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MULTINATIONALITY AND FIRM VALUE:

THE ROLE OF REAL OPTIONS AWARENESS

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We contribute to multinationality and real options theories by considering the role of firm heterogeneity in real options awareness for MNCs. We test the joint impact of real options awareness (RO-AWN) and multinationality on firm value using an extensive sample of U.S-listed international firms over the ten-year period 1996-2005. We show that when a firm's growth options and degree of RO-AWN are considered, multinationality has a significant positive impact on firm value and performance as measured by Tobin's Q, return-on-assets and the 3-year average stock returns. We find that the benefits of multinationality accrue asymmetrically to firms differing in RO-AWN. Managers who are more aware of their corporate real options are able to significantly enhance firm value. Our findings are robust to a range of dataset and measurement specifications, endogeneity issues and controlling for alternative theories of the firm.

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1. INTRODUCTION

Real options theory (ROT) suggests that strategic growth options and multinational flexibility switch options enable firms to adapt to business uncertainty and enhance corporate value (Kogut and Kulatilaka, 1994; Trigeorgis, 1996). Little is known, however, about the role of firm practices and management in recognizing, exploiting and managing real options opportunities (Coff and Laverty, 2001; Adner and Levinthal, 2004; Barnett, 2008; Hackbarth, 2009), leaving largely unaddressed the question of how value creation actually does take place in multinational corporations (MNCs). Recent work by Tong and Reuer (2007) and Driouchi and Bennett (2011) provides evidence that heterogeneous managerial characteristics can affect the relationship between multinationality and firm downside risk. Also related and directly relevant, Aabo et al. (2016) document how heterogeneity in firm characteristics alters the real options facilitating effects of multinationality on firm value. Yet, there is little evidence on the impact of managerial quality, practices and particularly real options attention on firm value and upside performance. To study this issue, one needs to account for related categories of real options and consider multinational flexibility effects jointly, besides controlling for endogeneity and alternative theories of the multinational firm. Examining the broader spectrum of real option platforms available to the firm and their impact on value and performance is important for two main reasons: first, to understand how real options know-how and practices affect the value creation process involving different types of real options (and their potential interactions); and second, to assess the degree of integration and coordination of real option related resources and managerial attention within firms (e.g., whether real options are managed as a bundle owing to a high awareness of interactions or treated in isolation).

Our study provides new and comprehensive evidence on the heterogeneity of real options practice and attention, and its effects on long-term value creation and performance, across all US-listed multinational firms over the period 1996-2005. To our knowledge, this is the first research to study real options practice, management quality and the real options determinants of firm value by considering growth options, multinational switching and operating options all together. We examine the joint effect of multinationality and real options awareness (*RO-AWN*) on firm value and performance as measured by Tobin's Q, return on assets (*ROA*) and the three-year average stock returns, while also explicitly accounting for other determinants of MNC value creation postulated by alternative theories of the firm. As such, this paper complements the single-option focused contributions of Tong et al. (2008a) and Driouchi and Bennett (2011) on the role of heterogeneous characteristics on IJVs and downside risk.[2] It also supplements recent work in financial economics and management confirming that differences in management practices across firms can help explain differences in value and performance (see e.g., Bhagat and Bolton, 2008; Antia et al., 2010; Mishra, 2014; Cheung et al., 2017).

A key premise of our paper is that firms are heterogeneous in their ability to realize the real option benefits of multinationality (e.g., Allen and Pantzalis, 1996; Pantzalis, 2001; Aabo et al., 2016). This is partly a result of organizational differences in the identification, maintenance and exercise of real options opportunities (Bowman and Hurry, 1993; Barnett, 2008). Borrowing from management theory, we address this source of heterogeneity by examining how real options

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[2] Emphasizing multinational switching only and controlling for basic firm characteristics, Driouchi and Bennett (2011) test the moderating role of real options awareness in the multinationality-downside risk relationship on a sample of large multinational corporations. Our paper differs in a number of respects: 1) it examines the determinants of firm value in all US-listed international firms, 2) it studies the value implications of real options while accounting for the antecedents of multinationality, growth options and real options awareness, 3) it controls for alternative theories of the firm and endogeneity, and 4) it studies a larger sample of aware firms. Tong et al. (2008a) focus on growth option value in the context of international joint ventures only. Focused on value creation, our multiple options paper differs by looking at awareness, as well as multinational flexibility and real options effects, simultaneously and comprehensively.

awareness (*RO-AWN*), as a proxy for real options practice and management's differential ability to recognize, appraise and exercise real options opportunities, affects the relationship between multinationality (*MULTI*) and firm value, quantifying both its direct and indirect effects on valuation and performance outcomes. From a behavioral perspective, *RO-AWN* influences the mental frame that shapes managers' ability to identify, develop and exploit real options opportunities. It also affects the identification of shadow options and their transformation into real options resources to be exploited by firms (Hurry et al., 1992; Barnett, 2005). Through sense-making and active search, real options awareness provides managers with knowledge and information to both learn from uncertainty and exercise flexibility in decision making (Bowman and Hurry, 1993). As a firm-specific characteristic, *RO-AWN* also helps clarify how the benefits from multinational switching flexibility and other forms of real options should depend on the active role of managers in uncertain business environments. We posit that a firm's real option value potential can be fully realized only if managers are strongly aware of (and pay proper attention in terms of integration, coordination and exercise decisions to) the real option opportunities available in operational and strategic choices. Differences in *RO-AWN* across multinational firms should, therefore, help explain long-term firm value and performance differentials.

We provide a real options explanation of how heterogeneous managerial attention and practices in the form of *RO-AWN* can alter the relationship between multinationality (in terms of the scope and breadth of international operations) and firm value, leading to competitive advantage in an uncertain global business environment. Based on evidence of real options practice in industry (e.g., Billington *et al.*, 2002; Hartmann and Hassan, 2006), we revisit the valuation and flexibility implications of multinational real options in terms of firm heterogeneity (Kogut, 1984; Kogut and

Kulatilaka, 2001). The notion of *RO-AWN* is backed up by observation of real options adoption in a number of corporations (e.g., Triantis and Borison, 2001; Li, 2007; Driouchi and Bennett, 2012), and is linked to the role of knowledge, learning and adaptability in firm evolution and upside performance (e.g., Kogut, 1984; Miller, 2002).[3] *RO-AWN* presupposes the ability to pay attention to real options (Barnett, 2005, 2008) and is accompanied by organizational investments in real options learning and decision support, thus contributing to management quality. The outcomes from such learning can serve as inimitable knowledge resources and capabilities available to the firm (Bowman and Moscowitz, 2001) and result in the development of an awareness specificity for each firm. This specificity influences the nature of the relationship between real options and firm performance, contributing both directly and indirectly to value creation.

Using panel data on a large sample of U.S. international (non-financial) firms differing in their degree of real options awareness, growth options and multinationality, we unveil the value-enhancing and moderating impact of *RO-AWN* on multinational firm value. To study the underlying mechanisms in a robust manner, we control for value driver effects predicted by other theories of the multinational firm (e.g., internalization, market power, diversification, transaction cost economics, growth opportunities). This helps isolate our real options predictions from complementary theory effects, providing a cleaner estimation of the relationship between real options awareness and long-term value. We moreover employ a two-stage multivariate model of firm value, considering endogeneity, reverse-causality and self-selection bias issues, while accounting for the drivers of multinationality, future-oriented growth options and awareness effects through propensity score matching and Heckman estimation procedures (Heckman, 1979; Rosenbaum and Rubin, 1983; Mishra, 2014; de Andres et al., 2017). Our findings are robust to

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[3] A subset of firms in our sample are users and adopters of the real options "technology" (Mun, 2003; Trigeorgis, 2005).

alternative definitions of multinationality, different value and performance indicators and a range of dataset specifications.

The remainder of the paper is organized as follows: the next section provides an overview of related literature and develops our hypotheses. A description of our data, sampling procedures and methodology is given in Section 3. Section 4 provides a discussion and interpretation of our findings, including robustness/sensitivity checks, endogeneity controls and selection bias correction. Section 5 concludes and discusses implications.

2. LITERATURE AND HYPOTHESES

The broader question of how firm resources and heterogeneous or firm-specific characteristics enhance value and long-term performance has received considerable attention in economics and management research since Vernon (1966). Key to this question is the extent to which strategic investments and the multinational organizational form contribute to value creation. Debate on this fundamental issue is ongoing. To this day, there is no clear consensus on the nature of the relationship between multinationality and firm performance, or whether multinational and strategic investments unequivocally create long-term value for firms. Existing evidence tends to be circumstantial or conditional on method, measurement and theoretical perspective (e.g., Michel and Shaked, 1986; Tallman and Li, 1996). This is partly attributed to various alternative theories put forth to explain the economic and managerial motives behind strategic investments and related internationalization decisions, as well as the difficulty in reconciling competing arguments methodologically.

The market power hypothesis (Bain, 1956; Hymer, 1976), for example, predicts that firms with large market shares and well-diversified products can earn supernormal returns and exercise

market power advantages in international markets. Internalization and transaction cost theories advocate that a key motive for firms' expanding abroad is leveraging their intangible assets in a multinational context and minimizing transaction costs (Brouthers *et al.*, 2008). Diversification arguments prescribe that going multinational is driven by risk reduction benefits and related business (segment) expansion considerations (Chang and Thomas, 1989; Anjos, 2010). Knowledge-based and organizational learning views assert that firms increase their foreign presence to enhance or capitalize on unique knowledge, innovation and organizational flexibility (Kogut and Zander, 1993). As a result of such complex and simultaneous linkages (and their potentially confounding effects), the value contribution of multinationality might also be partly attributable to management quality and skills (Hennart, 2007), firm heterogeneity, practices or other endogenous and moderating factors (Villalonga, 2004; Choi et al., 2014).

Related empirical real options research examining the value and performance implications of multinationality is similarly inconclusive (Allen and Pantzalis, 1996; Reuer and Leiblein, 2000) as results appear mixed or context dependent (e.g., Pantzalis, 2001; Tong and Reuer, 2007; Driouchi and Bennett, 2011). Studies on strategic option effects also produce mixed or conditional findings (e.g., Reuer and Leiblein, 2000; Pantzalis, 2001; Tong *et al*., 2008a,b). The above evidence reinforces Hennart's (2007) conjecture on the role of management and firm-specific characteristics in extracting value from multinational and strategic resources. What is missing from the extant empirical real options literature is an explicit recognition of the behavioral and specific factors that influence firms' and managers' ability to create, maintain and exercise (multinational) real options opportunities (Aabo et al., 2016; de Andres et al., 2017). Studying *RO-AWN*, as one key such factor, might thus help identify why some firms benefit significantly from

multinationality while others do not, and clarify when and how multinational flexibility and related investment decisions help increase firm value.

