Journal of Business Research 63 (2010) 303–309

Contents lists available at ScienceDirect

Journal of Business Research

Influence of industry type on the relationship between international operations and risk☆

B. Elango *

Management and Quantitative Methods Department, College of Business, Illinois State University, Campus Box 5580, Normal, IL 61790-5580, United States

ARTICLE INFO

Article history:
Received 19 July 2007
Accepted 10 March 2009

Keywords:
International operations
Strategic risk
Global and multi-domestic industry

ABSTRACT

Reducing strategic risk has become an issue of paramount importance to corporations. One way to reduce such risk is through international operations. However, published research reports conflicting findings on the relationship between international operations and risk reduction. In addition, the literature leaves one avenue largely unexplored, namely, industry influence. Using a sample of 367 firms, this study tests for the relationship between internationalization and risk across global and multi-domestic industries. Study findings indicate a negative relationship between risk and internationalization, indicating that firms are benefited by reduced risk through internationalization. Additionally, regression models indicate the incremental rate of benefits due to internationalization is greater in the case of global industries, compared to multi-domestic industries.

1. Introduction

In recent years, one of the major concerns for corporations has been to reduce surprises in corporate earnings. This motivation, coupled with the requirements of the Sarbanes–Oxley Act, has led to many firms incorporating enterprise risk management techniques in their operations. While the usage of risk management techniques has met with success in reducing the impact of operational risk factors, it is not evident that such approaches can address strategic risks faced by a company. Strategic risks refer to risks that can devastate a company's shareholder value (Slywotzky and Drzik, 2005). Therefore, addressing strategic risks is one of the biggest challenges today in corporate strategy.

One method for a firm to reduce strategic risk is by increasing the scope of operations across countries, providing real options in managerial choices. Real options are investments in real assets, which confer to the firm the right to undertake certain actions in the future (Myers, 1977; Trigeorgis, 1996; Amram and Kulatilaka, 1999). Real options captures the flexibility afforded to managers in adapting decisions to evolving uncertainty in the environment, thereby reducing downside risk while accessing upside opportunities (Tong and Reuer, 2007a). These real options are different from commonly known financial options (e.g., financial derivatives, insurance contracts) available in public markets, as real options are not traded and are specifically tied to the flexibility offered by a firm's current strategies, resource profile and its environment (McGrath, 1997; McGrath et al., 2004). This notion of real options has been tested and validated in strategy, international business, finance and economics literature (Reuer and Tong, 2007) and can serve us well in enhancing our understanding of risk management (Li et al., 2007).

While strong rationale can be provided for risk reduction for international operations using the notion of real options (Kogut, 1983), extant research presents contradictory empirical evidence on the linkage between internationalization and risk reduction. For instance, (Kim et al. 1993) reported that international diversification was associated with the twin benefits of lower risk and higher returns, supporting the notion of flexibility and competitive options. Allan and Pantzalis (1996) and Tang and Tikoo (1999) empirically show that multinational operational flexibility enhances the ability of a firm to respond profitably to changes in the global environment, which results in increased market value for the firm. However, Lee and Kwok (1988) report lower financial leverage ratios by MNCs, which questions the underlying notion of risk reduction through international operations. Additionally, Reeb et al. (1998) report that systematic risk increases for a firm with higher levels of internationalization. Similarly, Reuer and Leiblein (2000) report that U.S. manufacturing firms with greater multinationality do not obtain lower levels of downside risk.

Although published research has explored the question if international operations lead to risk reduction, this conflicting finding serves as a stimulus for this study. In particular, this study seeks to add to

☆ The Katie School of Insurance Research Grant Program funded this project. The findings reported and the views expressed in this research are those of the author and do not necessarily reflect the position of Katie Insurance School. I thank Chris Anderson, Jason Clay, Sarita Cox, Jim Jones and Matt Schlenz for the help offered by them during the various phases of this study. I also thank the JBR Associate Editor Hans Mühlbacher and the reviewers for their suggestions for their guidance during the review process.

* Tel.: +1 309 438 5930; fax: +1 309 438 5510.
E-mail address: elango@ilstu.edu.

0148-2963/$ – see front matter © 2009 Elsevier Inc. All rights reserved.
doi:10.1016/j.jbusres.2009.03.016

prior research on this topic by incorporating the industry differences in the testing of the relationship between international operations and risk reduction. This need to incorporate an industry's characteristics is consistent with one of the fundamental themes in strategy and organizational theory literature, wherein it is recognized that that a firm's strategy outcomes would be influenced by the underlying opportunities or constraints of the industry environment (Goddard et al., 2009). Therefore, this study will test to see if the benefits of risk reduction due to international operations hold across industries wherein there are differences in the nature of international competition (Porter, 1986). Additionally, the operationalization of internationalization has been a subject of debate in the broader international business literature, as studies tend to use unidimensional measures (Sullivan, 1994). Therefore this paper uses a multidimensional operationalization of internationalization and empirically tests for the following two questions: 1) *Are firms benefited by reduced risk through internationalization?* and 2) *How do the risk reduction benefits vary across the global and multi-domestic industries?* The sample for this study will be manufacturing firms whose SIC codes lie between 2000 and 3999 (representing the majority of U.S. manufacturing industries). This study will serve to increase our understanding of corporate strategy development to reduce strategic risk and present significant implications for risk management and international business.

