate for the USA and has not invested in this market. Although FHC A reports a higher potential loss rate for China and Hong Kong, given the cultural advantages, language advantages, and higher ER_j makes these two markets good targets for investment. Finally, the department head indicated a growing willingness to hire foreign employees to strengthen the international operating experience or to cooperate with foreign financial institutions. This strategy will assist FHC A to invest money in foreign markets with different cultural countries.

5.2. Financial holding company B

With the goal to become a leading financial holding company for overseas Chinese communities, financial holding company B (FHC B) strives to be an upright and trust worthy financial institution and to provide one stop financial services for customers. The company is approved by the Ministry of Finance for investment banking, bills financing, credit cards, trusts, insurance, securities, futures, venture capital, and investments in overseas financial institutions. An interview was conducted with the administrative and financial manager of FHC B's venture capital corporation. In addition to providing the risk attitude and investment decision model of FHC B, the manager described the investment strategy of the venture capital industry. FHC B maintains a neutral attitude towards risk and consults with the risk management department for most investment decisions. The venture capital company focuses on the future profit potential of the target investment as well as the changes in its stock prices. Regarding Basel II, the manager expressed that the banking subsidiary of FHC B has become a member of the joint research taskforce, and as such has incorporated the Basel II system to enhance their risk management system and strengthen their operating constitution. Although the venture capital corporation is not directly involved in the Basel II's implementation process, the guidelines underline their decisions. On the whole, the chief of FHC B's venture capital corporation authorizes project managers to make investment decisions. Therefore, the risk attitudes and professional experience of project managers greatly influences the final investment results. The variables considered for international investment decisions by FHC B's venture

capital corporation include country risk, industry risk, technology risk, company leader risk and financial risk. Based on these variables, weights are assigned and the risk value is calculated. Finally, according to the risk evaluation result and the return rate of project, the manager decides whether or not to invest in the project. Therefore, based on the suggestion of the manager [28], FHC B's investment decision model was corrected as follows:

$$\begin{aligned}
\text{Maximize}\quad & \text{Return rate} \\
& = \sum_{j=1}^{n}(\text{Return rate}_j \ * \ \text{Discount}_j) * \text{Iv}_j \\
\text{Subject to}\quad & \sum_{j=1}^{n}(\text{Cost}_j * \text{Iv}_j) \leqslant \text{Cost}_\text{F} \\
& \text{Iv}_j = (0,1) \\
& \text{Return rate}_j = \frac{(\text{ER}_j - \text{Cost}_j)}{\text{Cost}_j} \\
& \text{Retrun rate}_j > 0\% \\
& 0 \leqslant \text{Discount}_j \leqslant 1 \\
& j = 1,2,3,\ldots,n
\end{aligned}$$

where

Return rate the expected return rate of total investment.

Return rate$_j$ the expected return rate of investment under j market condition.

Discount$_j$ the different discount of return rate under return rate$_i$ condition.

Discount$_j$ W_1 * country risk + W_2 * industry risk + W_3 * technology risk + W_4 * company leader risk + W_5 * financial risk; where W_v = weight value on various risk variables. $0 \leqq W_\text{v} \leqq 1$, $\sum_\text{v} W_\text{v} = 1$.

For FHC B's model, the Discount variable is similar to the 1-Loss$_j$ variable used by FHC A. For example, if Loss$_j$ equals to 0.3, then the Discount$_j$ is 0.7. Therefore, the higher the value of Discount$_j$, the higher the estimated return rate. The authors listed the same five countries used for FHC A's interview and invited the financial manager to estimate the values for Discount$_j$, ER$_j$, and Cost$_j$. Given to the value of ER$_j$ and Cost$_j$, the return rate$_j$ is calculated. Therefore, given the revised model and investment data from FHC B's manager and annual yearbook, Table 6 was constructed. Following a risk neutral investment strategy and assuming sufficient market knowledge, FHC B adopts a higher discount rate (lower loss rate) than FHC A to evaluate their investment projects. Table 7 shows the investment decision of FHC B using two different Cost$_\text{F}$ restrictions.

In this interview, FHC B gives the China market a lower Discount$_j$ and has not invested in the

Table 6
Financial holding company B's revised investment decision model (unit: NT$ thousands)

The investment plans	Market no. $j = 5$	Discount$_j$	ER$_j$	Cost$_j$	Return rate$_j$ = [(ER$_j$ − Cost$_j$)/Cost$_j$] * Discount$_j$
1	Indonesia	0.7	2,200,000	1,691,023	[(3,000,000 − 1691023)/1691023] * 0.6 ≒ 0.21
2	China	0.5	200,000	150,000	[(350,000 − 150,000)/150,000] * 0.5 ≒ 0.17
3	Hong Kong	0.7	260,000	200,000	[(360,000 − 200,000)/200,000] * 0.7 ≒ 0.21
4	USA	0.8	1,100,000	889,020	[(1,500,000 − 889,020)/889,020] * 0.8 ≒ 0.19
5	Taiwan	0.9	155,000	120,000	[(180,000 − 120,000)/120,000] * 0.9 ≒ 0.26

Note: Data are from the financial holding company B's 2002-year book and interviews with the manager of the venture capital corporation.