2.1. Multinationality and firm value

In terms of value creation mechanisms, multinationality enables firms to take advantage of growth and switch options that domestic counterparts cannot (Kogut, 1984). This is partly achieved through enhanced physical downside risk reduction and a better exploitation of upside opportunities (Kogut and Kulatilaka, 1994; Lee and Song, 2012). As a result of more changes in global factor market prices, exchange rate fluctuations and differential tax policies across countries, and therefore an increased need for multinational switching flexibility, the value of multinationality tends to increase with increased foreign presence and more countries of foreign operations (Allen and Pantzalis, 1996; Krapl, 2017). Thus we expect the more the alternative foreign operations choices within the multinational network, the greater the value conferred to the firm (Kogut, 1984; Trigeorgis, 1996).[4] This leads to the following *baseline* hypothesis:

H1: The higher a firm's multinationality, the higher its value.

2.2. Real options awareness and firm value creation

Already established in the real options and management literature (Reuer and Leiblein, 2000; Tong *et al*., 2008a), the above baseline hypothesis serves as a platform for our subsequent real options-based predictions on the value implications of multinational flexibility and real options. It does

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[4] As the number of countries with foreign subsidiaries rises, the correlation structure among alternative country operations within the MNC's portfolio mix increases (becomes more positive), lowering the incremental switching option value of the MNC network. Also, organizational coordination costs increase with size and complexity and the marginal benefits likely decline, suggesting a logarithmic association.

not, however, in itself consider the role of management or real option practices in the value creation equation. While as hypothesized multinationality generates valuable growth potential and switching flexibility to be exploited by multinational firms, it is unclear how such potential and related shadow options are developed and turned into real value-creating real options resources. Accounting for *RO-AWN* should thus help clarify the link between multinational real options and the value creation process of the firm, as well as how much of the firm's real options potential is actually realized by managers and their firms.

Being part of firm intangible resources and know-how, *RO-AWN* should specifically help contribute to the three stages of activity underlying the real options value-creation process. These stages relate to: (1) how shadow options are identified and how staging or investment sequencing takes place under uncertainty (Bowman and Hurry, 1993); (2) how new information from internal firm operations or the international markets is interpreted and used as meaningful signals for real options exploitation (Bowman and Hurry, 1993); and (3) when and to what degree various categories of options are optimally exercised, extended or abandoned (Adner and Levinthal, 2004; Coff and Laverty, 2007).

RO-AWN differs across firms partly because of path-dependent firm choices and practices, unique firm characteristics as well as heterogeneous access to resources facing market imperfections (Bowman and Hurry, 1993; Barnett, 2005; Driouchi and Bennett, 2011). As a result of increased management attention, more theory-guided option development and exercise, and better integration and coordination of real options activities, high real options awareness can help bring more discipline and reduce biases across the above three decision-making stages, thus extracting more (realized) value from strategic investments and multinational flexibility. Due to limited visualization and representation of real option opportunities, agency problems and bounded

rationality (Coff and Laverty, 2007), relatively low or no awareness may result in behavioral biases such as escalation of commitment, inability to identify or structure options effectively, as well as biased, suboptimal or sometimes more costly option exercise decisions leading to missed real option potential and underperformance in one or more of the three stages.

In terms of multinational flexibility, *RO-AWN* should help firms identify strategic and operating switch options in international business environments to cope with business uncertainty. Multinational shadow options can then be converted into flexible platforms exploited by MNCs for risk containment or opportunity exploitation purposes (Kogut, 1984; Bowman and Hurry, 1993). This process involves flexible resource (re)allocation, organizational learning routines and development of skills and procedures for effective real option exploitation (Kogut and Kulatilaka, 1994; Barnett, 2005). Managerial attention, sense-making, experience and intuition are key to these processes. The higher is *RO-AWN* within the firm, the more effective or likely is the integration of real-options related resources in multinational operating systems and policies, and the lower the costs and biases of maintaining and coordinating real options activities under incomplete information (Barnett, 2005; Coff and Laverty, 2007). By contrast, low *RO-AWN* results in higher organizational costs associated with coordination and option disposal or switch operations, and higher risk of ineffective or biased option exercise decisions due to agency and managerial cognition problems (Coff and Laverty, 2007). This suggests that multinational switching activities would be less effective with lower or no real options awareness, resulting in suboptimal, ill-timed or infrequent switching. Only when *RO-AWN* is high would the appraisal and monitoring of option exercise or switching decisions be disciplined and guided, and the likelihood of bias in option exercise be contained. Multinational switching should thus be more effective and valuable with high *RO-AWN*. This leads to the following hypothesis:

H2: The positive impact of multinationality on firm value is stronger for firms with higher real options awareness.

In terms of direct value effects, *RO-AWN* can lead to long-term competitive advantages for MNCs due to a superior and holistic recognition, selection and management of real options, both operational and strategic. This can be achieved partly through retrospective sense-making and more active exploration of the real options bundle (Bowman and Hurry, 1993; Li, 2007). Higher *RO-AWN* enables firms' managers to be more conscious in recognizing the gap between potential and realized (or realizable) real options value (Barnett, 2005, 2008), to better manage the overall trade-off between flexibility and commitment (Coff and Laverty, 2007; Li, 2007), and to more effectively process opportunity arrival and expiration signals in jointly exercising multinational switching and other types of real option opportunities. Low *RO-AWN* results in suboptimal exploration and exploitation of such real options opportunities, more costly coordination of the broader real options resources, mis-investment problems and behavioral decision-making pitfalls (e.g., escalation of commitment or ambiguity aversion) along the staged option chain (Miller and Shapira, 2004; Coff and Laverty, 2007). Without the awareness specificity, firms might also overlook important shadow options and miss taking crucial strategic positions for adaptability and core competence development (Barnett, 2005, 2008). Only when *RO-AWN* is high will the option realization process be complete, managers can act effectively on the aforementioned information signals, and the link between strategic action and firm value creation can be strong (Bowman and Hurry, 1993; Barnett, 2005, 2008). Managerial and market perceptions of option values are thus more (less) close when *RO-AWN* is high (low). As a result of superior attention and induced real

options know-how, firms with the high awareness specificity can generate differential or excess returns. This leads to the following hypothesis:

H3: The higher the degree of real options awareness, the higher the firm's value.

3. SAMPLE AND METHODOLOGY

3.1. Sample description

Our sample consists of all U.S. listed (non-financial) multinational firms during the ten-year period 1996-2005. Characterized by a number of turbulent events and changes in economic fundamentals, especially in the 1996-2002 period (collapse of LTCM, Russia's sovereign default, Asian financial crisis, and the dot-com crisis), this volatile period serves well our purpose of testing ROT predictions on multinational flexibility and real options effects. To construct our panel dataset, we used financial, market and fundamental information on all 1539 U.S. listed international firms (excluding financial institutions) with publicly available data in the Compustat disc platform over the period 1996-2005. Negative equity firms were omitted because of their different growth and real options characteristics compared to those of going-concern counterparts. The resulting 1389 firms were separated into aware and unaware firms for comparison. Data on multinationality were collected from the *International Directory of Corporate Affiliations* of LexisNexis, Compact Disclosure data platform and the submitted financial statements of firms obtained from the U.S. Securities and Exchange Commission (SEC). Our comprehensive sampling approach allows studying performance and growth option effects across size, industry, multinationality and *RO-AWN* groups.

Hand-collected *RO-AWN* data were obtained through content analysis of real options diffusion documented in the public domain, such as the popular press (e.g., the *Economist*, *Financial Times*, *CFO Magazine* etc.),[5] related practice-oriented academic literature (e.g., Bowman and Moscowitz, 2001; Triantis and Borison, 2001; De Neufville, 2003), reports from related consulting services firms (e.g., the Real Options Group, Decisioneering, Palisade, Deloitte), managerial sections of company reports (e.g., Schlumberger, Petrobras, Philips), and secondary data from the International Real Options Conference database. Our data collection procedure is in line with prior accounting and financial management research on the use of valuation models by analysts (e.g., Bradshaw, 2002; Demirakos *et al.*, 2004), firms' derivatives use, and recommendations of stock market analysts research (Breton and Taffler, 2001). We follow the content analysis methodology to study evidence of real options practice in industry and identify firms with the awareness specificity. Confirming the existence of a cluster of managerially aware firms, the above sources were subjected to further analysis whereby aware firms were categorized according to the strength of real options activity or diffusion evidence and references to the real options logic in the relevant documents. Firms with stronger evidence of real options activity or actual use were classified in the "high" awareness group. Specifically, when evidence of use, application and real options activity/diffusion was clear and/or confirmed by multiple sources, the firm was categorized in the high awareness group, otherwise it was placed in the lower awareness group. Examples of companies in the high awareness category include: Amgen, Anadarko, BP, Philips, Lilly, Cable & Wireless, BHP and Chevron (e.g., Borissiouk and Peli, 2001; Lint and Pennings, 2001; Schwartz and Trigeorgis, 2001; Trigeorgis, 2005; Amram et al., 2006). Firms with weak evidence or with limited attendance to real options conferences or workshops were

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[5] This adoption activity dates back to the mid-1990s (*Business Week*, 1999; *CFO Europe*, 1999; Trigeorgis, 1999; *CFO Magazine*, 2003; De Neufville, 2003).

considered of "low" awareness. Firms in this category included AstraZeneca, British Gas, Bristol-Myers Squibb and Sun Microsystems among others. Firms with no evidence of real options activity from the above information sources were categorized as "unaware" of real options. Separate and independent assessments were conducted by each of the authors for this specific data gathering and categorization procedure. The samples resulting from these evaluations were compatible in terms of composition. Additional examples of firms with high awareness included Merk, Boeing, Shell, Rio Tinto, Petrobras and Serono, among others (e.g., Cornelius et al., 2004; Smit and Trigeorgis, 2004; Mathews et al., 2007). The overall number of firms (158 MNCs) identified as aware of real options is consistent with survey evidence on the practice of real options among *Fortune* corporations (8-10% adoption overall) (see Ryan and Ryan, 2002).

The awareness data gathering involved obtaining documented evidence on real options practice and industry applications (e.g., Kemna (1993) on Shell; Billigton *et al.* (2001) on HP; Keefer (2004) on Sprint), factual evidence of real options adoption (e.g., Nichols (1994) on Merck), concrete evidence of managers' interest in the real options methodology (Ryan and Ryan, 2002; Busby and Pitts, 1997; Graham and Harvey, 2001), evidence of real options consulting activity (e.g., PwC, Deloitte), evidence of attendance at executive workshops and conferences (e.g., Decisioneering, the Real Options Group), and use of real options logic and terminology in the managerial sections of company reports (e.g., Petrobras, Boeing, Motorola, Philips). A list of 165 documented real options aware (*RO-AWN*) firms, of which 158 are MNCs, resulted from this data collection procedure. This sample is 56% larger than that of Driouchi and Bennett (2011) who study downside risk in the case of 101 large managerially aware multinational corporations. Using the published evidence and our content-based categorization, 72 firms were deemed to be of "high" real options awareness (*HRO-AWN*) while 93 were considered of "low" *RO-AWN* (*LRO-AWN*).