2. Real options and internationalization

2.1. Internationalization and risk reduction

Kogut (1983) provided the conceptual foundation linking the notion of real options with international operations. He argued that when a firm internationalizes operations, it gains operational flexibility within its multinational network. International operations allow a firm to shift value chain activities across subsidiaries which are dispersed when opportunities arise and disappear. This flexibility creates "real options", allowing a firm to respond to uncertainties by optimizing its operations within the network (Kogut, 1983; Kogut and Kulatilaka, 1994). Such options in international operations offer firms the strategic choice of reducing downside risk. For instance, given the rarities of observing perfect synchronization of markets (e.g., in pricing, currency rates, growth rates, interest rates, business cycles), risk can be reduced by a firm through diversification of markets (Riahi-Belkaoui and Alnajjar, 2002). When a firm has an internationally diversified network, it allows for shifting of operations in response to changes of relative prices in inputs or outputs (i.e., demand and supply) across the network. Additionally, these firms have the ability to arbitrage restrictions in prices, taxes and financial regulations through transfer pricing and other mechanisms within their network (Subramaniam and Watson, 2006). Therefore, such exploitation of varying market conditions allows the internationalized firm to reduce cost of production or enhance revenue generation compared to a purely domestic firm, assuming that cost increases due to dispersed operations are lower than the resulting enhanced revenue and cost savings. Kogut and Kulatilaka (1994) provide justification for such options through a model of production switching between two countries when there are volatile changes in exchange rates. Empirical evidence is provided by Rangan (1998) in his study of U.S. MNCs, wherein he found that exchange rate movements induce shifts in manufacturing and sourcing practices of such firms.

The benefits of such real options in international operations may not be limited to economic factors alone, but can also apply to reducing political risk and competitive risk. First, international operations allow the multinational to reduce political risk associated with focused operations in one country. While it is true in most instances that international operations in a host country may be politically riskier than investments in a home country, there exists a potential to reduce the combined risk of international activities even relative to the home country (Qian, 1996). For instance, dispersed operations make a firm less susceptible to the risk of political pressure and governmental changes (Brewer, 1981), allowing it to reduce commitments in risky countries. Second, operation in multiple markets provides for a firm to strike back against aggressive moves made by competitors, thereby reducing the risk for an international firm to face aggressive competitive challenges (Hamel and Prahalad, 1985). Additionally, operating in multiple countries allows a firm to selectively withdraw from markets where the competition is intense, thereby affording the option of competitive avoidance (Elango, 1998). Therefore, international operations can be considered as a portfolio of real options, allowing the firm to respond to changing conditions and enabling it to reduce risk through internationalization (Kogut, 1989; Kogut and Kulatilaka, 1994). Consequently, the following hypothesis is proposed:

Hypothesis 1. Internationalization has a negative relationship to strategic risk.

2.2. Industry, internationalization and risk reduction

While the earlier section argued that a multinational network offers real options, increasing the ability of the firm to respond to changes in the environment, in this section we postulate that the extent of options are constrained by the industry in which the firm operates. This need to incorporate industry characteristics is consistent with one of the fundamental themes in strategy literature, wherein it is recognized that that a firm's strategy should reflect the underlying opportunities or constraints of the environment (Luo, 1999). Studies on international strategy offer empirical evidence to support the notion that the type of industry impacts international strategy choices and the resulting outcomes (Birkinshaw et al., 1995; Johansson and Yip, 1994; Roth and Morrison, 1990).

In the international strategy literature, industries have been classified in a broad continuum, based on the importance of international competition (Doz, 1985; Prahalad and Doz, 1987; Porter, 1980; Morrison, 1990). Visualized as a spectrum, located at one end are industries which are global, and at the other are industries which are multi-domestic in nature. Examples of multi-domestic industries are consumer packaged goods and machinery tools, while global industries include semiconductors, aircraft manufacturing, etc. In global industries, firms face significant pressure to reduce costs and therefore tend to make relatively standardized products across countries served. In contrast, firms in multi-domestic industries face less pressure to reduce costs, but have a greater need to offer products suited to local requirements (Porter, 1986).

Given the variation across industries in the ability of firms to sell common products, it places restraints on the ability of a firm to transfer or redeploy real assets across countries. This is due to the fact that real assets are to some degree irreversible and the ability to redeploy them varies by industry (Dixit and Pindyck 1994; Rivoli and Salorio, 1996). To the degree an asset cannot be redeployed, its option value would be limited, leading to a decrease in its risk reduction benefits. Therefore, it stands to reason the notion of real options in international operations and its attendant benefit in risk reduction exists only when "…the multinational network could realize the option value of switching raw materials, production, and sales across subsidiaries…" (Li, 2007: p: 82). Vassolo et al. (2004) point out that when a firm can leverage its options portfolio across various settings, the economic benefits from the portfolio will be higher due to super-addictive (i.e., synergistic) properties. Therefore, in the case of global industries, since a firm uses a greater commonality of product across various markets, the risk reduction benefits would be higher since the portfolio is likely to be super-addictive. On the other hand, in multi-domestic industries, the option to switch would be constrained since

localized products and production processes cannot be shifted across markets (Li, 2007). Therefore, the following hypothesis is proposed:

Hypothesis 2. The strength of the negative relationship between internationalization and strategic risk is higher in global industries in comparison to multi-domestic industries.

