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Diversification strategies and firm performance in Vietnam

Evidence from parametric and semi-parametric approaches[1]

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Abstract

This paper is based upon the assumption that a firm's profitability is determined by its degree of diversification which is, in turn, strongly related to the antecedent decision to carry out diversification activities. This calls for an empirical approach that permits the joint analysis of the three interrelated and consecutive stages of the overall diversification process: diversification decision, degree of diversification and outcome of diversification. We apply parametric and semi-parametric approaches to control for sample selection and the endogeneity of the diversification decision in both static and dynamic models. For the analysis, we use the census dataset on the whole firm population in Vietnam, as a representative of transition countries. After controlling for industry fixed-effects, the empirical evidence from the firm-level data shows that diversification has a curvilinear effect on profitability: it improves firms' profit up to a point, after which a further increase in diversification is associated with declining performance. This implies that firms should consider optimal levels of product diversification when they expand their product offerings beyond their core business. Other noteworthy findings include the following: (i) the factors that

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stimulate firms to diversify do not necessarily encourage them to extend their diversification strategy; (ii) firms that are endowed with highly technological resources and innovation investment are likely to successfully exploit diversification as an engine of growth; and (iii) while industry performance does not have a strong influence on the profitability of firms, it impacts their diversification decision as well as the degree of diversification.

JEL classifications: L21, L25, C14, C23.
Keywords: Diversification, firm performance, panel data, sample selection, parametric and semi-parametric models.

1. Introduction

What determines the optimal boundaries of the firm across industries? How does a firm expand from its core business into other product markets? These questions have raised substantial research interests, starting with the initial landmark article 'The Nature of the Firm' by Coase (1937) and the book *The Theory of the Growth of the Firm* by Penrose (1959). Since then, different theories (the resource-based view, transaction cost, agency theory, etc.) have been proposed to explain firm diversification (Andrews, 1980; Rumelt, 1974). The early industrial organization literature argued that no significant relationship exists between diversification and performance, meaning that when entering new markets, existing firms have no special advantages (see, e.g., Arnould, 1969; Markham, 1973). Various later studies have shown that, depending on the degree of relatedness of a firm's diversification activities, diversification generates multiple outcomes (Palich *et al.*, 2000; Qian, 2002). A common finding among these studies is that the diversification–performance relationship is nonlinear: they are positively related up to a point, after which a further increase in diversification is associated with declining performance.

Notwithstanding this change of perspective, research has focused primarily on the single causal effect of degree of diversification relatedness on firms' subsequent performance and has neglected the whole diversification process in which firms are involved until the final diversification outcome is recognized. The important question that is left unanswered is the following: why is it that not all firms engage in diversification activities or receive equally positive outcomes from their diversification strategies? An exploration of the antecedent factors that determine a firm's likelihood to diversify, as well as how much it can diversify upon its green-light decision, might lead to an answer.

First, we argue that it may not be appropriate to analyze the diversification–performance relationship in a single-equation framework, because it is strongly related to the predetermined factors that induce firms to engage in diversification. Thus, we investigate the whole process in three interrelated and consecutive stages: diversification decision (what factors influence a firm's decision to diversify?);

diversification degree (once a firm decides to diversify, what determines the degree of its diversification relatedness?); and diversification outcome (how does a firm's diversification degree influence its profitability?). The first two equations are by nature interrelated (only after the firm decides to diversify, can we observe the firm's degree of relatedness to its core business); therefore we take into consideration that their disturbances are correlated.

Second, we are aware that ANOVAs or cross-sectional least-squares regressions are inadequate to study the relationship between diversification and performance, because these methodological approaches treat the decision to diversify exogenously. Consistent with Maksimovic and Phillips (2002) and Lang and Stulz (1994) among others, who show that firm and industry characteristics influence a firm's decision to diversify – that is, that diversification decisions are endogenous, we take into account the sample selection and endogeneity issues by applying parametric and semi-parametric estimation methods for both static and dynamic treatments of firm-level panel data. Initially, sample selection will be tested and corrected for the first two stages. Four different estimation approaches are employed for the robustness check of the results: the standard Heckman's two-stage method, the Vella–Wooldridge parametric approach, the Heckman kernel-based propensity score matching, and the Semykina and Wooldridge (2010) procedure. Then, to control for the endogeneity of diversification degree (given their diversification decision and diversification degree choice), we apply the Blundell–Bond linear dynamic GMM estimation approach for the static and dynamic treatments.

Apart from the novelty of investigating the diversification/performance relationship in a comprehensive three-stage process and controlling for selectivity and endogeneity issues, this research also contributes as a pioneer in studying the diversification activities of firms in a transition country such as Vietnam. Although the nature of diversification activities in developing countries seems to differ fundamentally from that in developed countries (Nachum, 1999), we argue that diversification can also be a growth strategy for firms in transition countries, irrespective of whether they were previously state-owned or fully private (Loc *et al.*, 2006).

The dataset used for the empirical analysis is from the annual enterprise survey conducted by the Vietnam General Statistics Office (GSO). It allows us to take into account a period in which the reform that was implemented during the 1990s started to have effects (Sakellariou and Fang, 2014). In fact, the database covers the entire population of existing firms from 2002 to 2010 which is more than one million observations. The 2002–2010 period represents a typical transition in the Vietnamese economy, with some remarkable milestones that are critical for economic performance at both the macro- and micro-levels. Vietnam's trade liberalization with the US in 2001 and its entrance into the WTO in 2007 are noteworthy. However, due to the high churning rate of firms and to trace their diversification activities and performance over time, we extract a balanced panel of 26,289 non-agricultural firms established before 2002 and still existing in 2010 (236,601 observations). For the survival bias analysis of the diversified firms, the whole unbalanced panel dataset is used.