These two subsets are roughly of comparable size and the resulting subsamples are deemed largely free from statistical imbalance.[6] We address potential self-selection bias and endogeneity issues by performing a battery of statistical and robustness tests, including 2SLS regressions, subsample analyses, propensity matching and Heckman two-stage procedure (see e.g., Park et al., 2013 and Mishra, 2014).

3.2. Variables specification and statistical methods

To investigate the validity of our main hypotheses, we use proxies for multinationality (*MULTI*) and real options awareness (*RO-AWN*) and examine their joint impact and interactions on long-term firm value and performance as measured by Tobin's Q, return-on-assets (*ROA*) and the firm's three-year average stock returns (*AvgStkRtn*). We also control for future-oriented growth options (*GO*) as well as changes in growth options (*ΔGO*). These two constructs have been used in prior real options research dealing with firm valuation and stock returns (e.g., Trigeorgis and Lambertides, 2014). We additionally control for other standard firm characteristics, such as systematic risk (beta, *β*), investment growth (*INVG*), size (*SIZE*), leverage (*LEV*), industry effects (*IND*) and endogeneity. We include structural fixed-year effects in our longitudinal sample.

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[6] Because of the relative rarity of real options practice in firms (lack of systematic use) and the rather weak evidence of real options attention in industry (e.g., Ryan and Ryan, 2002), we employed content analysis to infer the relative degrees of awareness in our sample (see e.g., Holsti, 1968). Using various sources, we obtained a representative sample of aware firms producing a procedure for categorization. This was aimed to capture the heterogeneity in real options practice among MNCs and serves our purpose of contrasting the value determinants of aware firms with those of less or non-aware counterparts. The list is available from the authors upon request.

3.2.1. Dependent variable(s)

We measure long-term firm value and performance using the annual Tobin's Q ratio ($Q_{i,t}$) for each firm i (e.g., Frijns et al., 2016). Tobin's Q is calculated by dividing the market value of a firm's assets (measured as market value of outstanding equity plus book value of debt) by its replacement cost proxied by the firm's book assets. By using Tobin's Q, issues of estimating rates of return or marginal costs are avoided. For further validation and robustness, we also employ the firm's forward return on assets (*ROA*) and the average stock returns (*AvgStkRtn*) over three years as alternative indicators of long-term value and performance.

3.2.2. Independent variables

Our first main explanatory variable, the degree of real options awareness (*RO-AWN*), represents a key construct in the relationship between multinational real options resources and firm value. It aims to capture the extent to which real options potential is realized by firms and their managers. We posit that *RO-AWN* is a crucial behavioral link between real options exercise or exploitation and firm value creation as it can have significant moderating effects arising from heterogeneity. Based on the categorization procedure described above, variable *RO-AWN* is estimated as the natural logarithm of 1 plus the value weight of its awareness group: group (a) "no awareness" has a weight of 0, group (b) "low" awareness has a weight of 1, and group (c) "high" awareness a weight of 2. The higher the real option awareness of a firm, the higher its *RO-AWN* score. Firms with no (evidence of) real options awareness get a *RO-AWN* value of zero. An alternative specification of *RO-AWN* using dummy variables is also adopted to account for the specific effects of high and low awareness.

Multinationality (*MULTI*), our second key explanatory variable, reflects the diversity and breadth of a firm's global activities. As standard in the literature on international scope (e.g., Allen and Pantzalis, 1996; Reuer and Leiblein, 2000), multinationality is measured as the natural logarithm of 1 plus the number (M) of foreign countries in which the firm has operating subsidiaries (*MULTI* = ln(1+M)). This specification is also indicative of multinational shifting abilities across a broader network of subsidiaries. It may further capture the marginal declining benefits of multinationality (see e.g., Aabo et al., 2016). For additional robustness, we use the percentages of foreign sales (*FS*), foreign assets (*FA*) and foreign operating income (*FOI*) as alternative *MULTI* specifications. Throughout the paper, we focus primarily on ln (1+M) and foreign sales (*FS*) as our main proxies for multinationality.

Besides the above main variables, we include other real options-related independent factors to control for firm strategic characteristics. Strategic growth options ($GO_{i,t-1}$) represents the prior infrastructural capabilities the firm has put in place (at *t-1*) to create strategic growth opportunities. Its measurement (e.g., see Trigeorgis and Lambertides, 2014) involves regressing a number of option-related independent variables on growth option values (see also Kester, 1984; Cooper, Gulen and Schill, 2008), estimating the model parameters on recent 3-year industry data and using the estimated coefficients and current firm data to obtain a predicted *GO* score for each firm *i* at time *t* (see eq. (3)). In addition to the level of strategic growth options (predicted *GO* score), $\Delta GO_{i,t}$ is also included to capture recent enhancement (*change*) in growth option value and not confound investment growth effects.

3.2.3. Control variables

We employ a number of standard control variables from the literature on firm value and returns. Each firm i's market or systematic risk, beta ($\beta_{i,t-1}$), is estimated over the previous 36 months using the Sharpe-Lintner model (CAPM) as in Fama and French (1992). Firm size ($SIZE_{i,t-1}$) is measured as the natural logarithm of the book value of firm i's total assets in the previous period. Investment growth ($INVG$) is measured by change in firm capital expenditures. It is estimated as the (three-year period) average capital expenditure at year-end minus the beginning-of-period one, deflated by beginning-of-year total assets. Leverage ($LEV_{i,t-1}$) is measured in market value terms as the natural logarithm of total liabilities divided by fiscal year-end firm value (V = ME + LT) at time $t-1$. $IND_{i,t}$ equals the median performance of the industry firm i operates in, used to capture industry effects. Fixed effects are used to capture time variation accounting for unobserved heterogeneity at the firm level and capturing effects of economy-wide variations or other unobserved factors. Independent and control variables are lagged to mitigate potential problems of reverse causality and endogeneity. Variables $INVG$ and ΔGO are not lagged as they represent changes. IND is used to capture industry effects within the same period and is not lagged. Control variables are listed in the second line of eq. (1) below.

3.2.4. Model specification and analytical procedure

We specify and test the following two-stage least squares (2SLS) multivariate model using panel data:

$$V_{i,t} = a + bMULTI_{i,t-1} + cROAWN_{i,t-1} + dGO_{i,t-1} + g\Delta GO_{i,t} + hMULTI_{i,t-1} * ROAWN_{i,t-1}$$

$$+ m\beta_{i,t-1} + nSIZE_{i,t-1} + pLEV_{i,t-1} + qSIZE_{i,t-1} * LEV_{i,t-1} + rINVG_{i,t} + uIND_{i,t} + e_i$$

(1)

where [7]

$V_{i,t}$: firm i's value and performance measured by Tobin's Q, ROA and AvgStkRtn at time t,

$MULTI_{i,t-1}$: firm i's degree of multinationality at time $t-1$,

$ROAWN_{i,t-1}$: firm i's degree of real options awareness at time $t-1$,

$GO_{i,t-1}$: firm i's preexisting level of strategic growth options at time $t-1$,

$\Delta GO_{i,t}$: firm i's change in strategic growth options in year t,

$MULTI_{i,t-1} * ROAWN_{i,t-1}$: firm i's interaction term between multinationality and ROAWN at time $t-1$,

$\beta_{i,t-1}$: firm i's systematic risk (beta) at time $t-1$,

$SIZE_{i,t-1}$: firm i's size (total assets) at time $t-1$,

$LEV_{i,t-1}$: firm i's leverage at time $t-1$,

$SIZE_{i,t-1} * LEV_{i,t-1}$: firm i's interaction term between size and leverage at time $t-1$,

$INVG_{i,t}$: firm i's capital investment growth $(\text{increase in CAPEX})$ in year t,

$IND_{i,t}$: firm i's median industry performance level at time t.

MULTI, RO-AWN and *GO* are endogenous variables in eq. (1) as they are influenced by other primary market factors and firm-specific characteristics. We follow a two-stage statistical procedure (2SLS) where predicted values of multinationality, awareness, and growth options from the first stage are used as determinants of value and performance in the second-stage analysis.

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[7] In the first-stage regression *MULTI* is instrumented by market concentration, intangibles, firm-specific volatility, R&D intensity (*RD*) with controls for prior performance, prior size and prior level of multinationality; the predicted value of *MULTI* is then used in the second-stage regression. In the first-stage regression *RO-AWN* is instrumented by prior performance, prior size and prior level of multinationality, with the predicted value of *RO-AWN* then used in the second-stage regression.

3.2.5. First- and second-stage regressions

Multinationality endogenous effects are tackled using four instruments (market concentration, intangibles, firm-specific volatility, and R&D intensity) and three control variables (past performance, prior multinationality and prior size). The firm's market power and ability to exploit shared growth options relative to competition for a given industrial structure is proxied by market concentration (*MCON*), measured as the square root of the firm's Herfindahl-Hirschman Index (*HHI*) if the firm has above-average Tobin's Q, and zero if the firm has below-average Q. Intangibles (*INTANG*) are measured by the natural logarithm of the ratio of intangible assets to total assets. Firm-specific volatility (*VOLAT*) is estimated from the standard deviation (σ) of firm *i*'s equity returns based on the past 36 monthly stock returns. R&D intensity (*RD*) is calculated using the natural logarithm of the ratio of R&D expenses to sales for each firm. Following previous studies on the drivers of multinationality (e.g., Tong and Reuer, 2007; Grubaugh, 1987), we test the following first-stage model:

$$MULTI_{i,t} = a + bMCON_{i,t-1} + cINTANG_{i,t-1} + dVOLAT_{i,t-1} + eRD_{i,t-1} + gMULTI_{i,t-1} + hSIZE_{i,t-1} \qquad (2)$$

where

$MCON_{i,t-1}$: firm i's market concentration at time $t-1$,

$INTANG_{i,t-1}$: firm i's intangible assets at time $t-1$,

$VOLAT_{i,t-1}$: firm-specific volatility or business uncertainty for firm i in year $t-1$,

$RD_{i,t-1}$: firm i's research and development $(R \& D)$ intensity at time $t-1$,

$MULTI_{i,t-1}$: firm i's multinationality index at time $t-1$,

$SIZE_{i,t-1}$: firm i's size $($natural logarithm of total assets$)$ at time $t-1$.

We also account for past performance via lagged *ROA* or *Q* in our first-stage regressions.

RO-AWN is predicted using firm characteristics such as past performance *(ROA$_{i,t-1}$* or *Tobin's Q$_{i,t-1}$)*, multinationality (*MULTI$_{i,t-1}$*), and firm size *(SIZE$_{i,t-1}$)* in the first-stage regressions. The predicted value of *RO-AWN* is then used in our second-stage procedure.[8] In future research and using ExecuComp data, we intend to examine the behavioral and governance antecedents of *RO-AWN* and how they might affect firm characteristics. Estimation of our growth options control variable (*GO*) follows the below dynamics (see Trigeorgis and Lambertides (2014) for theoretical arguments and variable specification):

GO = f(idio. volatility, return skewness, leverage, organizational slack, cash flow position, R&D intensity, cumulative sales growth, market power, fixed effects, industry effects, interactions)   (3)

We ran our second-stage multivariate panel data regressions based on (all or parts of) eq. (1) using the predicted values for *MULTI, RO-AWN* and *GO*. Standard statistical and robustness tests (z-statistics and model Wald Chi-square) are reported in Tables 4-7 and discussed in the following section. As a market-based valuation measure, Tobin's Q should immediately reflect the positive impact on firm value of our main explanatory variables (*MULTI* and *RO-AWN*). As a measure of profitability and operating performance, *ROA* should also reflect the positive implications of *RO-AWN* in MNCs. The same holds for the 3-year average stock return used as another indicator of long-term firm performance.