We recognize two caveats to this argument. First, exploitation of such options requires the firm to have the ability to understand, monitor and respond to external opportunities appropriately. Additionally, the firm must have systems and structures which allow for redeployment of assets within its multinational operations (Kogut, 1985). Second, Tong and Reuer (2007b) caution that incremental benefits of such options could be reduced as a firm's exposure to number of markets increases and coordination costs rise due to organizational complexity.

3. Research methodology

The following sections will summarize the data collection procedure, operationalization of variables, and selection of control variables used in this study.

3.1. Data collection procedure

The primary research objective of this study is to determine if there are any differences in the internationalization–risk relationship across the two categorizations of industries commonly alluded to in the international strategy literature. The first step was to classify manufacturing industries into two categories based on their SIC codes. This study uses the methodology and measures developed by Makhija et al. (1997) to classify industries based on the level of international trade (LIT) and intra-industry trade (IIT) in an industry, using data collected from the U.S. Department of Commerce. LIT captures the degree of foreign market orientation of the firm's domestic industry, while IIT captures the relative reliance of the domestic industry on foreign sales and foreign purchases. However, it should be noted that Makhija et al. split industries into four groups: integrated global, multi-domestic, simple global, and multi-domestic transitional. Since the theoretical arguments made in the hypothesis section focused either on multi-domestic or integrated global industries (semiconductors, aircraft manufacturing, etc.) wherein there is a large amount of intrafirm trade, this study's focus is limited to these two industries. Following the practice of Makhija et al., multi-domestic industries are classified as those measuring less than .5 for both LIT and IIT, while integrated global (henceforth referred to as global) industries are those measuring more than .5 for both LIT and IIT. Industries (i.e., transitional or simple global industries) which did not fit into either of these two groups were not included in the analysis.

Once global and multi-domestic industries were identified by their SICs, the second step involved identifying firms in the WorldScope database within these SICs. WorldScope was chosen for firm level data because it presents firm level information on the extent of foreign sales and foreign assets held by the firm (i.e., independent variable) along with the variables of interest of this study. Additional information on the subsidiaries of firms across countries was collected from the *Directory of Corporate Affiliations*. Because of data constraints across the three sources (i.e., U.S. Department of Commerce, WorldScope database and the *Directory of Corporate Affiliations*), this study focuses on the time period 1995–1997 and on firms whose revenue is in excess of $10 million at the time of initiation of this study. For instance, the *Directory of Corporate Affiliations* reports information on firms with revenues in excess of $10 million, and certain industry data which were required for computing IIT and LIT measures for classifying industries were available only for this time period. After elimination of firms with missing values, the final sample consisted of 367 firms, with 157 firms representing the global industry and 210 representing the multi-domestic industry.

3.2. Variable operationalization

In the broader literature of international business, there have been repeated calls for the usage of multidimensional measures of internationalization, as one dimension may not capture internationalization completely (Christophe and Lee, 2005; Sullivan, 1994). A review of the literature indicated that a significant number of studies use percentage of foreign sales to total sales, which is referred to as foreign sales ratio (e.g., Buhner, 1987; Grant, 1987; Grant et al., 1988; Geringer et al., 1989; Kim et al., 1993; Collins, 1990; Tallman and Li, 1996; Capar and Kotabe, 2003; Elango, 2006; Thomas, 2006). A few of the studies use percentage of foreign assets to total assets, also known as foreign asset ratio (Daniels and Bracker, 1989; Elango, 2000). Others have measured internationalization as international market diversification measure (Hitt et al., 1997) or as country depth captured by the number of subsidiaries an MNC has in a particular country as well as the number of countries in which a firm operates, which is referred to as country breadth (Tang and Tikoo, 1999).

We believe each of the above variables measure important components of internationalization and capture different facets of internationalization (Petersen and Welch, 2002). For instance, foreign sales ratio and foreign asset ratio capture the exposure to international markets in terms of sales and assets. However, these two commonly used measures do not capture the diversity of markets, number of countries, or level (depth) of involvement of a firm in a country. For these reasons there have been calls for the use of multidimensional measures of internationalization (Sullivan, 1994).

One multidimensional alternative is the transnational index used in United Nations reports (e.g., UNCTAD, 2006). This index is operationalized as the average of foreign sales ratio, foreign asset ratio and foreign employee ratio. However, this measure has been criticized in the literature for its shortcomings. First, it does not differentiate the spread of the operations by the multinational firm. Second, the inter-correlation between several items in the scale is below what would be considered an acceptable threshold (i.e., .35 and .39) for such scales (Ietto-Gillies, 1998).

We measure internationalization as a summation of foreign sales ratio, foreign asset ratio, international diversification, country breadth, and country depth. Since these items are expressed as ratios, the highest score a firm can potentially receive is 5. The logic of using linear combinations of single items is advanced by Sullivan (1994), wherein he claims such combinations improve psychometric properties, as they reduce measurement error and confounds while allowing reliability of the scale to be estimated (Bagozzi et al., 1991). The reliability coefficient (Cronbach's Alpha) for this was scale was .763, higher than .7 recommended by Nunnally (1978) for internal consistency and comparable to Sullivan's study which has a reliability of .79.