Controlling for individual-level, firm-level and industry-level characteristics, we find that the factors stimulating firms to undertake diversification decisions do not necessarily influence their degree of diversification in the same direction and to the same magnitude. The main findings are as follows: (i) diversification has a curvilinear effect on firm-level profitability, because product diversification improves firms' profit up to a point, after which a further increase in diversification is associated with declining performance; (ii) while the impact of technical employees on the firm's diversification activities is controversial, innovation intensity stimulates firms to diversify and to take the stable and safe-related pathway (both of these factors are positively associated with firm performance); (iii) firms with higher debt ratios are less diversified, but once they diversify, they are more likely to adopt risky unrelated options and thus have lower profitability; (iv) less diversified firms spend more on, and benefit more from, marketing investment, and marketing-intensive firms are generally more focused on their main business field; (v) newer and larger firms are more likely to engage in diversification; (vi) industry-level characteristics, including low profitability, high concentration and maturity significantly stimulate firms to diversify into other business sectors and have a significant impact on their overall performance.

The paper is structured as follows: Section 2 summarizes the theoretical discussion of product diversification and its relationship with the performance of firms; Section 3 gives an overview of the dataset and presents the variables adopted together with their descriptive statistics and correlation matrix; Section 4 develops the approach(es) that we apply to obtain the final empirical estimation after conducting relevant tests for the existence of sample selection and endogeneity; Section 5 discusses the estimation results. Section 6 controls for the potential survival bias of our estimation; and, finally, Section 7 offers some concluding remarks and directions for future research.

2. Literature survey

Numerous researchers have proposed various definitions and measures of product diversification. For example, Ansoff (1965) focused on entry into new markets with new products; Kamien and Schwartz (1975) emphasized a firm's degree of product and market involvement; and Rumelt (1974) and other scholars[2] focused on the strategy of adding related or similar product/service lines to existing core business either through the acquisition of competitors or through the internal development of new products/services, which implies an increase in managerial competence within the firm.

Diversification is, thus, a matter of degree of relatedness among the activities carried out by a firm. Product relatedness denotes the extent to which a firm's different lines of business are linked by a common skill, market, purpose, or resource (Luo, 2002; Rumelt, 1974): for instance, using the same types and proportions of human expertise (Farjoun, 1994) or relying on the same inflows of technology (Robins and Wiersema, 1995). Empirical studies normally measure diversification as the number of activities a firm undertakes in different sectors. Such studies thus characterize resources at the industry level only, thereby failing to address the heterogeneity of firm-level resource bases. The degree of relatedness is then measured with reference to the system of standard industrial classification (SIC) codes. While this type of measure has inherent limitations due to not taking into account the internal managerial effort or resource requirements underlying observable diversification activities and relying on proximity among SIC codes (Silverman, 1999), it has been commonly applied in empirical parts of this work due to its availability and straightforward nature.

Montgomery (1994) distinguishes between three motivations for diversification. First, the market-power view postulates that diversified firms will thrive at the expense of non-diversified firms not because they are more efficient but because they have access to 'conglomerate power' (Montgomery, 1994, p. 165). Under the market power search approach, the diversification strategies undertaken by growth-oriented managers may well exploit scope economies and simultaneously increase firms' market power. An efficient way to increase firms' market power is the multimarket contact hypothesis (Scott, 1993), according to which firms meeting in several markets have a greater incentive to network with each other to sustain their collective power. Conversely, multiproduct firms can create positive spillovers by cross-subsidization activities that is, the market strength and value of the resources in one particular industry may increase due to investment in another industry (Foss and Christensen, 2001; Teece *et al.*, 1994).

Second, the resource view argues that rent-seeking firms diversify in response to excess capacity in productive resources. In this sense, a firm's level of profit and the breadth of its diversification are functions of its resource stock (Montgomery, 1994, p. 167). The deployment of surplus resources and free cash flows is one of the prime motives for diversification (Hoskisson and Hitt, 1990). However, the asset specificity embedded in firms' resources on the one hand creates sustainable competitive power for the owner relative to the competitors, but on the other hand, it is a challenge that impedes the firm's ability to transfer resources to new applications or transplant them into a new context (Montgomery and Wernerfelt, 1988). Therefore, the value of diversification will depend on the complementarities that exist between the internal resources and the business/industry that the firm enters, as well as the diversification mode that it chooses. This opens the way for several empirical predictions revolving around the relatedness of diversification activities: the more closely these activities are related or complementary, the more profitable the diversification is expected to be.

Third, the agency view emphasizes the benefits a firm's managers may reap at the expense of its shareholders (Montgomery, 1994, p. 166). Considering diversification in large firms as being a result of the separation between ownership and control, the agency approach predicts a negative relationship between diversification and firm performance. Hoskisson and Hitt (1990) suggest that diversification, firm size and executive compensation are highly correlated to the extent to which diversification provides benefits to managers who are unavailable to investors. Diversification can also lead to the problem of moral hazard due to a conflict of interest between managers who have an interest in costly diversification as a form of compenzation and investors who prefer to concentrate on the core business to maximise their returns (Bhide, 1990).

Finally, focusing on the distribution of the firm's activities over industries, transaction cost economists suggest that diversification is an alternative contractual method by which a firm can exploit its surplus resources (Silverman, 1999). By the same token, Grossmann (2007) submits that diversification may be a means to expand the firm's boundaries in the presence of the internal coordination problems that naturally arise in large firms. However, no matter how business activities are related, the transfer of product and process technology among different industries with varied characteristics normally requires certain modification and adjustment, thereby incurring varying degrees of transaction costs (Qian, 2002). When a firm moves into a market with only a weak connection to its primary line of business (unrelated diversification), it often lacks the know-how and managerial resources to prevail against the competition in this new industry. Diversification beyond a certain degree raises internal governance and administration costs to the point that performance suffers (Jones and Hill, 1988). Thus, many of the most significant failures of diversification can be traced to the failure of achieving sufficient relatedness between business sectors, which implies that the resources in one industry are substitutes for, or complements to, the resources in another industry (Lien and Klein, 2006).

Empirically, diversification is normally approached by focusing either on the synergies exploited by diversified firms and the optimal organizational structure for managing a multiproduct firm (strategic management approach) or on the relationships between market/industry structure and firm-level diversification (industrial organization approach). In each discipline, the empirical literature has grown with scarce contacts with the other one (Vannoni, 2004).