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[8] The explanatory variables in the basic model (*INVG*, *β,* etc.) are excluded from the first-stage regressions as they do not affect the instrumented/endogenous variables in a statistically significant way. This is valid econometrically since at least one explanatory variable of the basic model is included in the first stage model. To mitigate model identification problems, the Kleibergen-Paap and Stock-Yogo tests were conducted. The under identification and weak identification hypotheses were rejected, reassuring that our first-stage models are well identified. We also tested for issues of over identification and instrumental variable relevance in our models using the Sargan-Anderson likelihood and Hansen-J econometric procedures; outcomes from these tests confirm quality instruments were used.

Insert Table 1 about here

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4. RESULTS AND DISCUSSION

Table 1 Panel A provides descriptive statistics for our overall sample of 1389 firms. Panel B compares the characteristics of aware firms (*RO-AWN*) and manufacturing multinational firms (*MANUFACTURING*) against those of the overall sample (*ALL*). The median firm in the overall sample (*ALL*) has a size of $15,694 m (= exp(9.66)), a Tobin's Q of 1.56, a growth options (*GO*) score of 0.16, and a foreign sales (*FS*) ratio of 0.26 (the mean firm 0.29). The median aware firm has a comparable Tobin's Q (1.52) as the median MNC in the sample (1.56), similar *ROA* and *GO* ratios but higher average stock returns. *RO-AWN* firms have foreign subsidiaries in 12 countries on average (with the median firm in 14 countries). Manufacturing MNCs have subsidiaries in 13 countries and a higher foreign sales ratio (0.31). Panel C shows the specific distribution of our sample of *RO-AWN* firms, with low vs. high real options awareness across various economic sectors. In terms of number of firms, the Manufacturing sector (54) and Chemicals and Pharmaceuticals (27) exhibit the greatest awareness, followed by the Natural Resources and Energy sectors. In terms of industry concentration, Chemical and Pharmaceuticals (17%) and Electricity and Energy (15%) MNCs display the highest awareness.

Table 2 presents the correlation matrix for our instrumental, explanatory and control variables. There is no clear evidence of serial correlation or multicollinearity (VIFs < 5). Besides size (which exhibits some correlation with several variables), the only relatively strong (positive) correlation is observed between multinationality (*MULTI*) and *RO-AWN*. This motivates the inclusion of an interaction term (*MULTI*RO-AWN*) and the consideration of endogenous factors

in our panel data analysis. In line with Aabo et al. (2016) and for further robustness, we also control for potentially confounding size effects in our analysis through residual-based indicators of multinationality.

Insert Table 2 about here

4.1. Regression findings

First-stage results. We first discuss our first-stage regression results on the drivers of multinationality, real options awareness, and strategic growth options. Results are summarized in Table 3. Panel A suggests that past size and market concentration can increase the likelihood of going multinational; this effect is stronger when domestic firms are added to the sample. In line with real options predictions, high business volatility (*VOLAT*) increases the likelihood of expanding or coordinating business activities abroad. Intangibles (*INTANG*) also appear to be a significant determinant of multinationality. R&D intensity (*RD*) is loosely (positively) associated with multinationality. Finally, past performance *(ROA or Q)* and prior degree of multinationality are significantly positively related to next period's multinationality. Regarding the determinants of *RO-AWN*, Panel B confirms that past size, prior multinationality and lagged performance are significantly associated with *RO-AWN,* underlining the role of such firm-specific factors in real options awareness building. In terms of growth option (*GO*) determinants, Panel C shows that idiosyncratic volatility, firm return skewness (*SKEW*), R&D intensity (*RD*), cumulative sales growth (*SG*), organizational slack (*SGA*) and market power (*HHI*) are all positively associated with firm strategic growth options, in line with Trigeorgis and Lambertides (2014). Leverage (*LEV*) and cash flow coverage (*CFC*) are negatively associated with *GO* in line with Aabo et al. (2016). *CFC* is significant only when the GO model (eq. (3)) is implemented on the universe of all US-listed

firms. These first-stage results serve as the basis for our second-stage regressions, which take into account endogeneity and self-selection issues.

Insert Table 3 about here

Second-stage results. The results of the second-stage panel data regressions analyzing long-term firm value and performance as measured by Tobin's Q are shown in Table 4 Panel A. Results using *ROA* and average stock returns as alternative dependent variables are shown in Table 4 Panel B. The upper part of Table 4 Panel A shows the impact of our main variables *MULTI* and *RO-AWN* (and their interaction) on Tobin's Q; the next parts shows *GO* and *ΔGO* effects; the lower part considers the control factors. Model 0 reports the impact of the control variables, including business volatility, on firm value. Models 1, 1' and 1'' describe the incremental univariate impact of multinationality (*MULTI*), real options awareness (*RO-AWN*), and the joint *GO* and *ΔGO* variables alone, given the control variables. Models 2 and 2' present multivariate results with the main variables *MULTI* and *RO-AWN* first alone and then controlling for *GO* and *ΔGO*. Model 3 reports the combined effects of *MULTI*, *RO-AWN*, *GO* and *ΔGO,* along with the interaction term *MULTI*RO-AWN* on Tobin's Q while controlling for other effects. Table 4 Panel B summarizes *ROA*- and *AvgStkRtn*-related results using the specifications of Models 2' and 3. Significance levels for all models are determined using standard z-tests, with the corresponding z-statistics shown in parenthesis below each coefficient along with an indication of significance level. Adjusted overall R^2 and model Wald Chi-square statistics, along with Model rho, are shown at the bottom of each column.

Insert Table 4 Panel A about here

The significance of the control variables in Table 4 Panel A is generally in line with prior research. Business volatility, measured by the standard deviation of stock returns, has a positive and significant effect on firm value in Model 0. This is consistent with ROT predictions on the mediating role of real options in the volatility-value relationship and validates our use of business volatility as a driver of multinationality in subsequent Models 1-3. Models 1, 1' and 2 in Panel A show that *MULTI* and *RO-AWN*, individually and jointly, have significant positive effects on Tobin's Q (beyond the control variables). This is in line with our theoretical predictions and provides support for hypotheses H1 and H3: multinationality and real options awareness increase firm value beyond standard determinants ($p < 0.01$). Comparing coefficients in Model 2, the positive effect of *RO-AWN* on Tobin's Q appears to be stronger than its *MULTI* counterpart. Most of the control variables retain their signs when adding *MULTI* and *RO-AWN* (or both) to the models.[9] Outcomes from Models 1'' and 2' also show that growth options (*GO)* as well as positive changes (*ΔGO*) are associated with higher (positive) value. This is in line with growth options-related theories and recent evidence from Trigeorgis and Lambertides (2014). The positive effects of *MULTI* and *RO-AWN* on firm value are maintained after including growth options factors in the regressions.[10] Similar patterns are observed in Model 2' in Table 4 Panel B. Hypotheses 1 and 3 are, therefore, also valid for alternative indicators of firm value and performance. Finally, Model 3 in Table 4 Panel A indicates that the positive impact of multinationality is enhanced through its

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[9] The association between leverage and Tobin's Q is significant negative. This may be because well-performing firms enjoy a higher market value of equity (lowering the leverage ratio measured in market value terms) or profitable firms can raise more funds from internal sources, needing less external funds to borrow.

[10] In terms of economic significance, the positive contribution of *GO* to firm value is more important than that of *MULTI*.

interaction with *RO-AWN*. This provides support for Hypothesis 2 on the moderating role of *RO-AWN* in the relationship between multinationality and firm value. Multinationality in conjunction with real options awareness can increase Tobin's Q by up to 0.95 (0.164+0.715*ln(3)). This impact is economically significant and large in comparison to the mean Tobin's Q of 2.28. The direct positive effect of multinationality on performance is maintained when including the interaction term *MULTI*RO-AWN* in the regressions. This further corroborates H1. It is noteworthy that, on its own, *MULTI* becomes insignificant when accounting for distress effects and adding negative equity firms to our MNCs sample (unreported). This is line with extant evidence and highlights the role of firm-specific characteristics in the multinationality-value equation (see e.g., Aabo et al., 2016). After controlling for size, specific characteristics and real options determinants, *MULTI* appears to increase value only for firms without negative equity and that are unlikely to be distressed. In other words, multinational flexibility is useful for firms if they have the required financial resources to exercise and exploit their real options (see also Aabo et al., 2016). The moderating effect of *RO-AWN* on multinationality is maintained across both samples (with and without negative equity firms), further corroborating H2.

Insert Table 4 Panel B about here

Table 4 Panel B reports findings for Models 2' and 3 using alternative indicators of value and performance. Results are very similar. Multinationality (*MULTI*) and *RO-AWN*, individually and jointly, have positive and significant net effects on performance as measured by *AvgStkRtn* and *ROA* (we report Log (1+ Tobin's Q) results for comparison) (Models 2').[11] *MULTI*RO-AWN* in Model 3 is also positive and significant. In terms of economic significance, multinationality in

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[11] Similar conclusions are found when ME is used as an alternative dependent variable.

conjunction with real options awareness can potentially increase *AvgStkRtn* and *ROA* by up to 12.7% and 5.3%, respectively. These results provide further robust evidence in support of Hypotheses 1, 2 and 3 concerning a significant positive (indirect and direct) role of *RO-AWN* in enhancing long-term firm value via multinationality and its related real options flexibility benefits. Accounting for endogeneity, alternative theories of the firm and heterogeneity in real options practice, our models confirm that multinationality increases firm value, on its own and in interaction with real options awareness, in our sample of 1389 firms.[12]

Insert Table 5 about here

Table 5 revisits the above conclusions using alternative definitions and measures of multinationality in Model 3. These include the raw number of countries in which the firm has foreign operating subsidiaries (ln (1+M)), and the firm's foreign sales (*FS*), foreign assets (*FA*), and foreign operating income (*FOI*) ratios. In line with Aabo et al. (2016), for robust inference and additional validation we also report residuals-based specifications of multinationality after controlling for size effects. Though Table 5 presents findings for all four alternative proxies for comparison, throughout the rest paper we focus on the multinationality implications of ln (1+M) and *FS* only. The findings in Table V corroborate the role of size in the multinationality-performance equation (e.g., *FA* and *FOI* are positive and significant only after being "cleaned" from size effects) and also confirm our predictions on the moderating effect of *RO-AWN* on the relationship between multinationality and firm value, besides the direct positive effects of *RO-AWN* and *MULTI* (p < 0.01). *MULTI* and *MULTI*RO-AWN* are consistently positive and