The dependent variable strategic risk is measured as variance in ROA. According to Bromiley et al. (2001), such variance measures have been used by the majority of studies on strategic risk. This practice of using variance measures to capture risk started with Bowman (1980) and has been subsequently practiced in many studies on risk (Jemison, 1987; Bettis and Mahajan, 1985; Fiegenbaum and Thomas 1988; Jegers, 1991; Gooding et al., 1996). We chose to focus on Return on Assets (ROA), as it is a commonly-used measure in many previous studies in the internationalization–performance literature (e.g., Grant et al., 1988; Hitt et al., 1997; Palich et al., 2000) and is of significant interest to managers and investors alike, being widely used to evaluate firm strategic performance. Additionally, because the study sample consists of manufacturing firms, this variable is of particular concern, as it focuses on the income stream of sunk investments made by the firm (Reuer and Leiblein, 2000).

3.3. Control variable selection

Based on past research, this study incorporates five firm-level control variables (firm size, firm growth rate, debt ratio, research

Table 1
Variable definition and data sources.

Variable	Description/Data source
Risk	*Variance (ROA)*$_{t=1-3}$
Internationalization	Σ(Foreign Sales Ratio, Foreign Asset Ratio, International Diversification, Country Ratio, Country Depth) Foreign Sales Ratio = Foreign Sales/Total Sales. *Source: WorldScope Database.* Foreign Asset Ratio = Foreign Assets/Total Assets. *Source: WorldScope Database* International Diversification = $1-\Sigma ID_i^2$ where ID represents the percentage of a firm subsidiaries across the five geographic regions of the world (North America, South America, Asia, Africa and Europe). *Source: Directory of Corporate Affiliations.* Country Breadth = Number of Countries/100. *Source: Directory of Corporate Affiliations.* Country Depth = $\Sigma(N_{ij}/d_{ij}$*Total Number of Subsidiaries) where, i = Number of Countries; j = Number of Subsidiaries; N_{ij} = The number of subsidiaries in a country$_i$; $d_j=2$ if j is 5 or more; $d_j=4$ if j is 4; $d_j=8$ if j is 3; $d_j=16$ if j is 2; and $d_j=32$ if j is 1. *Source: Directory of Corporate Affiliations.*
Product diversification	$1-\Sigma p_i^2$ (where p_i represents the percentage of firm revenue generated on product line i). Source: WorldScope database. *Source: WorldScope Database.*
Research intensity	Research and development expenditures/Sales. *Source: WorldScope Database*.
Sales growth	Percentage change in firm size. *Source: WorldScope Database*.
Debt ratio	Debt/Assets held by the firm. *Source: WorldScope Database*.
Firm size	Number of employees. *Source: WorldScope Database*.
Industry dummy	Firms in global industries were dummy coded 1, 0 otherwise.

intensity, and diversification) in the testing of the relationships. These five variables were selected based on previous research and need to be controlled for, as they have been commonly known to influence performance outcomes of internationalization (e.g., see Tallman and Li, 1996; Hitt et al., 1997; Lu and Beamish, 2001). Firm size is measured by the number of employees, as large firms can have scale or scope advantages (or disadvantages) over small firms (Wu and Shanley, 2009). Debt ratio is included in the models to control for the effect of financial leverage on risk. Correspondingly, firm growth rate is controlled for, as firms with higher growth rates are likely to have higher risk in the short run. Two other variables (research intensity and diversification) were included in the models, as they have been deemed critical in the international business literature in influencing outcomes of internationalization (Lu and Beamish, 2004). Moreover, these two variables also represent major dimensions of firm strategy. Incorporation of these five control variables will allow for interpreting the study's findings with greater confidence. The operationalizations of these variables are based on previous research in the literature (e.g., Elango, 2005) or represent well-established ratios which need no elaboration and are presented in Table 1 along with the data sources.

4. Discussion of results

The methodology employed in the testing of the hypotheses is the use of multiple regression models. Descriptive statistics of the variables used in the regression models, along with correlation values, are presented in Table 2. A review of the correlation tables indicates that the likelihood of multicollinearity issues influencing or biasing the results of the regression models used in this study is minimal. Additionally the independent variables used in the regression models were mean-centered to remove non-essential multicollinearity. Table 3 presents the results of regression models (1–4) . The first model is the control model, while in the later models the internationalization, industry dummy, and interaction term (internationalization*industry dummy) are added sequentially. Incremental *R*-square and *F* values are presented in the case of each of the models (in the following pairwise comparisons: 1–2, 2–3, 3–4). In each of the comparisons the incremental *R*-squares were significant, supporting the rationale for the inclusion of the variables.

Table 3
Regression results between internationalization and risk ($N=367$).