Within the strategic management approach, despite being based on various sets of management guidelines that address the question of the appropriate scale and scope of the firm, corporate strategies converge in dealing with the conflicting demands of synergies and responsiveness with respect to allocating resources (Wit and Meyer, 2005). On the one hand, the synergy of interrelated businesses within a diversified firm brings the benefit of economies of scope, which arise from sharing common tangible inputs, such as markets, distribution systems, product and process technologies and manufacturing facilities (Rumelt, 1974; Teece, 1980), as well as intangible assets such as brand names and know-how (Qian, 1997), managerial capabilities, routines and repertoires (Grant, 1988). The more interrelated the businesses, the greater the potential for organizational synergy (Salter and Weinhold, 1981). On the other hand, synergy has harmful effects owing to responsiveness, such as higher governance costs, slower decision making, strategy incongruence, dysfunctional control and dulled incentives (Wit and Meyer, 2005). Thus, the fundamental challenge facing corporate diversification stems from 'managing the conflict between the new and old (business activities) and overcoming the inevitable tensions that such conflict produces for management' (Dess *et al.*, 2003, p. 358).

With respect to the industrial organization approach, diversification as the proxy for economies of scope is investigated in relation to firms' innovative capabilities. Firms are assumed to have different innovative capabilities that lead them to pursue different types of product diversification (Cohen and Klepper, 1992). A firm with a diversified portfolio of products may be better positioned to determine the general applicability of new ideas than a firm with a narrower portfolio of products; this is because the former is able to capture internal knowledge spillovers. Indeed, firms that sell only one category of products are less likely to engage in R&D than those that sell a broader range of products (Piga and Vivarelli, 2004). Given the same competencies for the production and delivery of core products, together with the same incentives to diversify, firms that possess more dynamic capabilities will be more likely to expand their product scope (Doving and Gooderham, 2008).

Regardless of which disciplinary and theoretical perspective one adopts, most studies support a curvilinear relationship between diversification and profitability (for a review, see Palich *et al.*, 2000; see also Yigit and Berham, 2013). The appropriateness of product diversity is judged by the balance between (positive) synergy effect and (negative) responsiveness effect, as well as the balance between economies of scope and diseconomies of scale, which indicates a limit on how much a firm can diversify. If a firm goes beyond this point, its market value suffers (Markides, 1992). However, we cannot explain the extent to which the positive effect of synergy fades away and is replaced by the negative effect of responsiveness or why moderate levels of diversification yield higher levels of performance than either limited or extensive diversification (Tran and Zaninotto, 2012). Why is it that not all firms engage in diversification activities or receive equally positive outcomes from their diversification strategies? This can be partly explained by different motives that determines firms' engagement with diversification: the efficiency motive or bounded-rational herding behaviour (Tran *et al.*, 2015). The exploration of the antecedent factors that determine a firm's likelihood of diversifying, as well as how much it can diversify upon its green-light decision, might lead to an answer.

3. Data description and definition of variables

The dataset used for the empirical analysis is the annual enterprise survey database conducted by the GSO from 2002 to 2010. It covers the entire population of existing firms over 9 years, which comprises more than one million observations. The GSO survey is comprehensive and harmonized across provinces and industries to obtain a coherent view of various aspects of firms, including segment data (ISIC code, industry sales, size and assets), accounting data (debt, revenue, profit), basic demographic data (year of inception, ownership type, size of labour force), and innovation data. However, due to the high churning rate of firms, and because we want to trace the diversification activities and performance of firms over time, we extract the balanced panel of 26,289 non-agricultural firms that were established before 2002 and were still in existence until 2010 (236,601 observations) for the empirical evidence of the three-staged diversification process. To control for the potential survival bias of diversified firms, the entire population of firms will be used.

Following is the list of variables we use in this paper. The choice of variables is based on the different theoretical foundations reviewed above. The industrial organization literature focusing on the relationship between firm performance and a host of industry structure variables suggests the list of our industry-level variables: industry concentration, industry growth/profitability, industry lifecycle, and so on. The market power theory states that firms diversify to reduce industry competition and concentration; its prescriptions can, therefore, be tested by means of an industry concentration variable. The resource-based or capability-based view explains the determinants of diversification and firm performance from the excess of various firm resources: human resources (labour size of the firm), financial/physical resources (economic size, capital intensity of the firm), marketing and R&D resources (Montgomery and Hariharan, 1991) (marketing expenditure, technological resources and innovation intensity). The agency theory proposes that the combination of ownership structure, risk and resource availability affects the direction of diversification and can, therefore, be tested by including debt ratio and ownership type variables in the analysis.

3.1 Firm performance

In this paper, we adopt two measures of firm performance: which are return on sales (ROS) and growth of sales. ROS indicates how net income is earned from each thousand Vietnamese dong (VND) of total sales. It is the ratio between after-tax profits and total annual sales. The rationale for using ROS, rather than the widely used logarithm of profit or ROA (return on assets) is as follows: the logarithm of profit excludes firms operating at loss (negative profit) from the analysis, whereas assets would carry book values and require a longer time frame of availability. For growth of sales, we use an adjusted measure $\frac{Sales_t - Sales_{t-1}}{1/2 \times (Sales_t + Sales_{t-1})}$. Since our sales growth exhibits high dispersion, the advantage of this measure is the symmetry around zero and the boundedness between -2 and 2.

3.2 Product diversification index

In this paper, we measure diversification by the entropy index, the most common and robust of all five properties of a diversification index (Gollop and Monahan, 1991). $Entropy = \sum_t^n S_i \ln(1/S_i)$ where S_i is the share of segment i in the firm's sales, and ln $(1/S_i)$ is the weight for each segment i. The segment information from the ISIC codes is used to construct it. The index is sensitive to changes in the number and distribution of products: it is bounded below by zero ($0 \leq E < ln(n)$). As the number of products increases, the entropy index increases at a decreasing rate; however, as the distribution of products becomes more equal, it increases at an increasing rate. The index is 0 when the firm produces in only one industry and is equal to $ln\ (n)$ in cases in which the sales are equally distributed among n industries.