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[12]Joint tests were conducted to verify if our explanatory variables are altogether jointly statistically significant. Results confirm that our explanatory variables are jointly statistically significant supporting the validity and strength of our models.

significant across all specifications, once again validating our hypotheses and theoretical predictions. For example, we find that a one unit increase in *RO-AWN* is associated with an addition of 14.5% in the firm's performance sensitivity to changes in the residual foreign sales ratio. These findings suggest that highly aware firms might be more opportunity-exploitation driven or downside risk protective in terms of multinational switching and physical hedging capabilities (see e.g., Aabo and Simkins, 2005). *RO-AWN* firms also seem to enhance value from multinational real options, strengthening competitive advantage directly through real options awareness.[13]

Our main finding from Tables 4 and 5 is that firms that are aware of their real options are able to create more value from multinational switching flexibility and foreign sales infrastructure. It appears these multinational firms are more successful in managing some of the organizational and learning processes associated with their corporate real options (involving option identification, integration, maintenance, exercise and disposal) than their non-aware counterparts. The above likely entails: 1) the recognition and staging of (multinational) shadow option opportunities, 2) better processing of information and uncertainty signals, and 3) more effective exercise and coordination of real options resources across the multinational network. *RO-AWN* is in effect a proxy for more effective real options decision making within the MNC (manifesting managerial quality), in line with Hennart's (2007) conjecture and our earlier predictions that management skills, heterogeneous characteristics and practices can contribute to competitive advantage and value creation differentially across firms and borders. Overall, *RO-AWN* firms are more effective at managing their multinational investment decisions, narrowing the gap between real option

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[13] In terms of other standard real option effects, we find the interaction of *MULTI* and *GO* to be negatively associated with firm value, confirming the non-additive interaction effects of multiple options (Trigeorgis, 1993). We also find a negative relation between *RO-AWN* and *GO*, suggesting that managerially aware firms may have already exploited much of their growth potential. This accords with the predictions of Bernardo and Chowdry (2002).

potential and realized option value. The next section discusses further robustness checks and additional findings.

4.2. Further robustness checks, selection bias correction and additional findings

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Insert Table 6 Panel A about here

Our results are robust to a range of alternative dataset or measurement specifications, summarized in Table 6 Panels A and B. In Table 6 Panel A, Multinationality - measured by the number of countries with foreign operations or with the foreign sales ratio - is consistently positively related to firm value, both on its own and via the interaction term *MULTI*RO-AWN*, in line with previous findings reported in Tables 4 and 5. This holds for our "all MNCs" sample (Specification 1), as well as for a sample composed exclusively of manufacturing MNCs (Specification 2). Specification (3) shows similar robustness results after excluding smaller firms from the sample. Specifications (4) and (5) use alternative definitions of *RO-AWN*, based on subsample analysis (dummy variables), first defined as a single dummy variable (0 non-aware, 1 aware) and then second without the logarithmic transformation (A = 0, 1, 2).[14] Results are broadly comparable to those of the benchmark model. We also verify whether our line of reasoning for *RO-AWN* holds for investment growth (*INVG*) and operating options, and find that real options awareness tends to enhance the positive effect of *INVG* on firm value ($p < 0.1$) (Specification 6). This suggests that managers of aware firms are also better at utilizing and managing their capital investments (past growth options turned into assets in place and operating options) and in balancing the trade-off

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[14] The impact of low *RO-AWN* is positive but insignificant in the second-stage regressions, suggesting that superficial knowledge without broader organizational capabilities may not be sufficient to ensure superior performance. We find also that the interaction term *MULTI*RO-AWN*SIZE* is significant and positive, highlighting the structuring features of real option management in large firms.

between exploitation and exploration than non-aware counterparts.[15] The above findings and conclusions are robust to alternative indicators of firm value and performance (*AvgStkRtn* and *ROA*), as shown in Table 6 Panel B.

Insert Table 6 Panel B about here

Table 7 reports robustness test comparisons after controlling for self-selection, small sample bias and endogeneity issues using Heckman (1979) and propensity score matching techniques (Rosenbaum and Robin, 1983) on both *MULTI* and *RO-AWN*.[16] These procedures necessitate considering domestic firms (without negative equity) in our dataset. The coefficients of the main model corrected for selectivity bias under the Heckman method are shown in the third and fourth columns of Table 7. The results are generally consistent with our panel 2SLS findings (shown for comparison in the first two columns) indicating that self-selection bias is not a major issue. Multinationality in itself appears positive and significant for *FS* confirming H1 (*MULTI* as ln (1+M) is also significant when omitting the dominant *MULTI*RO-AWN* effect from the regression), and is exhibiting a beneficial influence on firm value in interaction with *RO-AWN* as predicted by H2. H3 on the direct effect of *RO-AWN* on performance is also supported under *MULTI* and *FS* specifications. To address further the relatively small size of the *RO-AWN* dataset and control for endogeneity, propensity score matching is implemented in Specification 3 of Table

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[15] In a sample extension, we find that the positive effects of multinationality and real options awareness on long-term value and performance could also hold for domestic and multinational (manufacturing) firms (excluding negative equity). However, more *RO-AWN* data for domestic firms would be needed to corroborate this claim. Our Heckman and propensity regressions in Table 7 attempt to partly address this issue.

[16] Our two-stage Heckman and propensity procedures also consider domestic firms (without negative equity) in the analysis. The two-stage Heckman method was originally employed on cross-sectional data. It was extended by Heckman on panel data (see Wooldrige, 1995). Applications include Tong and Reuer (2007) and Chung *et al.* (2010). See Rosenbaum and Rubin (1983) for technical details on the propensity score matching procedure and Villalonga (2004) on the application of this procedure to the diversification discount.

7. The last two columns (Columns 5-6) of Table 7 present our propensity score findings based on *MULTI* and *RO-AWN* criteria. The overall conclusions regarding our main explanatory variables also hold under the propensity score matching approach.

Insert Table 7 about here

Our overall conclusion, based on all above robustness procedures and additional statistical tests accounting for a variety of issues (endogeneity, selection-bias, alternative sample and measurement specifications, fixed-year and industry effects), is that multinationality can enhance long-term firm value. This positive effect is more pronounced in the presence of real options awareness, such that *RO-AWN* and management quality can be sources of competitive advantage especially for less financially constrained MNCs.

5. CONCLUSIONS AND MANAGERIAL IMPLICATIONS

Our study offers important insights into the value implications of real options management in U.S. listed non-financial international firms. It highlights the role of firm practices and real options awareness as a key heterogeneity factor affecting the link between multinationality and real options with long-term firm value creation. We focus on firm value and performance measured by Tobin's Q, return-on-assets and 3-year average stock returns and examine related determinants, such as growth options and multinational switching flexibility under a unified and comprehensive explanatory framework. Controlling for structural real options and other firm characteristics, we isolate the moderating effect of real options awareness on the multinationality-value relationship, underlining the process of real options-based decision making and potentially the role of management quality in multinational organizations. We find that aware firms are better able to

manage their multinational switching flexibility and utilize their capital investment than their unaware counterparts. This finding is in line with the management theory predictions of Bowman and Hurry (1993), Barnett (2005) and Coff and Laverty (2007) on the role of management in real options integration, maintenance, exercise and disposal. Our paper is novel in empirically studying such managerial process dynamics together by examining real options and multinational flexibility effects concurrently, and in assessing the role of firm heterogeneity in the form of real options awareness in long-term firm value creation. Our extensive findings help clarify important questions on the pertinence of real options in corporate strategy. They call for further research that goes beyond the concept of real options reasoning to also consider behavioral, structural and infrastructural aspects of real options management in corporate finance and decision making. Future research could investigate the antecedents of real options awareness in firms across countries and industries and link them to firm characteristics and other performance outcomes.

Resulting implications of our findings for management are rather evident. Firms should invest in knowledge acquisition and management quality building and develop organizational real options capabilities and infrastructure to effectively exploit the benefits of flexibility in strategic investment and operating/switching decisions. This specifically concerns the three stages of activity underlying the real options logic: 1) option identification and staging, 2) option integration and information signalling, 3) exercise and exploitation of flexible firm resources. Each stage performance can be improved with increased real options attention and good management of financial resources. This should enable more effective planning, structuring and managing of an MNC's network of operations to take better advantage of changes in input prices, labor costs, demand or exchange fluctuations and other global or environmental factors. Organizations need to develop flexible systems and management practices to proactively deal and cope with uncertainty,

and to more effectively manage and exercise their corporate real options (e.g., expand, scale-down, switch, extend, contract and abandon) while containing behavioral biases and coordination costs associated with implementing the real options logic. Real options awareness and a flexible multinational infrastructure may equip organizations with the necessary decision apparatus to benefit from fluctuations or return differentials in global markets. When real options are identified and exploited or exercised appropriately through increased awareness, enhanced long-term value and performance are likely to follow. Acquiring the necessary knowledge, through training, skills development and managerial learning, and putting in place adequate infrastructure and practices to responsibly enhance real options awareness in large organizations should be a priority on managers' agendas in these times of heightened global uncertainty.

Acknowledgments

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Table 1

Descriptive statistics for the overall and specific subsamples

Panel A. Overall sample (*ALL*) (N = 1389)

Variable	Mean	Median	S.D.
Tobin's Q	2.279	1.563	2.166
ROA	0.044	0.043	0.098
AvgStkRtn	0.174	0.126	0.504
RO-AWN	0.886	0.693	0.203
MULTI	2.704	2.833	1.213
FS	0.295	0.260	0.215
GO	0.118	0.159	0.690
INVG	0.132	0.073	0.188
β	1.103	1.043	0.670
SIZE	9.713	9.661	1.376
LEV	-1.121	-0.915	0.809

The overall sample consists of 1389 multinational firms (non-negative equity) listed in the Compustat database during 1996-2005. 165 firms were classified as real options aware; 158 were MNCs. Tobin´s Q: the ratio of the market value of a firm's assets (measured by the market value of its outstanding equity and the book value of its debt) to its replacement cost (firm's book value of assets), *ROA*: forward average return-on-assets over three years, *AvgStkRtn*: average stock returns over three years. *RO-AWN*: degree of real options awareness, *MULTI*: degree of multinationality (countries), *FS*: foreign sales ratio, *GO*: strategic growth options measured as {$GO = f$ (idiosyncratic volatility, skewness, organizational slack, cash flow coverage, cumulative sales growth, market power, R&D intensity)}. *INVG*: the change in capital expenditures, *β*: beta calculated based on 36 monthly returns, *SIZE*: measured as the natural logarithm of total assets, LEV: leverage measured by (the natural logarithm of) total liabilities divided by firm market value.