Table 7
Optimal solutions for FHC B are using Lingo and Excel software (unit: NT$ thousands)

The investment plans	Cost$_{F1}$ = 3,000,000				Cost$_{F2}$ = 4,000,000			
	Market no. $j = 5$	Iv$_j$	Max return rate	Total cost	Market no. $j = 5$	Iv$_j$	Max return rate	Total cost
1	Indonesia	1	0.873	2,900,043	Indonesia	1	1.0397	3,050,043
2	China	0			China	1		
3	Hong Kong	1			Hong Kong	1		
4	USA	1			USA	1		
5	Taiwan	1			Taiwan	1		

Note: Invest in a market when Iv$_j$ = 1 and withdraw from a market when Iv$_j$ = 0. The maximum return rate and total cost were computed using values for Iv$_j$, Cost$_j$, and the projected return rate$_j$.

market. The reason given is that the Taiwan government hasn't completed the investment law to let native financial institutions enter the China market. Therefore, FHC B would follow the law and delay investment in the China market. However, they have a high willingness to enter the China market after the investment laws are revised. Possessing extensive international experience and operating many foreign branches, FHC B holds a positive attitude toward international investment. However, FHC B's guidelines have restricted operations as a global Chinese financial institution. Since most of their foreign branches currently target overseas Taiwanese and Chinese, expanding the market base to include new cultures will help FHC B become a global financial institution.

6. Discussion and conclusion

Internationalization involves many challenges and most companies have difficulties deciding how to execute their internationalization strategies. Numerous models have been designed for managers to efficiently and accurately assess their investments or projects. However, owing to shortcomings such as operating complexity or the demand for instant response, most managers simply select the method they are accustomed to for quicker decision-making. Some managers expressed dissatisfaction with traditional net present value (NPV) or discounted cash flow (DCF) techniques [33]. For example, the cash flow must be forecast over the expected time of the future profits, taxation policy, exchange rates, and political climate. The appropriate risk-adjusted discount factor must be obtained and most firms seldom change the discount rate to match the increased risk. In spite of these shortcomings, using a firm's characteristics to establish a specific risk evaluation system is important for building a profitable investment strategy. In our research, the authors transform the risk viewpoint to the probability of profit which decreases with increasing risk values. The revised international investment decision model helps companies develop and adjust their international strategy based on risk attitudes and financial variables commonly used by financial holding companies. Table 8 compares Johanson and Vahlne's model with the revised international investment decision model. The management implications and future directions of the revised international investment decision model follow. First, the authors choose PR_j, $Cost_j$, ER_j ($Outcome_{ij}$, P_{ij}), $Cost_F$, Iv_j, $1\text{-}Loss_j$, $Discount_j$ to be the parameters used in the models. By transforming the international process model [24,25] into an integer programming model, the spirit of risk related models [32,40] and respondents' opinions were included. For example, the risk attitude of investors can be changed to model investment experiences. Although the meaning of PR_j, $1\text{-}Loss_j$ and $Discount_j$ are similar, these parameters are decided by investors under different risk considerations. The case study showed that the estimated values of $1\text{-}Loss_j$ and $Discount_j$ for the same markets from two different firms were quite different. Owning to market uncertainty, the accidental enlarging of investment costs or the misestimate of sales volumes and product prices often occur, hence, the values of $Cost_j$ and ER_j are not certain and better estimation procedures are needed. In conclusion, the revised investment decision model is dynamic, supports Johanson and Vahlne's viewpoint, and provides a new quantitative approach for firms. Based on custom-made

Table 8
Comparison of Johanson and Vahlne's model to the revised international investment decision model

	Equality	Strategies	Decision
Johanson and Vahlne model	$R_i \leqq R_i^*$	None	Invest
	$R_i > R_i^*$	Fixed U_i, if C_i can be decreased, let $R_i \leqq R_i^*$	Invest
		Fixed C_i, if U_i can be decreased, let $R_i \leqq R_i^*$	Invest
		If both U_i and C_i can be decreased, let $R_i \leqq R_i^*$	Invest
		None	Withdraw
The international investment decision model	$ER_j * PR_j \geqq Cost_j$	None	Invest
	$ER_j * PR_j < Cost_j$	Fixed ER_j, if PR_j can be increased, let $ER_j * PR_j \geqq Cost_j$	Invest
		Fixed PR_j, if ER_j can be increased, let $ER_j * PR_j \geqq Cost_j$	Invest
		If both PR_j and ER_j can be increased, let $ER_j * PR_j \geqq Cost_j$	Invest
		If $Cost_j$ can be decreased, let $ER_j * PR_j \geqq Cost_j$	Invest
		None	Withdraw

The sum of $Cost_j$ must be restricted to less than $Cost_F$.

models, the firms are involved in formulation of models for their investment decisions.

Second, risk factors are numerous and accurate evaluation challenges the best managers. Most risk factors are related to market uncertainty, lack of market knowledge and lack of investment experience. With the rise of the Internet, information gathering methods have changed. Investors are better enabled to collect market information, to become familiar with the market and evaluate market risk. Kurtzman, Yago and Phumiwasana [29] indicate that without transparency in a countries' legal, economic, regulatory and governance, global investment and commerce is hindered. Hence, the transparency of information and trustworthiness in a country or market influences the risk evaluation of investors. Emerging markets welcome investors to boost the development of their countries. The prerequisite for attracting investors to a market is to increase the transparency of the market information. Building better market information databases, providing market databases over the Internet, and decreasing political risk facilitates international investment decision-making for investors.

Finally, the authors invited the respondents to express their opinions and operating guidelines. Therefore, the model parameters reflect the respondents' decision making processes. Future research directions should enlarge the model and build in functions for risk attitude, risk factors, and cost parameters. Future research should verify the model for other industries to aid their international investment decision process.

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