3.3 Probability of diversification

A dummy is adopted as the dependent variable in Equation (1) to distinguish single business firms from diversified firms. It attains 1 if firms have their business operations in more than one industry (one main industry and other subsidiary ones) and 0 otherwise.[3]

3.4 Control variables

We introduce two categories of control variables: (i) firm level: firm size, age, capital intensity, debt ratio, marketing expenditure, level of competition, technological resources, innovation intensity, and whether the firm exports its products/services; and (ii) industry-level profitability proxied by average industry ROS, industry life cycle proxied by industry size dispersion and industry concentration. The 1-year lagged values of selected variables – such as debt ratio, marketing expenditure, export, technological resources and innovation intensity – will be used instead in order to prevent their potential endogeneity.

3.4.1 Innovation intensity

This is measured as the proportion of innovation investment[4] in the total annual investment. It is expressed in decimal points and, thus, has values between 0 and 1. We allow for a nonlinear relationship by including squared innovation intensity.

[3] Here the cut-off threshold $\bar{c}$ separates firms operating in only one industry (i.e., reporting ISIC code in only the main industry column) from those operating in more than one industry (i.e., reporting ISIC code in both the main industry and industry 1 column). This binary variable can capture the dynamics or trend of diversification of firms over time as well. Firms can enter and exit diversification on a yearly basis: therefore, the threshold $\bar{c}$ will attain the values 1 and 0, respectively. We restrict our analysis to non-agricultural firms only.

[4] In this paper, innovation investment includes three components: (i) construction and assembly work; (ii) machinery and equipment; and (iii) technology renovation. It is therefore largely a measure of technological change embodied in intermediate and capital goods, which has been shown to be a major determinant of the overall innovation activities of SMEs (Santarelli and Sterlacchini, 1990).

The innovation process is likely to increase the firm's external absorptive capacity (Levinthal, 1996) and internal knowledge base, leading to greater flexibility and adaptability in new industries.

3.4.2 Technological resources

Grossmann (2007) indicates that technological resources are the driving forces behind a positive relationship between product diversification and firm performance. It has been widely recognized that these may be measured through indicators of R&D inputs, R&D processes and R&D outputs (for a review, see Audretsch, 1995). One crucial indicator of R&D inputs, the share of R&D employees over the total labour force, could be used as a proxy for technological resources. However, on the one hand, it is likely that technical employees with specialized knowledge may be less willing to absorb new knowledge. On the other hand, specialized workers might be productive whenever the firm invests enough in innovation activities. Thus, we will also consider the effect of the interaction term between innovation intensity and technological resources.

3.4.3 Firm size

This is measured in relation to both economic size and labour size. Economic size is taken as the natural logarithm of total firm assets. Labour size is measured as the natural logarithm of the total number of employees. Quadratic terms are also added to establish a nonlinear relationship between firm size and performance. The logarithm transformation was used because size is highly skewed, and extreme values strongly affect correlations with other variables. Firm size is normally used as a proxy for competitive position and firms' advantage within an industry (Johnson *et al.*, 1997).

3.4.4 Firm age

This is related to the level of experience, learning and managerial competencies that a firm accumulates. The age effect on firm performance is inconclusive and controversial, depending on the specific environment and industry in which the firm operates. In view of the dynamic features of an emerging market, aging may impede the ability of a firm to be alert and to capture profit opportunities in a timely and efficient manner. The effect of firm age is explored by means of the number of years that the firm has been in continuous operation.

3.4.5 Capital intensity

Due to the nature of technology, some firms are more capital-intensive than others. Within any particular industry, a firm may choose a highly automated process or a more labour-intensive one. As Porter (1976) states, the capital intensity in the form of industry-specific assets acts as a barrier to exit. In general, capital intensity imposes a greater degree of risk, because assets are frozen in long-lived forms that may not be easy to sell. Given that return (and risk) varies with capital intensity, the differences in profitability are likely to be associated with capital intensity between diversified and undiversified firms. As Shepherd (1979) notes, there are several ways to measure capital intensity, and all show similar patterns. The present study uses the ratio of net fixed assets to total number of employees.

3.4.6 Debt ratio

The finance literature indicates that the leverage situation of firms strongly influences their value. On the one hand, Opler and Titman (1994) find that highly leveraged firms lose a substantial market share to their more conservatively financed competitors. On the other hand, diversification can improve debt capacity, thereby reducing the chances of bankruptcy by going into new products/markets (Higgins and Schall, 1975) and improving asset deployment and profitability (Teece, 1982). Thus, the 1-year lagged debt ratio, measured as the ratio of total debts to total assets in the previous year, is adopted to isolate the effect of a firm's leverage capacity on its diversification/performance.

3.4.7 Marketing expenditure

When a firm enters a new market, it might need to spend resources to acquire a stock of new customers. Corporate marketing activities reflect the organization's vision and distinctive competencies to enhance awareness and provide unified support for its products. Economic intuition suggests that the benefits of corporate marketing are likely to be higher for firms that are less diversified and that such firms should, therefore, spend more on marketing (Raju and Dhar, 1999). Given the importance of corporate marketing strategy in explaining the dependent variables of interest, we will consider the effect of marketing expenditure on the firm's degree of diversification and its entrepreneurial performance.

3.4.8 Level of competition

In times of uncertainty, companies economise on search costs and therefore imitate the actions of other successful firms. This increases the complexity and uncertainty caused by firm-level competition within its 4-digit ISIC industry. Thus, the level of competition that the firm is facing might be correlated with diversification degree, firm performance, and more importantly, the proposed instruments. Including firm-level fixed effects does not solve this problem, because the competition level is time variant. Following Bloom *et al.* (2013), we will construct a proxy of firm-specific competition level.[5]

[5] Let the amount of firms in the sample be N. Define the vector $S_i = (S_{i1}, S_{i2}, \ldots, S_{iN})$ where S_{in} is the average share of sales of firm i in the four digit industry n across all years in the sample. The product market closeness index for firms i and j is calculated as $SIC_{ij} = \frac{S_i S_i'}{(S_i S_i')^{1/2} (S_j S'_j)^{1/2}}$. This index is bounded below by zero and above by one, based on the overlap of product lines between firms. Finally, the competition level for firm i at time t can be defined as $COMP_{it} = \sum_{j \neq i} SIC_{ij} Sale_{jt}$, where $Sale_{jt}$ is the total sales of firm j at time t.