Panel B. Specific subsamples

Variable		RO-AWN FIRMS	MANUFACTURING MNCs	ALL MNCs
Tobin's Q	Mean	2.233	2.420	2.279
	Median	1.516	1.619	1.563
	S.D.	2.143	2.218	2.166
ROA	Mean	0.039	0.053	0.044
	Median	0.043	0.051	0.043
	S.D.	0.128	0.085	0.098
AvgStockRet	Mean	0.183	0.198	0.174
	Median	0.131	0.145	0.126
	S.D.	0.494	0.505	0.504
MULTI	Mean	2.542	2.669	2.704
	Median	2.711	2.833	2.833
	S.D.	1.313	1.195	1.213
FS	Mean	0.298	0.305	0.295
	Median	0.258	0.277	0.260
	S.D.	0.217	0.220	0.215
SIZE	Mean	9.413	9.666	9.713
	Median	9.467	9.648	9.661
	S.D.	1.603	1.390	1.376

RO-AWN is the subsample of aware MNCs (N = 158), *MANUFACTURING* is the subsample of manufacturing MNCs (N = 712), *ALL* is the overall sample presented for comparison (similar to Panel A).

Panel C. Distribution of aware firms (*RO-AWN)* by industry and across sectors

Sector	Low	High	Total	% of total	% of sector
Manufacturing	32	22	54	34.18%	7.58%
Telecommunications	7	8	15	9.49%	8.00%
Food & Drinks	4	1	5	3.16%	12.73%
Chemicals & Pharma	13	14	27	17.09%	17.09%
Electricity & Energy	11	5	16	10.13%	14.81%
Petroleum Refining	4	6	10	6.33%	10.42%
Mining Oil & Gas	3	6	9	5.70%	10.98%
Other	14	8	22	13.92%	14.10%
Total	88	70	158	100%	10.27%

Table 2

Correlation matrix among key variables

Variable	MULTI	FS	RO-AWN	GO	ΔGO	β	INVG	SIZE	LEV	MCON	INTANG	VOLAT	RD
MULTI	1.000												
FS	0.025	1.000											
RO-AWN	0.544	0.012	1.000										
GO	-0.048	-0.025	-0.063	1.000									
ΔGO	0.001	0.026	0.003	0.017	1.000								
β	0.034	-0.008	0.031	0.061	-0.012	1.000							
INVG	-0.010	0.009	-0.012	0.005	0.007	-0.033	1.000						
SIZE	0.200	0.006	0.244	-0.341	-0.003	0.092	-0.063	1.000					
LEV	0.019	0.006	0.024	-0.162	-0.008	-0.114	-0.162	0.351	1.000				
MCON	0.010	-0.015	-0.003	-0.133	-0.017	-0.020	-0.075	-0.014	0.120	1.000			
INTANG	-0.030	0.005	0.067	-0.023	0.002	0.027	0.005	-0.135	-0.036	-0.027	1.000		
VOLAT	-0.008	-0.029	0.025	-0.144	0.029	-0.340	-0.022	0.335	-0.046	0.073	-0.068	1.000	
RD	0.005	0.011	-0.020	-0.126	-0.168	-0.024	-0.004	-0.054	0.150	0.075	-0.041	-0.075	1.000

The overall sample consists of 1389 multinational firms (non-negative equity) listed in the Compustat database during 1996-2005. 165 firms were classified as real options aware; 158 were MNCs. Tobin´s Q: the ratio of the market value of a firm's assets (measured by the market value of its outstanding equity and the book value of its debt) to its replacement cost (firm's book value of assets), *ROA*: forward average return-on-assets over three years, *AvgStkRtn*: average stock returns over three years. *RO-AWN*: degree of real options awareness, *MULTI*: degree of multinationality (countries), *FS*: foreign sales ratio, *GO*: strategic growth options measured as {*GO* = *f* (idiosyncratic volatility, skewness, organizational slack, cash flow coverage, cumulative sales growth, market power, R&D intensity)}. *INVG*: the change in capital expenditures, *β*: beta calculated based on 36 monthly returns, *SIZE*: measured as the natural logarithm of total assets, LEV: leverage measured by (the natural logarithm of) total liabilities divided by firm market value.

Table 3

First-stage regression results on the determinants of multinationality *(MULTI)*, real options awareness *(RO-AWN)* and growth options *(GO)*.

Panel A. Determinants of multinationality

Depended variable: *MULTI*		
Market Concentration *(MCON)*[L]	<0.001	<0.001
(market pow er advantage hypothesis)	(0.82)	(3.24)***
Intagibles *(INTANG)*[L]	-0.793	-0.010
(internalization or transaction costs theory)	(-4.01)***	(-3.86)***
Volatility *(VOLAT)*[L]	0.001	0.002
(real options & diversif ication theories)	(2.42)**	(2.55)***
Research & Development *(RD)*[L]	0.192	<0.001
(know ledge-based theory)	(0.53)	(0.14)
Return on Assets *(ROA)*[L]	0.002	
(past performance)	(2.77)***	
Tobin's Q *(TQ)*[L]		0.004
(past performance)		(4.19)***
Multinationality *(MULTI)*[L]	0.515	0.266
(past degree of multinationality)	(24.38)***	(30.72)***
Firm Size *(SIZE)*[L]	0.036	0.003
(past firm size)	(1.73)*	(15.99)***
Overall R^2	0.726	0.725

*p<0.10, **p<0.05, ***p<0.01
[L] lagged (t-1)
z-statistics are in parentheses

Table 3 Panel A shows our first-stage regression results for endogenous variable *MULTI*. *MULTI* is instrumented by market concentration (*MCON*), intangibles (*INTANG*), firm-specific volatility (*VOLAT*), R&D intensity (*RD*) with controls for prior performance (*ROA* or *Q*), prior size (*SIZE*) and prior level of multinationality (*MULTI*); the predicted value of *MULTI* is then used in the second-stage regression.

Panel B. Determinants of awareness (*RO-AWN*)   Panel C. Determinants of growth options (*GO*)

Depended variable: *RO-AWN*		
Firm Size *(SIZE)*[L] (past firm size)	0.035 (8.94)***	0.037 (9.16)***
Multinationality *(MULTI)*[L] (past degree of multinationality)	0.008 (2.04)**	0.011 (2.81)***
Return on Assets *(ROA)*[L] (past performance)	0.376 (7.19)***	
Tobin's Q *(TQ)*[L] (past performance)		0.018 (7.81)***
Overall R^2	0.779	0.801

*p<0.10, **p<0.05, ***p<0.01
[L] lagged (t-1)
z-statistics are in parentheses

Depended variable: *GO*	
Firm-specific volatility (*FSPVOL*)	0.193 (19.96)***
Leverage (*LEV*)	-0.054 (-7.40)***
Skewness (SKEW)	0.021 (2.45)***
Organizational slack (*SGA*)[L]	0.070 (6.14)***
Cash flow coverage (*CFC*)[L]	-0.001 (-0.40)
R&D intensity (*RD*)[L]	0.076 (3.01)***
Cumulative sales growth (*SG*)[L]	0.001 (2.51)***
Market power (*HHI*)	0.003 (5.57)***
Overall R^2	0.302

*p<0.10, **p<0.05, ***p<0.01
[L] lagged (t-1)
z-statistics are in parentheses

Table 3 Panels B and C show our first-stage regression results for endogenous variables *RO-AWN* and *GO*. In Panel B: *RO-AWN* is instrumented by prior performance (*ROA* or *Q*), prior size (*SIZE*) and prior level of multinationality (*MULTI*), with the predicted value of *RO-AWN* then used in the second-stage regression. In Panel C: strategic growth options *GO* is measured as {*GO* = *f* (idiosyncratic volatility, skewness, organizational slack, cash flow coverage, cumulative sales growth, market power, R&D intensity)}.

Table 4

Panel A. Panel data regressions (2SLS) explaining firm value using Tobin's Q

Independent Variables	Model 0	Model 1	Model 1'	Model 1"	Model 2	Model 2'	Model 3
Multinationality *(MULTI)*^{L}		0.427 (19.87)***			0.143 (10.68)***	0.095 (6.19)***	0.164 (5.08)***
Real Options Awareness *(RO-AWN)*^{L}			0.104 (4.95)***		0.487 (2.08)***	0.582 (2.25)**	0.646 (2.49)***
Interaction *(MULTI*RO-AWN)*^{L}							0.715 (2.43)**
Growth Options *(GO)*^{L}				0.383 (3.35)***		0.819 (13.73)***	0.820 (13.74)***
Change in Growth Options *(ΔGO)*				0.058 (2.27)**		0.372 (5.61)***	0.374 (5.62)***
Systematic Risk *(β)*^{L}	0.102 (1.51)	0.002 (0.11)	0.016 (0.42)	0.003 (0.07)	-0.046 (-3.63)***	-0.061 (-3.55)***	-0.062 (-3.60)***
Firm Size *(SIZE)*^{L}	0.454 (5.11)***	0.619 (5.34)***	-0.269 (-6.61)***	-0.506 (-11.00)***	0.081 (4.64)***	0.115 (4.83)***	0.074 (2.51)***
Leverage *(LEV)*^{L}	-7.177 (-19.30)***	-3.018 (-20.62)***	-2.202 (-26.03)***	-0.922 (-8.30)***	-2.598 (-59.90)***	-2.598 (-51.56)***	-2.586 (-51.06)***
Interaction *(SIZE*LEV)*^{L}	0.430 (10.96)***	0.379 (9.86)***	0.111 (6.71)***	-0.189 (-10.37)***	0.216 (20.25)***	0.171 (17.28)***	0.171 (17.33)***
Investment Growth *(INVG)*	3.317 (2.28)**	0.463 (2.21)**	-0.359 (-0.66)	1.177 (1.77)*	0.867 (5.51)***	1.592 (5.34)***	1.567 (5.25)***
Industry *(IND)*	-0.001 (-0.11)	-0.016 (-3.13)***	-0.049 (-4.06)***	-0.078 (-4.76)***	0.003 (0.77)***	0.004 (0.46)	0.003 (0.34)
Business Uncertainty *(σ)*^{L}	0.309 (3.24)***						
Overall R^2	0.475	0.240	0.241	0.294	0.423	0.428	0.431
Wald chi^2	1697.42	1113.35	1990.61	1837.71	7754.35	7743.34	7754.78
Model rho	0.979	0.703	0.755	0.895	0.679	0.682	0.679
N	13890	13890	13890	13890	13890	13890	13890

*p<0.10, **p<0.05, ***p<0.01
^{L} *lagged (t-1)*
z-statistics are in parentheses

Table 4 Panel A presents our main 2SLS results. Model 0 reports the impact of the control variables, including firm-specific business volatility or business uncertainty (*σ*), on firm value. Models 1, 1' and 1'' describe the incremental univariate impact of multinationality (*MULTI*), real options awareness (*RO-AWN*), and the joint *GO* and *ΔGO* variables alone, along with the control variables. Models 2 and 2' present multivariate results with main variables *MULTI* and *RO-AWN* first alone and then controlling for *GO* and *ΔGO*. Model 3 reports the combined effects of *MULTI*, *RO-AWN*, *GO* and *ΔGO,* along with the interaction term *MULTI*RO-AWN* on Tobin's Q while controlling for other effects.