	Model 1	Model 2	Model 3	Model 4
Independent variables				
Sales growth	−.037	−.037	−.044	−.051
Research intensity	.266***	.286***	.269***	.267***
Firm size	−.045	−.026	−.035	−.023
Debt ratio	.035	.045	.068	.063
Product diversification	−.137***	−.128***	−.132***	−.139*
Internationalization		−.176***	−.168***	−.198***
Industry dummy			.175***	.284***
Interaction term (Internationalization *Industry dummy)				−.242**
Adjusted *R*-square	.081	.112	.139	.167
F value	7.658***	8.661***	9.441***	8.886***
Incremental *R*-square		.031	.027	.028
F value		2.1752**	2.4739***	3.1465***

*** = $p<.01$, ** = $p<.05$, *= $p<.1$. All the independent variables were mean centered in the regression models to remove non-essential multicollinearity. All beta values reflected standardized beta values.

Model 1 served as a control model for this study (*R*-square = .081, $p<.01$). The major motivation for this model was to use it to capture the incremental effect of internationalization on risk in Model 2. While the five variables in the control model were selected based on previous research, two of them, research intensity and product diversification were significant, indicating the need for controlling these variables (beta = .266 and −.137, $p=<0.1$, respectively). These two variables act in opposite directions: research intensity increases the risk of the firm, and product diversification reduces the risk of the firm.

Model 2 adds the internationalization term to Model 1 (*R*-square = .112, $p<.01$). Internationalization is negatively related to risk (beta = −.176, $P<.01$), indicating firms with international operations have less variance in returns, which is supportive of Hypothesis 1. Firms in the sample represent both multi-domestic and global industries. Model 3 adds the industry dummy to Model 2 variables to capture the influence of industry (*R*-square = .139, $p<.01$). The industry dummy loaded positively on risk (beta = .175, $p<.01$), indicating industry of the firm is a contributor to the underlying risk profile of a firm. In Model 4 the interaction term (internationalization*industry dummy) is added to the previous model, which loads negatively with risk (beta = −.242, $p<.01$). The results of

Table 2
Means, standard deviations and correlations ($N=367$).

Variables	Mean	Std. Dev.	1	2	3	4	5	6	7
1. Sales growth	10.26	20.90	1						
2. Research intensity	4.29	4.77	.071	1					
3. Firm size	40,939	439,685	−.009	.060	1				
4. Debt ratio	21.05	16.11	.023	−.285(**)	−.013	1			
5. Product diversification	.28	.23	−.127(*)	−.154(**)	.087	.104(*)	1		
6. Internationalization	1.37	.69	−.001	.097	.119(*)	.030	.053	1	
7. Risk	21.06	38.26	.001	.271(**)	−.041	−.055	−.174(**)	−.157(**)	1

*** = $p<.01$, ** = $p<.05$.

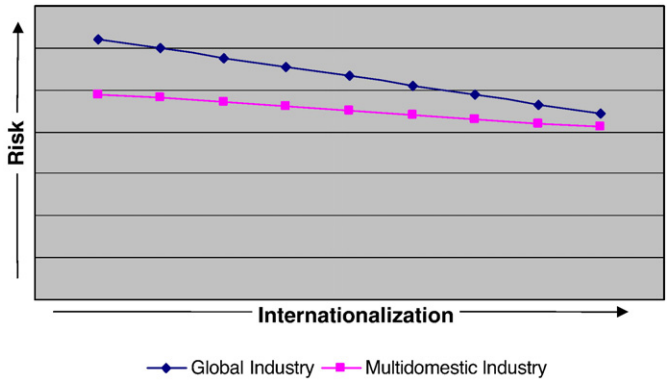

Fig. 1. Internationalization risk relationship across multi-domestic and global industries.

Model 3 and Model 4 taken together support the hypothesis that firms in global industries incur greater benefits of risk reduction compared to firms in multi-domestic industries.

To better understand the benefits of this reduced risk, we plotted the relationship for internationalization, industry and risk, while holding other variables constant (Fig. 1). Fig. 1 illustrates that there is a negative relationship between internationalization and risk across the two industries studied. While firms in both industries are benefited by reduced risk through internationalization, the incremental benefits of internationalization are much greater (indicated by the steeper slope) in the case of global industries. This finding is very much consistent with the two assertions made in the hypothesis section, wherein it was hypothesized that internationalization leads to risk reduction benefits; it also argued that incremental benefits would be higher in the case of firms in global industries compared to firms in multi-domestic industries (Tables 4 and 5).

4.1. Robustness tests

To increase confidence in the study findings, we conducted two robustness tests. First, Model 4 from Table 3 was replicated using industry-adjusted risk measures and is reported in Table 4. In this measure of risk, firm level ROA variance was divided by the three-digit SIC industry ROA variance to adjust for industry differences. The results of Model 5 (see Table 4) are very similar to those of Model 4 (Table 3) for the variables of interest to this study. For instance, the beta loading in Model 4 (which used unadjusted risk numbers as the dependent variable) and Model 5 (which used industry-adjusted risk numbers as the dependent variable) for internationalization, industry dummy, and interaction term were −.198 vs. −.145, .284 vs .263, and −.242 vs. −.297, respectively. However, to our surprise, product diversification, which contributed to reduction in risk (beta = −.137, $p<.1$: Model 4) turned non-significant with much lower beta loading (beta = −.033: Model 5). Second, we conducted split sample analysis, wherein we ran regression models separately for global and multi-domestic firms. Model 6 pertains to firms in global industries and Model 7 pertains to firms in multi-domestic industries. Both of the regression models were significant (F values of 4.132, $P<.01$; and 5.912, $P<.01$, with adjusted R-square values of .142 and .149, respectively), but beta loadings indicate that the impact of these variables is quite different for firms in global and multi-domestic firms. While internationalization loaded negatively in the case of both industries, in the case of global industries the loading was higher compared to multi-domestic industries (beta = −.217 and −.140, $p<.01$). To confirm the expectation that the slopes across the models vary, we also conducted a Chow test. We found ($F=3.2346$, $P<.01$) that the independent variables have different effects for firms in global versus multi-domestic industries.