3.4.9 Average industry profitability

We include observations across multiple industries; therefore, it is essential to consider industry average level performance. One motive for firms' diversification is when their core business has matured or started to decline or when they want to reduce cyclical fluctuations in sales. Their diversification will be in the direction of those emerging industries with increasing profitable opportunities. The prevailing approaches to measure industry-level performance are to include *either* the industry average level of a particular performance measure (ROA, ROS, profit, etc.) *or* industry dummy variables (Tanriverdi and Venkatraman, 2005). The latter approach reduces the statistical power of the model due to a significant increase in variables (Sharp *et al.*, 2013); therefore, this paper uses the average ROS of all firms in the 4-digit industry as the proxy for industry profitability level.

3.4.10 Industry size dispersion

The effect of industry lifecycle is proxied by the size dispersion of each industry, which is calculated by the standard deviation of firm size from the average firm size. Small-size standard deviation indicates the dominance and prevalence of large firms – that is, the maturity of the industry – whereas large-size standard deviation suggests the prevalence of small firms and the availability of abundant profitable opportunities. These opportunities stimulate new entries and indicate the growing stage of the industry. The transition to a new technology in an industry involves a shakeout of first-generation firms. As product markets mature, the shakeout becomes more severe (Jovanovic and MacDonald, 1994).

3.4.11 Industry concentration[6]

Industries with high concentration rates are characterized by scale-intensive firms. Scale economies and other sources of market power reduce the threat from potential entrants, thereby allowing incumbents to raise prices without inviting entry. Such a relationship was found in influential studies (such as Montgomery, 1985); but the relationship between industry concentration and the probability of firm entry or exit remains controversial (Schmalensee, 1989). For concentration, we use the market share of the top four companies in a given industry. This calculation determines whether an industry is an oligopoly, a monopoly, or neither. Lower figures indicate a greater degree of competition, while higher figures indicate an oligopoly or a monopoly.

3.4.12 Regional control

Regional factors play an important role and contribute significantly to the explanation of new business survival (Fritsch *et al.*, 2006). According to Storey (1994), a strong correlation exists between local characteristics and firm growth. Vietnam

[6] All industry-level controls (industry profitability, industry size dispersion and industry concentration) were constructed for the main four-digit industry only.

currently has 64 provinces; therefore, 64 provincial dummies are included in the analysis to isolate unobserved heterogeneity across different Vietnamese provinces.

3.4.13 Ownership type

Six dummies – which stand for state-owned firms, partnership and cooperatives, private firms, limited liability firms, joint stock firms, and foreign-invested firms – are also included to control for the impact of legal ownership type on firms' diversification activities and entrepreneurial performance.

Appendix A lists and summarizes the descriptive statistics of all adopted variables. Appendix B presents the pair-wise correlation matrix of the dependent variable and independent variables. We can see from the correlation matrix that, out of 136 pair-wise correlations, 68 are statistically significant at the 1 percent significant level. However, most are not numerically substantive, with correlation coefficients below 0.3. The only pair-wise correlation that is greater than 0.3 is the one between economic size and labour size (0.736).

4. Estimation model

We analyze firm diversification strategies and performance in three stages: (i) decision, (ii) degree, (iii) outcome. We control for sample selection bias in the first two stages. As pointed out by Campa and Kedia (2002) and Lang and Stulz (1994), poor performers diversify in search of growth opportunities because they have exhausted such opportunities in their existing activities. The endogeneity of diversification degree is controlled in the third stage to account for firm-level characteristics that influence both firms' diversification decision/degree and firm values. Conversely, it is plausible to assume that it takes some time for the pay-off of firms' diversification to be recognized. We adopt the dynamic model in which the lagged-dependent variable is included to isolate the effect of time lag on performance and potential performance shock.

4.1 Diversification equation

The selection equation can be specified as follows:

$$DI_{it} = \begin{cases} 1 \text{ if } DI^*_{it} = w_{it1}\alpha_1 + \varepsilon_{it1} > \bar{c} \\ 0 \text{ if } DI^*_{it} = w_{it1}\alpha_1 + \varepsilon_{it1} \leq \bar{c} \end{cases} \quad (1)$$

where DI_{it} is an observable indicator that takes the value 1 if firm i diversifies in year t, and 0 otherwise; DI^*_{it} is a latent variable reflecting the firm's diversification effort such that firm i decides to diversify if it is above a given threshold $\bar{c}$, w_{it1} is a set of explanatory variables affecting the firm's decision to diversify, and ε_{it1} is the error term.

Once the firm decides to diversify, the next decision point is the degree of diversification –that is the extent to which the new products / services are unrelated to the core product portfolio of the firm:

$$Entropy_{it} = \begin{cases} DI_{it}^{*} = w_{it2}\alpha_2 + \varepsilon_{it2} & \text{if } DI_{it} = 1 \\ 0 & \text{if } DI_{it} = 0 \end{cases} \tag{2}$$

where w_{it2} is a set of determinants of the degree of relatedness of the firm's diversification. Under the selection rule described by Equations (1) and (2), we have:

$$E(Entropy_{it} \backslash w_{it1}, w_{it2}, DI_{it} > 0) = w_{it2}\alpha_2 + E(\varepsilon_{it2} \backslash \varepsilon_{it1} > \bar{c} - w_{it1}\alpha_1, w_{it1}, w_{it2}). \tag{3}$$

The least-squares method of regressing *Entropy* on w_2 is an inconsistent estimator of α_2 if the second term on the right side of Equation (3) is non-zero. If we are willing to assume that error terms in both Equations (1) and (2) are N (0, ∞), the standard Heckman (1979) two-stage method provides consistent estimators. However, in many empirical problems, the distribution of the errors is not known or is subject to heteroscedasticity of an unknown form. In such cases, the maximum likelihood estimator will not provide a consistent estimate. In addition, for censored panel data with fixed effects, the maximum likelihood estimation methods will generally be inconsistent even when the parametric form of the conditional error distribution is correctly specified (Honore, 1992). Thus, it is important to develop estimation methods that provide consistent estimates for the sample selection dataset when the error distribution is non-normal or heteroscedastic. Vella (1998) and Wooldridge (1995) relax this assumption and propose alternative two-stage estimation methods that may have better finite sample properties.