Table 4

Panel B. Panel data regressions (2SLS) explaining firm value using alternative performance proxies (*AvgStkRtn* and *ROA*)

Independent Variables	1		2		3	
	AvgStkRtn		ROA		log(1+TobinsQ)	
	Model 2'	Model 3	Model 2'	Model 3	Model 2'	Model 3
Multinationality *(MULTI)*[L]	0.120	0.115	0.068	0.051	0.512	0.512
	(4.52)***	(5.18)***	(10.16)***	(6.28)***	(49.95)***	(49.94)***
Real Options Awareness *(RO-AWN)*[L]	0.051	0.107	0.063	0.050	0.398	0.380
	(4.85)***	(5.49)***	(10.48)***	(7.08)***	(42.84)***	(36.73)***
Interaction *(MULTI*RO-AWN)*[L]		0.011		0.002		0.008
		(7.68)***		(3.48)***		(3.89)***
Growth Options *(GO)*[L]	0.066	0.090	0.136	0.136	0.156	0.156
	(2.52)***	(3.22)***	(20.93)***	(20.92)***	(10.42)***	(10.39)***
Change in Growth Options *(ΔGO)*	0.612	0.599	0.131	0.131	0.103	0.103
	(24.75)***	(22.66)***	(18.50)***	(18.51)***	(8.06)***	(8.07)***
Systematic Risk *(β)*[L]	0.034	0.040	0.014	0.014	0.016	0.017
	(4.71)***	(5.14)***	(5.31)***	(5.28)***	(3.91)***	(3.96)***
Firm Size *(SIZE)*[L]	0.071	0.190	0.005	0.030	0.049	0.032
	(5.96)***	(8.98)***	(3.32)***	(3.69)***	(9.04)***	(4.52)***
Leverage *(LEV)*[L]	-0.409	-0.432	-0.030	-0.029	-0.008	-0.008
	(-20.48)***	(-19.85)***	(-4.13)***	(-4.07)***	(-29.29)***	(-29.27)***
Interaction *(SIZE*LEV)*[L]	0.023	0.026	0.006	0.006	0.001	0.001
	(6.27)***	(6.28)***	(4.01)***	(4.16)***	(27.12)***	(27.11)***
Investment Growth *(INVG)*	1.751	1.690	0.283	0.274	1.587	1.583
	(12.96)***	(11.70)***	(5.76)***	(5.57)***	(22.11)***	(22.06)***
Industry *(IND)*	0.023	0.023	0.048	0.048	0.015	0.014
	(6.50)***	(6.41)***	(6.19)***	(5.87)***	(7.61)***	(7.53)***
Overall R^2	0.122	0.124	0.257	0.254	0.325	0.326
Wald chi^2	2516.08	2233.93	2818.56	2831.69	5079.69	5101.2
Model rho	0.208	0.241	0.533	0.534	0.629	0.627
N	13890	13890	13890	13890	13890	13890

*p<0.10, **p<0.05, ***p<0.01
[L] lagged (t-1)
z-statistics are in parentheses

Table 4 Panel B reports findings based on Models 2' and 3 using alternative indicators of firm value and performance such as return-on-assets (*ROA*) and average stock returns (*AvgStkRtn*). Log (1+Tobin's Q) findings are reported for comparison.

Table 5

Panel data regressions (2SLS) explaining firm value using alternative multinationality proxies

Independent Variables	MULTI=Ln(1+M)	FS	Residual_MULTI	Residual_FS	Residual_FA	Residual_FOI
Multinationality $(MULTI)^L$	0.223	0.380	0.283	0.297	0.519	0.468
	(21.80)***	(18.22)***	(10.70)***	(11.27)***	(9.73)***	(8.73)***
Real Options Awareness $(RO\text{-}AWN)^L$	0.218	4.416	0.127	0.229	0.133	0.034
	(3.54)***	(18.30)***	(12.02)***	(15.19)***	(5.74)***	(4.27)***
Interaction $(MULTI*RO\text{-}AWN)^L$	0.031	0.702	0.042	0.043	0.040	0.040
	(5.98)***	(3.16)***	(12.18)***	(10.81)***	(10.64)***	(8.81)***
Growth Options $(GO)^L$	0.813	0.806	0.697	0.723	0.705	0.725
	(14.65)***	(13.68)***	(12.54)***	(12.11)***	(12.66)***	(12.94)***
Change in Growth Options (ΔGO)	0.320	0.378	0.331	0.385	0.328	0.325
	(5.28)***	(5.69)***	(5.47)***	(5.81)***	(5.41)***	(5.38)***
Systematic Risk $(\beta)^L$	-0.051	-0.034	-0.047	-0.054	-0.048	-0.049
	(-3.29)***	(-2.02)**	(-3.01)***	(-3.15)***	(-3.11)***	(-3.18)***
Firm Size $(SIZE)^L$	0.079	3.791				
	(2.01)**	(17.55)***				
Leverage $(LEV)^L$	-2.367	-2.479	-2.238	-2.512	-2.256	-2.329
	(-51.20)***	(-50.39)***	(-49.81)***	(-50.33)***	(-49.30)***	(-50.19)***
Interaction $(SIZE*LEV)^L$	0.117	0.169	0.090	0.150	0.092	0.105
	(13.24)***	(17.53)***	(10.31)***	(15.20)***	(10.35)***	(11.74)***
Investment Growth $(INVG)$	1.778	0.893	1.728	1.674	1.768	1.905
	(6.49)***	(2.99)***	(6.34)***	(5.63)***	(6.47)***	(6.99)***
Industry (IND)	0.009	0.000	0.011	0.009	0.012	0.012
	(1.18)	(0.02)	(1.49)	(1.18)	(1.56)	(1.64)*
Overall R^2	0.435	0.464	0.430	0.427	0.426	0.431
Wald chi^2	9097.31	8081.15	9122.00	7832.55	9062.68	9183.49
Model rho	0.672	0.653	0.688	0.684	0.690	0.691
N	13890	13890	13890	13890	13890	13890

*$p<0.10$, **$p<0.05$, ***$p<0.01$
^{L} lagged (t-1)
z-statistics are in parentheses

Table 5 reports findings based on Model 3 (Table 4 Panel A) using alternative definitions of multinationality. These include the raw number of foreign countries ln (1+M), and the foreign sales (*FS*), foreign assets (*FA*) and foreign operating income (*FOI*) ratios. *FA* and *FOI* are residual-based proxies for multinationality (after controlling for size).

Table 6

Panel A. Robustness tests based on alternative samples and measurement specifications (*MULTI* and *FS*)

Independent Variables	1		2		3		4		5		6	
	All MNCs		Manufacturing MNCs		All MNCs, excluding MVE<20mil.		All MNCs RO-AWN=0,1		All MNCs RO-AWN=0,1,2		All MNCs, including INVG*RO-AWN	
	MULTI	FS	MULTI	FS	MULTI	FS	MULTI	FS	MULTI	FS	MULTI	FS
Multinationality *(MULTI)*[L]	0.164	0.380	0.175	0.447	0.145	0.377	0.162	0.558	0.176	0.561	0.165	0.380
	(5.08)***	(18.22)***	(4.59)***	(17.88)***	(4.41)***	(17.78)***	(4.98)***	(12.73)***	(5.44)***	(12.84)***	(5.09)***	(18.21)***
Real Options Awareness *(RO-AWN)*[L]	0.646	4.416	0.561	5.218	0.507	4.400	0.505	5.323	0.882	5.342	0.610	4.417
	(2.49)***	(18.30)***	(2.19)**	(17.98)***	(2.01)**	(17.89)***	(2.12)**	(12.77)***	(2.76)***	(12.86)***	(2.35)**	(18.30)***
Interaction *(MULTI*RO-AWN)*[L]	0.715	0.702	0.838	0.523	0.564	0.556	0.673	0.552	0.807	0.555	0.702	0.684
	(2.43)**	(3.16)***	(2.35)**	(2.48)***	(1.89)*	(2.59)***	(2.29)**	(12.62)***	(2.70)***	(12.73)***	(2.38)**	(3.08)***
Growth Options *(GO)*[L]	0.820	0.806	1.055	1.035	0.882	0.876	0.821	0.767	0.822	0.771	0.820	0.807
	(13.74)***	(13.68)***	(13.29)***	(13.20)***	(13.37)***	(13.41)***	(13.76)***	(12.89)***	(13.78)***	(12.93)***	(13.76)***	(13.69)***
Change in Growth Options *(ΔGO)*	0.374	0.378	0.443	0.493	0.437	0.441	0.374	0.380	0.374	0.377	0.374	0.378
	(5.62)***	(5.69)***	(5.43)***	(6.07)***	(5.87)***	(6.42)***	(5.62)***	(5.71)***	(5.63)***	(5.69)***	(5.63)***	(5.70)***
Systematic Risk *(β)*[L]	-0.062	-0.034	-0.061	-0.034	-0.069	-0.039	-0.062	-0.085	-0.062	-0.088	-0.061	-0.034
	(-3.60)***	(-2.02)**	(-2.89)***	(-1.62)*	(-3.78)***	(-2.16)**	(-3.61)***	(-4.95)***	(-3.61)***	(-5.10)***	(-3.58)***	(-2.00)**
Firm Size *(SIZE)*[L]	0.074	3.791	0.110	-4.413	0.183	3.646	0.077	0.126	0.071	0.086	0.075	3.791
	(2.51)***	(17.55)***	(3.22)***	(16.97)***	(5.87)***	(16.54)***	(2.62)***	(4.26)***	(2.40)**	(2.89)***	(2.55)***	(17.55)***
Leverage *(LEV)*[L]	-2.586	-2.479	-2.598	-2.540	-2.871	-2.823	-2.586	-2.447	-2.587	-2.539	-2.588	-2.481
	(-51.06)***	(-50.39)***	(-43.63)***	(-44.08)***	(-48.28)***	(-48.40)***	(-51.07)***	(-49.10)***	(-51.12)***	(-50.45)***	(-51.10)***	(-50.42)***
Interaction *(SIZE*LEV)*[L]	0.171	0.169	0.188	0.203	0.209	0.219	0.171	0.155	0.172	0.171	0.172	0.170
	(17.33)***	(17.53)***	(16.34)***	(18.19)***	(18.98)***	(20.26)***	(17.31)***	(15.93)***	(17.46)***	(17.48)***	(17.38)***	(17.58)***
Investment Growth *(INVG)*	1.567	0.893	1.559	1.094	1.553	1.078	1.568	1.103	1.566	1.316	1.511	0.836
	(5.25)***	(2.99)***	(4.11)***	(2.88)***	(4.95)***	(3.45)***	(5.25)***	(3.69)***	(5.24)***	(4.41)***	(5.03)***	(2.79)***
Interaction *(INVG*RO-AWN)*											4.414	4.454
											(1.67)*	(1.69)*
Industry *(IND)*	0.003	0.000	0.007	0.004	0.008	0.008	0.003	0.013	0.003	0.015	0.003	0.000
	(0.34)	(0.02)	(0.71)	(0.66)	(1.00)	(1.00)	(0.36)	(1.66)*	(0.37)	(1.94)**	(0.33)	(0.03)
Overall R^2	0.431	0.464	0.470	0.518	0.441	0.481	0.430	0.441	0.432	0.447	0.431	0.465
Wald chi^2	7754.78	8081.15	5415.17	6041.82	7387.86	7896.6	7752.44	7788.19	7760.50	7984.92	7759.97	8087.04
Model rho	0.679	0.653	0.648	0.571	0.665	0.633	0.679	0.663	0.676	0.666	0.678	0.653
N	13890	13890	7120	7120	13840	13840	13890	13890	13890	13890	13890	13890

*p<0.10, **p<0.05, ***p<0.01

[L] lagged (t-1)

z-statistics are in parentheses

Specification (1) shows our panel (2SLS) results based on Model 3 (Table 4 Panel A and Table 5 for *FS*) as a benchmark. Specification (2) uses a subset of multinational manufacturing firms. Specification (3) excludes smaller firms (ME < $ 20mil) from the overall sample. Specifications (4) and (5) use alternative definitions of real options awareness (*RO-AWN*), based on subsample analysis (dummy variables), first defined as a single dummy variable (0 non aware, 1 aware) and then second without the logarithmic transformation (A = 0, 1, 2). Specification (6) tests the moderating effect of *RO-AWN* on *INVG* in the benchmark specification. Multinationality is defined as ln (1+M) and *FS*. Other variables are defined as before.