Table 4
Regression results between internationalization and industry adjusted risk ($N=367$).

	Model 5
Independent variables	
Sales growth	.078
Research intensity	.105***
Firm size	−.013
Debt ratio	−.056
Product diversification	−.033
Internationalization	−.145**
Industry dummy	.263**
Interaction term (Internationalization*Industry dummy)	−.297***
Adjusted R-square	.127
F value	4.877***

*** = $p<.01$, ** = $p<.05$, *= $p<.1$. All the independent variables were mean centered in the regression models to remove non-essential multicollinearity. All beta values reflected standardized beta values.

Table 5
Regression results between internationalization and risk across global and multi-domestic industries.

	Model 6 global industry ($N=157$)	Model 7 multi-domestic industry ($N=210$)
Independent variables		
Sales growth	−.043	−.045
Research intensity	.265***	.339***
Firm size	−.021	−.079
Debt ratio	.075	.083
Product diversification	−.159**	−.120*
Internationalization	−.217***	−.140***
Adjusted R-square	.142	.149
F value	4.132***	5.912***
Chow test results	3.2346***	

*** = $p<.01$, ** = $p<.05$, *= $p<.1$. All the independent variables were mean centered in the regression models to remove non-essential multicollinearity. All beta values reflected standardized beta values.

4.2. Limitations

Before proceeding to the final section of this paper, we wish to highlight this study's main limitations. The analysis presented in this study uses a limited set of control variables. For instance, it uses employees to control for firm size and it is quite possible that other industry dimensions (e.g., capital intensity, etc.) could also impact the study findings. The nature of the industry and its impact on internationalization is a topic of major interest within the IB literature (e.g., Elango, 1998) and cannot be covered adequately in one study, and additional studies are therefore needed in this regard. Other limitations include the usage of the single country sample and research design based on secondary data. Replication of this study's findings in varied country contexts, methodologies and time periods will alleviate these deficiencies. Finally, this study's paradigmatic focus has been on the notion of real options. A multinational firm's strategic choices and its outcomes is a dynamic, multidimensional, complex and iterative process and therefore global operations can be viewed in a multitude of perspectives (e.g., strategic flexibility, international diversification, etc.). Therefore, interpretation of the findings should be within the underlying parameters of this study. Despite these limitations, this study makes important contributions to the literature and has implications for theory and practice which are presented in the following section.

5. Concluding comments

This study's primary goal was to understand the role of industry in the relationship between internationalization and strategic risk reduction.

Based on the notion of real options, two hypotheses were proposed and tested across a sample of 367 firms. Both of these hypotheses were supported and this study's finding makes two important contributions to the literature. First, this study uses a multidimensional measure of internationalization to validate the notion of risk reduction through international operations. Study findings are consistent with the logic of real options argued in this paper, as well as previous studies in the topic (e.g., Kim et al., 1993; Allan and Pantzalis, 1996; and Tang and Tikoo, 1999). Second, this study adds to the knowledge on this sub-topic by showing how this relationship varies across global and multi-domestic industries. Consistent with Hypothesis 2 of this study, we find firms in global industries gain greater benefits from internationalization than do firms in multi-domestic industries. While the articulation of the hypothesis section was based on the notion that firms in global industries have a greater number of options that are super-addictive as products are more standardized, other supportive reasons can also be offered as to why this may be the case. Li (2007), drawing on management literature, points out organizational reasons why firms in multi-domestic industries may fail to optimize the benefits of risk reduction even when feasibility exists. This is due to the fact that subsidiaries of firms in multi-domestic industries are operated quite independently and hence have separate mandates compared to subsidiaries in global industries. Therefore, this local independence and autonomy could serve as a barrier, as it would discourage subsidiaries to cooperate when resources need to be shifted or transferred to other countries, even though it might be the optimal choice for the firm as a whole.

In closing, this study offers several implications for managerial practice and research. First, the study findings should be encouraging to firms seeking to reduce strategic risk. Firms are able to reduce risk by internationalizing operations, though the benefits of risk reduction are higher in global industries relative to multi-domestic industries. Through internationalization, firms in global industries may be able to offset some of the increased risk they incur due to their investments in research and development. Second, for researchers working in this area, this study uses a multidimensional measure of internationalization with desirable psychometric properties. While many have acknowledged the merits of using multidimensional measures of internationalization called for by Sullivan (1994), this study is one of the few which has pursued such an option with five dimensions. Finally, for researchers working on the topic of risk reduction, a fruitful avenue of further research would be focusing on the specific firm and industry factors which influence the nature of the slopes across industries. Replication of this study's findings across varied countries and time settings, as well as different conceptualizations of risk (e.g., downside risk) would also serve to increase our understanding of this topic, which is of fundamental importance to managers.