Under the assumption that (ε_{it1}, ε_{it2}) are independent of (w_{it2}, w_{it2}), Vella and Wooldridge note that $E(\varepsilon_{it2} \backslash w_{it2}, w_{it2}, \varepsilon_{it1}, DI_{it} > 0) = E(\varepsilon_{it2} \backslash \varepsilon_{it1}, DI_{it} > 0)$. If one further assumes that $E(\varepsilon_{it2} \backslash \varepsilon_{it1}) = \gamma\varepsilon_{it1}$, then the selection bias correction term is $\gamma\varepsilon_{it1}$. We can estimate ε_{it1} by $\widehat{\varepsilon_{it1}} = DI_{it} - w_{it1}\widehat{\alpha_1}$, where $\widehat{\alpha_1}$ is the probit estimator of α_1. Thus we can use ε_{it1}, rather than Heckman's (1979) inverse Mills ratio, as an additional variable in the conditional expectation. This method has two advantages relative to the standard Heckman procedure: (i) when w_{it2} and the inverse Mills ratio are near collinearity, ε_{it1} has more variation than w_{it2}, thereby making the Vella–Wooldridge estimator more stable and thus more efficient (see Wooldridge, 2002); (ii) the method is computationally less costly, relaxes the strong normality assumption, and is more robust to near collinearity in the data (Christofides *et al.*, 2003).

It is plausible to assume that $E(\varepsilon_{it2} \backslash \varepsilon_{it1}) = g(\varepsilon_{it1})$, where $g(\cdot)$ is an unknown function. We can easily illustrate that $E(Entropy_{it} \backslash w_{it1}, w_{it2}, \varepsilon_{it2}) = w_{it2}\alpha_2 + g(\varepsilon_{it2})$. Thus we have:

$$Entropy_{it} = w_{it2}\alpha_2 + g(\varepsilon_{it2}) + v_{it} \tag{4}$$

where v_{it} satisfies $E(v_{it}\backslash\varepsilon_{it1}, DI_{it}) > 0) = 0$. Following Robinson (1988) and using the data with $DI_{it} > 0$, from Equation (4) we can get:

$$Entropy_{it} - E(Entropy_{it}\backslash\varepsilon_{it1}) = [w_{it2} - E(w_{it2}\backslash\varepsilon_{it1}]\alpha_2 + v_{it}. \tag{5}$$

Semykina and Wooldridge (2010) propose the correction for selection bias that allows heterogeneously distributed and serially-dependent error terms in both selection and primary equations. Since the method allows for a rather flexible structure of the error variance and does not impose any non-standard assumptions on the conditional distributions of explanatory variables, it provides a useful alternative to the existing approaches. Assuming the error term (1) as $\varepsilon_{it2} = c_{i2} + u_{it2}$, and in Equation (2) as $\varepsilon_{it2} = c_{i2} + u_{it2}$; c_{i1} and c_{i2} are the unobserved fixed effects (maybe correlated with w_{it2}), and u_{it1}, u_{it2} are idiosyncratic errors. We assume that $E(u_{it}\backslash w_{i2}, c_i) \neq 0$ for some elements of w_{it2}. Further, we assume that $c_{i1} = f(w_{i1}) + a_{i1}$, where $f(\cdot)$ is a known function, and $E(a_{i1}\backslash w_{i2}) = 0$. Using a more flexible Chamberlain's (1980) specification, $c_{i1} = f(w_{i1}) + a_{i1} + \overline{w}_{i1}\theta_1 + a_{i1}$. Similarly, we also have $c_{i2} = g(w_{i2}) + a_{i2} + \overline{w}_{i2}\theta_2 + a_{i2}$. This condition is similar to the within transformation and produces the fixed-effects slope estimators in the balanced panel data. Combining with (2), we obtain:

$$\begin{aligned} Entropy_{it} &= w_{it2}\alpha_2 + \overline{w}_{i2}\theta_2 + a_{i2} + u_{it2} \\ &= w_{it2}\alpha_2 + \overline{w}_{i2}\theta_2 + \gamma E(v_{it2}\backslash w_{i1}, DI_{it}) + \epsilon_{it} \end{aligned} \tag{6}$$

where $v_{it1} \equiv a_{i1} + u_{it1}$, $v_{it2} \equiv a_{i2} + u_{it2}$, $E(\varepsilon_{it}\backslash w_{i1}) = 0$. With a slight abuse of notation, for $DI_{it} = 1$, Equation (6) can be written as:

$$Entropy_{it} = w_{it2}\alpha_2 + \overline{w}_{i2}\theta_2 + \gamma\lambda_{it} + \epsilon_{it}. \tag{7}$$

The propensity score approach has recently been adopted as an efficient method to address selection bias semi-parametrically (see Shadish *et al.*, 2002 for an overview). This paper will follow Heckman *et al.* (1998) to construct a regression-adjusted semi-parametric conditional difference-in-differences matching estimator. In other words, propensity scores take into account all the variables that might play a role in the selection process and create a predicted probability (i.e., propensity score) of diversification vs. non-diversification from a logistic regression equation and kernel-based matching. These scores can then be used to match diversification and non-diversification as a covariate in the main equation. The results from four estimation approaches – the standard Heckman's two-stage method, the Vella–Wooldridge parametric approach, the Semykina and Wooldridge model, and Heckman *et al.*'s kernel-based propensity score matching method – are reported in Table 1.