Table 6

Panel B. Robustness tests based on alternative samples and measurement specifications
(*AvgStkRtn* and *ROA*)

Independent Variables	1 All MNCs		2 Manufacturing MNCs		3 All MNCs, excluding MVE<20mil.		4 All MNCs RO-AWN=0,1		5 All MNCs RO-AWN=0,1,2		6 All MNCs, including INVG*RO-AWN	
	AvgStkRtn	ROA	AvgStkRtn	ROA	AvgStkRtn	ROA	AvgStkRtn	ROA	AvgStkRtn	ROA	AvgStkRtn	ROA
Multinationality *(MULTI)*^{L}	0.115	0.051	0.109	0.053	0.089	0.070	0.053	0.007	0.040	0.007	0.117	0.052
	(5.18)***	(6.28)***	(4.87)***	(6.31)***	(3.75)***	(8.71)***	(4.49)***	(3.63)***	(3.79)***	(3.66)***	(5.25)***	(6.38)***
Real Options Awareness *(RO-AWN)*^{L}	0.107	0.050	0.103	0.052	0.078	0.064	0.445	0.178	0.348	0.198	0.109	0.051
	(5.49)***	(7.08)***	(5.22)***	(7.07)***	(3.79)***	(9.18)***	(4.15)***	(5.48)***	(3.35)***	(5.61)***	(5.58)***	(7.18)***
Interaction *(MULTI*RO-AWN)*^{L}	0.011	0.002	0.010	0.002	0.014	0.002	0.070	0.004	0.051	0.004	0.011	0.002
	(7.68)***	(3.48)***	(7.21)***	(3.32)***	(9.07)***	(3.75)***	(3.93)***	(8.96)***	(3.18)***	(9.04)***	(7.76)***	(3.29)***
Growth Options *(GO)*^{L}	0.090	0.136	0.088	0.138	0.094	0.182	0.068	0.126	0.069	0.126	0.090	0.136
	(3.22)***	(20.92)***	(3.11)***	(20.43)***	(2.73)***	(24.09)***	(2.43)**	(19.72)***	(2.49)**	(19.75)***	(3.25)***	(20.88)***
Change in Growth Options *(ΔGO)*	0.599	0.131	0.604	0.133	0.577	0.048	0.604	0.123	0.604	0.123	0.599	0.131
	(22.66)***	(18.51)***	(22.10)***	(18.11)***	(19.30)***	(4.73)***	(22.79)***	(17.47)***	(22.79)***	(17.49)***	(22.64)***	(18.49)***
Systematic Risk *(β)*^{L}	0.040	0.014	0.035	0.014	0.032	0.016	0.041	0.013	0.041	0.014	0.041	0.014
	(5.14)***	(5.28)***	(4.35)***	(5.29)***	(3.55)***	(5.73)***	(5.24)***	(5.21)***	(5.19)***	(5.23)***	(5.18)***	(5.32)***
Firm Size *(SIZE)*^{L}	0.190	0.030	0.183	0.029	0.190	0.034	0.080	0.070	0.069	0.071	0.193	0.029
	(8.98)***	(3.69)***	(8.60)***	(3.47)***	(8.55)***	(4.29)***	(5.84)***	(11.35)***	(5.32)***	(11.41)***	(9.08)***	(3.50)***
Leverage *(LEV)*^{L}	-0.432	-0.029	-0.428	-0.027	-0.419	-0.018	-0.448	-0.031	-0.447	-0.031	-0.433	-0.030
	(-19.85)***	(-4.07)***	(-19.40)***	(-3.68)***	(-14.80)***	(-2.19)**	(-20.52)***	(-4.34)***	(-20.46)***	(-4.38)***	(-19.90)***	(-4.13)***
Interaction *(SIZE*LEV)*^{L}	0.026	0.006	0.026	0.006	0.021	0.006	0.027	0.005	0.028	0.005	0.026	0.006
	(6.28)***	(4.16)***	(6.25)***	(3.81)***	(4.23)***	(3.68)***	(6.61)***	(3.64)***	(6.80)***	(3.72)***	(6.35)***	(4.25)***
Investment Growth *(INVG)*	1.690	0.274	1.867	0.290	1.766	0.327	1.683	0.279	1.673	0.278	1.670	0.273
	(11.70)***	(5.57)***	(12.07)***	(5.33)***	(11.36)***	(6.43)***	(11.63)***	(5.66)***	(11.57)***	(5.66)***	(11.52)***	(5.54)***
Interaction *(INVG*RO-AWN)*											0.799	0.385
											(1.64)*	(2.48)***
Industry *(IND)*	0.023	0.048	0.023	0.047	0.023	0.049	0.024	0.048	0.024	0.048	0.023	0.048
	(6.41)***	(5.87)***	(6.20)***	(5.59)***	(6.03)***	(7.31)***	(6.70)***	(11.77)***	(6.64)***	(11.86)***	(6.38)***	(5.69)***
Overall R^2	0.124	0.254	0.127	0.257	0.130	0.285	0.122	0.242	0.122	0.243	0.124	0.255
Wald chi^2	2233.93	2831.69	2120.20	2623.83	1858.13	3073.45	2179.56	2808.55	2173.15	2810.30	2237.24	2838.46
Model rho	0.241	0.534	0.227	0.536	0.317	0.406	0.239	0.533	0.240	0.533	0.241	0.534
N	13890	13890	7120	7120	13840	13840	13890	13890	13890	13890	13890	13890

*$p<0.10$, **$p<0.05$, ***$p<0.01$

^{L} lagged (t-1)

z-statistics are in parentheses

Specification (1) shows our panel (2SLS) results based on Model 3 (Table 4 Panel B) as a benchmark. Specification (2) uses the subset of multinational manufacturing firms. Specification (3) excludes smaller firms (ME < $ 20mil) from the overall sample. Specifications (4) and (5) use alternative definitions of real options awareness (*RO-AWN*), based on subsample analysis (dummy variables), first defined as a single dummy variable (0 non aware, 1 aware) and then second without the logarithmic transformation (A = 0, 1, 2). Specification (6) tests the moderating effect of *RO-AWN* on *INVG* in the benchmark specification. The dependent variables are *AvgStkRtn* and *ROA*. Other variables are defined as before.

Table 7

Robustness test comparisons: Accounting for self-selection and endogeneity (Heckman and Propensity)

Independent Variables	1		2		3	
	2SLS		Heckman		Propensity	
	MULTI	FS	MULTI	FS	MULTI	FS
Multinationality $(MULTI)^L$	0.171	0.385	0.482	0.391	0.152	0.456
	(5.26)***	(18.48)***	(0.90)	(16.93)***	(5.09)***	(19.50)***
Real Options Awareness $(RO\text{-}AWN)^L$	0.724	4.482	0.782	4.423	0.306	5.321
	(2.79)***	(18.58)***	(2.93)***	(18.41)***	(1.69)*	(19.61)***
Interaction $(MULTI*RO\text{-}AWN)^L$	0.772	0.607	0.778	0.605	0.725	0.604
	(2.60)***	(2.82)***	(3.59)***	(2.68)***	(2.68)***	(2.68)***
Growth Options $(GO)^L$	0.815	0.844	0.821	0.807	0.962	0.882
	(13.70)***	(13.80)***	(13.76)***	(13.66)***	(14.33)***	(13.79)***
Change in Growth Options (ΔGO)	0.377	0.432	0.371	0.374	0.296	0.438
	(5.64)***	(6.37)***	(5.59)***	(5.68)***	(4.40)***	(5.83)***
Selection Bias correction - Inverse Mill's Ratio (IMR)			1.864	-0.371		
			(0.98)	(-1.02)		
Systematic Risk $(\beta)^L$	-0.060	-0.038	-0.060	-0.037	-0.066	-0.014
	(-3.47)***	(-2.18)**	(-3.49)***	(-2.16)**	(-3.80)***	(-2.76)***
Firm Size $(SIZE)^L$	0.028	3.802	0.172	3.760	0.132	4.563
	(2.96)***	(17.60)***	(7.88)***	(17.49)***	(4.77)***	(18.78)***
Leverage $(LEV)^L$	-2.492	-2.550	-2.609	-2.571	-2.403	-2.519
	(-49.72)***	(-47.97)***	(-51.63)***	(-51.74)***	(-40.57)***	(-47.43)***
Interaction $(SIZE*LEV)^L$	0.155	0.180	0.168	0.185	0.132	0.190
	(15.80)***	(17.64)***	(17.03)***	(19.08)***	(12.61)***	(18.18)***
Investment Growth $(INVG)$	1.354	1.130	1.561	1.098	1.840	0.980
	(4.52)***	(3.76)***	(5.43)***	(3.70)***	(6.31)***	(2.99)***
Industry (IND)	0.001	0.006	0.004	0.002	0.015	0.009
	(0.07)	(0.80)	(0.52)	(0.26)	(2.09)**	(2.03)**
Overall R^2	0.426	0.470	0.425	0.469	0.482	0.478
Wald chi^2	7566.94	8000.16	7708.38	8285.62	7726.48	7001.05
Model rho	0.677	0.633	0.687	0.656	0.501	0.643
N	52020	52020	12500	12500	10890	10890

*p<0.10, **p<0.05, ***p<0.01

^{L}lagged (t-1)

z-statistics are in parentheses

Specification (1) shows our panel (2SLS) results considering domestic and multinational firms (excluding negative equity) using *MULTI* and *FS* as multinationality proxies. Specification (2) shows the Heckman two-stage results using *MULTI* and *FS* as alternative multinationality proxies. Specification (3) shows the two-stage propensity score matching results using *MULTI* and *FS* as alternative proxies for multinationality. The dependent variable is Tobin's Q. Other variables are defined as before.