References

Allan L, Pantzalis C. Valuation of the operating flexibility of multinational corporations. Journal of International Business Studies 1996;27(4):633–53.

Amram M, Kulatilaka N. Real options: managing strategic investment in an uncertain world. Boston: Harvard Business School Press; 1999.

Bagozzi RP, Youjae Y, Phillips LW. Assessing validity in organization research. Administrative Science Quarterly 1991;36(3):421–58.

Birkinshaw J, Morrison A, Hulland J. Structural and competitive determinants of a global integration strategy. Strategic Management Journal 1995;16(8):637–55.

Bettis RA, Mahajan V. Risk/return performance of diversified firms. Management Science 1985;31(7):785–99.

Bowman EH. A risk/return paradox for strategic management. Sloan Management Review 1980;21(3):17–31.

Brewer HL. Investor benefits from corporate international diversification. Journal of Financial and Quantitative Analysis 1981;16(1):113–26.

Bromiley P, Miller KD, Rau D. Risk in strategic management research. In: Hitt MA, Freeman RE, Harrison JS, editors. The Blackwell handbook of strategic management. Malden: Blackwell; 2001.

Buhner R. Assessing international diversification of West German corporations. Strategic Management Journal 1987;8(1):25–37.

Capar N, Kotabe M. The relationship between international diversification and performance of service firms. Journal of International Business Studies 2003;34(4):345–55.

Christophe SE, Lee H. What matters about internationalization: a market-based assessment. Journal of Business Research 2005;58(5):636–43.

Collins JM. A market performance comparison of U.S. firms active in domestic, developed and developing countries. Journal of International Business Studies 1990;21(2):271–87.

Daniels JD, Bracker J. Profit performance: do foreign operations make a difference? Management International Review 1989;29(1):46–56.

Dixit AK, Pindyck RS. Investment under uncertainty. Princeton: Princeton University Press; 1994.

Doz Y. Strategic management in multinational companies. Oxford: Pergamon Press; 1985.

Elango B. The influence of industry and firm drivers on the rate of internationalization of U.S. firms. Journal of International Management 1998;1(4):201–21.

Elango B. An exploratory study into the linkages between corporate resources and the extent and form of internationalization. American Business Review 2000;XVIII(2):12–26.

Elango B. The influence of plant characteristics on the entry mode choice of manufacturing firms. Journal of Operations Management 2005;23(1):65–79.

Elango B. An empirical analysis of the internationalization performance relationship across emerging market firms. Multinational Business Review 2006;14(1):21–44.

Fiegenbaum A, Thomas H. Attitudes towards risk and the risk–return paradox: prospect theory explanations. Academy of Management Journal 1988;31(1):85-106.

Geringer JM, Beamish PW, daCosta RC. Diversification strategy and internationalization: implications of MNE performance. Strategic Management Journal 1989;10(2):109–19.

Goddard J, Tavakoli M, Wilson JOS. Sources of variation in firm profitability and growth. Journal of Business Research 2009;62(4):495–508.

Gooding RZ, Goel S, Wiseman RM. Fixed versus variable reference points in the risk–return relationship. Journal of Economic Behavior and Organization 1996;29(2):331–50.

Grant RM. Multinationality and performance among British manufacturing companies. Journal of International Business Studies 1987;18(3):79–89.

Grant RM, Jammine A, Thomas H. Diversity, diversification, and profitability among British manufacturing companies, 1972–84. Academy of Management Journal 1988;31(4):771–801.

Jegers M. Prospect theory and the risk–return relation: some Belgian evidence. Academy of Management Journal 1991;34(1):215–25.

Jemison DB. Risk and the relationship among strategy, organizational processes, and performance. Management Science 1987;33(9):1087–101.

Johansson JK, Yip GS. Exploiting globalization potential: U.S. and Japanese strategies. Strategic Management Journal 1994;15(8):579–601.

Hamel G, Prahalad CK. Do you really have a global strategy? Harvard Business Review 1985;63(4):139–48.

Hitt MA, Hoskisson RE, Kim H. International diversification: effects on innovation and firm performance in product diversified firms. Academy of Management Journal 1997;40(4):767–98.

Ietto-Gillies G. Different conceptual frameworks for the assessment of the degree of internationalization: an empirical analysis of various indices for the top 100 transnational corporations. Transnational Corporations 1998;7(1):17–39.

Kim WC, Hwang P, Burgers WP. Multinationals' diversification and the risk–return trade-off. Strategic Management Journal 1993;14:275–86.

Kogut B. Designing global strategies: profiting from operational flexibility. Sloan Management Review 1985;27(1):27–38.

Kogut B. Foreign direct investment as a sequential process. In: Kindleberger CP, Audretsch DB, editors. The multinational corporations in the 1980s. Boston: MIT press; 1983.

Kogut B. A note on global strategies. Strategic Management Journal 1989;10(4):383–9.

Kogut B, Kulatilaka N. Operating flexibility, global manufacturing and the option value of a multinational network. Management Science 1994;40(1):123–39.