Table 1. Probability of diversification decision

Variable	Joint MLE (1st step)	Heckman two-step (1st step probit)	Probability of diversification: Semykina and Wooldridge (2010) (stage 1 of 2SLS)	Probability of diversification: Heckman (1995) Propensity matching method
Firm age	−0.001** (0.0005)	−0.001** (0.0005)	−0.01** (0.001)	−0.004** (0.0008)
Firm's economic size	0.006 (0.016)	0.006 (0.016)	0.093 (0.054)	0.045 (0.031)
Firm's economic size squared	−0.006** (0.0008)	−0.006** (0.001)	−0.008** (0.002)	−0.009** (0.001)
Firm's labour size	0.785** (0.014)	0.785** (0.014)	0.762** (0.061)	1.526** (0.027)
Firm's labour size squared	−0.075** (0.0017)	−0.075** (0.0017)	−0.055** (0.007)	−0.148** (0.003)
Debt ratio $_{t-1}$	−0.117** (0.013)	−0.117** (0.013)	−0.104** (0.025)	−0.161** (0.023)
Capital intensity	0.000** (0.000)	0.000** (0.000)	0.000** (0.000)	−0.000** (0.000)
Technological resources $_{t-1}$	−0.131** (0.024)	−0.116** (0.026)	−0.525** (0.065)	−0.212** (0.052)
Innovation intensity $_{t-1}$	0.132** (0.019)	0.132** (0.019)	0.217** (0.038)	0.219** (0.085)
Innovation intensity squared $_{t-1}$	−0.007** (0.003)	−0.012 (0.01)	−0.017 (0.014)	−0.212* (0.102)
Technological resources × Innovation intensity $_{t-1}$	0.12* (0.067)	0.12 (0.067)	3.639** (0.201)	0.141 (0.248)
Export Y/N $_{t-1}$	0.037* (0.016)	0.037* (0.016)	0.253** (0.033)	0.104** (0.027)

Table 1. (Continued)

Variable	Joint MLE (1st step)	Heckman two-step (1st step probit)	Probability of diversification: Semykina and Wooldridge (2010) (stage 1 of 2SLS)	Probability of diversification: Heckman (1995) Propensity matching method
Marketing expenditure $_{t-1}$	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)
Competition level	0.000** (0.000)	0.000** (0.000)	0.000** (0.000)	0.000* (0.000)
Industry concentration	0.118** (0.021)	0.118** (0.021)	0.253** (0.065)	0.297** (0.038)
Average industry ROS	−0.014* (0.007)	−0.014* (0.007)	−0.011* (0.007)	−0.028* (0.012)
Industry size dispersion	−0.000** (0.000)	−0.000** (0.000)	−0.000* (0.000)	−0.000** (0.000)
Provincial dummies	$\chi^2(61)$ = 4,040**	$\chi^2(61)$ = 4,022**	$\chi^2(61)$ = 995.03**	$\chi^2(61)$ = 4,288**
Ownership type dummies	$\chi^2(5)$ = 2,782**	$\chi^2(5)$ = 2,765**	$\chi^2(5)$ = 142.45**	$\chi^2(5)$ = 2,459**
$\hat{\lambda}$			3.382** (0.033)	
$\hat{\lambda}$ × year dummies			$\chi^2(8)$ = 3,755**	
$\overline{w_i}$			$\chi^2(24)$ = 1,274**	
Intercept	−3.044** (0.076)	−3.044**(0.076)	−5.577** (0.202)	−6.201** (0.146)
Likelihood ratio test	$\chi^2(84)$ = 30,447**	$\chi^2(84)$ = 30,447**	$\chi^2(91)$ = 1,677.25**	$\chi^2(84)$ = 32,849**

***Note*:** *Significant at 5 percent level; **significant at 1 percent level; standard errors in parentheses. 210,312 observations.

Both the parametric and semi-parametric identification of the sample selection model generally requires an 'exclusion restriction'. This paper will adopt industry size dispersion as the exclusion restriction. We believe that firms residing in a mature market will be more likely to diversify their production to compensate for profit erosion in their home market. However, the degree of their diversification activities will be more influenced by their production capacity and managerial competences.

The Semykina and Wooldridge (2010) test, which is based on within transformation that allows the presence of arbitrary correlation between unobserved heterogeneity and explanatory variables, indeed indicates the presence of selection bias in the diversification degree equation.[7] The exclusion restriction test does support the relevance and validity of industry size dispersion.[8]

4.2 Performance equation

The firm performance equation can be written as follows:

$$ROS_{it} = ROS_{it-1}\beta_1 + Entropy_{it}\beta_2 + z_{it}\beta_3 + v_i + \epsilon_{it} \quad (i = 1, 2, \ldots, n; t = 1, 2, \ldots, T) \tag{8}$$

ROS_{it-1} is the 1-year lagged value of return on investment of firm i in year t. $Entropy_{it}$ is the diversification index of firm i. z_{it} is a matrix of control individual-level, firm-level and industry-level characteristics. v_i is an unobserved firm-specific, time-invariant effect which allows for heterogeneity in the means of the ROS_{it} series across firms, and ε_{it} is a disturbance term. The disturbances ε_{it} are assumed to be independent across individuals. We also treat the firm effects v_i as stochastic, which implies that they are necessarily correlated with the lagged-dependent variable ROS_{it-1}.

4.2.1 Test for violations of estimation assumptions

$$E(\epsilon_{it}\epsilon_{t'}t') = \begin{cases} \sigma_\epsilon^2 & i = i',\ t = t'\ (H1) \\ 0 & \text{otherwise } (H2) \end{cases}$$

Test 1. Heteroscedasticity (H1): We apply the likelihood ratio test for heteroscedasticity in panel data and find the strong existence of heteroscedasticity in our data.[9]

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7 $\chi^2_{\hat{\lambda}}(1) = 13{,}066$, P-value = 0.000; $\chi^2_{\hat{\lambda}-i,year}(8) = 67.16$, P-value = 0.000.

8 Quality test (correlated with diversification decision): $\chi^2_{\hat{\lambda}}(1) = 126.2$; P-value = 0.000; Bound *et al.* (1995) partial R^2: 0.006; $F(1, 236575) = 43.61$; P-value = 0.000.
Validity test (exogeneity condition, i.e., uncorrelated with diversification intensity): $\chi^2(1) = 1.72$; P-value = 0.19; Hansen J statistic: 0.709, P-value = 0.3999.