Lee KC, Kwok CCY. Multinational corporations vs. domestic corporations: international environmental factors and determinants of capital structure. Journal of International Business Studies 1988;19(2):195–217.

Li J. Real options theory and international strategy: a critical review. In: Tong WT, Reuer JJ, editors. Advances in strategic management. Oxford, UK: JAI Press; 2007.

Li Y, James BE, Madhavan R, Mahoney JT. Real options: taking stock and looking ahead. In: Tong WT, Reuer JJ, editors. Advances in strategic management. Oxford, UK: JAI Press; 2007.

Lu J, Beamish PW. The internationalization and performance of SMEs. Strategic Management Journal 2001;22(6/7):565–86.

Lu J, Beamish PW. International diversification and firm performance: the S-curve hypothesis. Academy of Management Journal 2004;47(4):598–609.

Luo Y. The structure–performance relationship in a transitional economy: an empirical study of multinational alliance in China. Journal of Business Research 1999;46(1):15–30.

Makhija MV, Kim K, Williamson SD. Measuring globalization of industries using a national industry approach: empirical evidence across five countries and over time. Journal of International Business Studies 1997;28(4):679–710.

McGrath RG. A real options logic for initiating technology positioning investments. Academy of Management Review 1997;22(4):974–96.

McGrath RG, Ferrier WJ, Mendelow A. Real options as engines of choice and heterogeneity. Academy of Management Review 2004;29(1):86-101.

Morrison A. Strategies in global industries: how U.S. businesses compete. Westpoint: Quaron Books; 1990.

Myers SC. Determinants of corporate borrowing. Journal of Financial Economics 1977;5(2):147–75.

Nunnally J. Psychometric theory. New York: McGraw-Hill; 1978.

Palich LE, Carini GR, Seaman SL. The impact of internalization on the diversification–performance relationship: a replication and extension of prior research. Journal of Business Research 2000;48(1):43–54.

Petersen B, Welch LS. Foreign operation mode combinations and internationalization. Journal of Business Research 2002;55(2):157–62.
Porter ME. Competitive strategy. New York: Free Press; 1980.
Porter ME. Competition in global industries: a conceptual framework. In: Porter ME, editor. Competition in global industries. Boston: HBS press; 1986.
Prahalad CK, Doz Y. The multinational mission: balancing local demands and global vision. New York: Free Press; 1987.
Qian G. The effect of multinationality measures upon the risk–return performance of US firms. International Business Review 1996;5(3):247–65.
Rangan S. Do multinationals operate flexibly? Journal of International Business Studies 1998;29(2):217–37.
Reeb DM, Kwok CCY, Baek HY. Systematic risk of the multinational corporation. Journal of International Business Studies 1998;29(2):263–79.
Reuer JJ, Leiblein MJ. Downside risk implications of multinationality and international joint ventures. Academy of Management Journal 2000;43(2):203–14.
Reuer JJ, Tong TW. How do real options matter? Empirical research on strategic investment and firm performance. In: Tong WT, Reuer JJ, editors. Advances in strategic management. Oxford, UK: JAI Press; 2007.
Riahi-Belkaoui A, Alnajjar FK. Multinationality as a determinant of earnings persistence. Managerial Finance 2002;28(3):83–96.
Rivoli P, Salorio E. Foreign direct investment and investment under uncertainty. Journal of International Business Studies 1996;27(2):335–54.
Roth K, Morrison AJ. An empirical analysis of the integration–responsiveness framework in global industries. Journal of International Business Studies 1990;21(4):541–64.
Slywotzky AJ, Drzik J. Countering the biggest risk of all. Harvard Business Review 2005;83(4):78–88.
Subramaniam M, Watson S. How interdependence affects subsidiary performance. Journal of Business Research 2006;59(8):916–24.
Sullivan D. Measuring the degree of internationalization of a firm. Journal of International Business Studies 1994;25(2):325–42.
Tallman S, Li JT. Effects of international diversity and product diversity on the performance of multinational firms. Academy of Management Journal 1996;39(1):179–96.
Tang CY, Tikoo S. Operational flexibility and market valuation of earnings. Strategic Management Journal 1999;20(8):749–61.
Thomas DE. International diversification and firm performance in Mexican firms: a curvilinear relationship? Journal of Business Research 2006;59(4):501–7.
Tong WT, Reuer JJ. Real options in strategic management. In: Tong WT, Reuer JJ, editors. Advances in strategic management. Oxford, UK: JAI Press; 2007a.
Tong WT, Reuer JJ. Real options in multinational corporations: organizational challenges and risk implications. Journal of International Business Studies 2007b;38(2):215–30.
Trigeorgis L. Real options: managerial flexibility and strategy in resource allocation. Cambridge, MA: MIT Press; 1996.
UNCTAD. FDI from developing and transition economies: implications for development. World Investment Report, New York and Geneva: United Nation; 2006.
Vassolo RS, Anand J, Folta TB. Non-additivity in portfolios of expansion options: a real-options based analysis of equity alliances in biotechnology. Strategic Management Journal 2004;25(11):1045–61.
Wu J, Shanley MT. Knowledge stock, exploration, and innovation: research on the United States electromedical device industry. Journal of Business Research 2009;62(4):474–83.