9 Likelihood ratio test for the presence of heteroscedasticity: $\chi^2(210305) = 349{,}210$; P-value = 0.000.

Test 2. Serial correlation in the time-series data (H2): The Wooldridge test for first-order autocorrelation in the panel data is insignificant even at the 5 percent level, which indicates the absence of first-order serial correlation in the ROS equation.[10]

Test 3. Endogeneity of the diversification index: The Durbin–Wu–Hausman test does indicate the strong presence of the endogeneity of diversification.[11]

4.2.2 Estimation methods

Several econometric problems may arise from estimating Equation (8): (i) The diversification index $Entropy_{it}$ is assumed to be endogenous; (ii) time-invariant unobserved firm characteristics (fixed effects) v_i may be correlated with $Entropy_{it}$ and z_{it}; (iii) the panel dataset has a short time dimension (T = 9) and a large number of firms (n = 26,289) Thus, the presence of the lagged-dependent variable ROS_{it-1} may give rise to autocorrelation, because it is correlated with fixed effects.

To deal with these problems, we apply the Blundell and Bond (1998) difference dynamic GMM estimation. Improving upon the work of Arellano and Bond (1991), Blundell and Bond (1998) proposed a system estimator that uses moment conditions in which lagged differences are used as instruments for the level equation in addition to the moment conditions of lagged levels as instruments for the differenced equation.

By transforming the regressors by first differencing, the fixed firm-specific effect is removed, because it does not vary with time:

$$\Delta ROI_{it-1} = \beta_1 \Delta ROI_{it} + \beta_2 \Delta Entropy_{it} + \beta_3 \Delta z_{it} + \Delta \epsilon_{it}. \tag{9}$$

Table 3 shows the estimation results of the performance equation for both ROS and growth of sales as the dependent variable. According to Baum and Schaffer (2003), GMM estimation is more efficient than 2SLS when heteroscedasticity is present.

5. Estimation results and discussion

The estimation results for the diversification decisions and diversification degrees of firms are given in Tables 1 and 2, respectively. Table 1 presents four estimation models: (i) the first step probit of Heckman two-step consistent estimates, (ii) the joint maximum likelihood estimation based on the joint normality of (ε_{it}, e_{it}), (iii) the first step of the Semykina and Wooldridge (2010) method, and (iv) the kernel-based propensity matching method.

[10] Test for serial correlation: $F(1, 26288) = 1.083$; P-value = 0.2979.

[11] Durbin–Wu–Hausman test: $\chi^2(1) = 25.04$; P-value = 0.0000.

Table 2. Diversification degree of firms

Variable	Degree of diversification (Entropy index)			
	Joint MLE (2nd step)	Heckman two-step	Semykina and Wooldridge (2010)	Vella and Wooldridge
Firm age	−0.0006** (0.0002)	−0.000 (0.0000)	−0.001** (0.000)	−0.001** (0.000)
Firm's economic size	0.018* (0.008)	0.018* (0.01)	0.023** (0.008)	0.045** (0.014)
Firm's economic size squared	−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)	−0.001 (0.001)
Firm's labour size	0.014* (0.009)	0.122** (0.035)	0.058** (0.008)	0.075** (0.013)
Firm's labour size squared	−0.001 (0.001)	−0.012** (0.003)	−0.003** (0.0008)	−0.065** (0.003)
Debt ratio $_{t-1}$	0.044** (0.006)	0.024* (0.008)	0.056** (0.006)	0.098** (0.016)
Capital intensity	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Technological resources $_{t-1}$	0.038* (0.013)	0.052** (0.016)	0.038** (0.015)	0.094** (0.024)
Innovation intensity $_{t-1}$	0.006 (0.01)	0.017 (0.012)	0.024** (0.009)	0.106** (0.017)
Innovation intensity squared $_{t-1}$	−0.002 (0.002)	−0.001 (0.002)	−0.002 (0.002)	−0.006** (0.002)

Table 2. (Continued)

Variable	Degree of diversification (Entropy index)			
	Joint MLE (2nd step)	**Heckman two-step**	**Semykina and Wooldridge (2010)**	**Vella and Wooldridge**
Technological resources × Innovation intensity $_{t-1}$	0.024 (0.051)	0.002 (0.053)	0.008 (0.051)	0.074 (0.052)
Export Y/N $_{t-1}$	−0.031** (0.007)	−0.023** (0.009)	−0.011* (0.008)	−0.111** (0.034)
Marketing expenditure	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)
Competition level	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)
Average industry ROS	−0.002 (0.002)	−0.005 (0.003)	−0.004* (0.002)	−0.011* (0.005)
Industry concentration	−0.03** (0.01)	−0.053** (0.013)	−0.02* (0.01)	−0.127* (0.018)
Provincial dummies	$\chi^2(60) = 438.1$**	$\chi^2(60) = 324.2$**	$\chi^2(60) = 427.7$**	$\chi^2(60) = 768.1$**
Ownership type dummies	$\chi^2(5) = 167.5$**	$\chi^2(5) = 138.1$**	$\chi^2(5) = 166.2$**	$\chi^2(5) = 525$**
$\hat{\lambda}$		−0.382** (0.065)	−0.029** (0.007)	
$\hat{\lambda}$ × year dummies			$\chi^2(8) = 177.72$**	
$\widehat{\varepsilon_{it}}$				0.000 (0.000)
Intercept	0.842** (0.058)	1.601** (0.192)	0.617** (0.046)	−2.732** (0.072)
Wald	$\chi^2(83) = 1{,}128.5$**	$\chi^2(83) = 873$**	$\chi^2(91) = 1{,}677.25$**	$\chi^2(25) = 2{,}759$**

***Note*:** *Significant at 5 percent level; **significant at 1 percent level; standard errors in parentheses. 210,312 observations.

Table 3. Firm performance

Variables	ROS		Growth of sales	
	GMM exogenous†	GMM endogenous‡	GMM exogenous†	GMM endogenous‡
ROS $_{t-1}$ / Growth of sales $_{t-1}$	0.003** (0.0004)	0.002** (0.0003)	−0.096** (0.019)	−0.094** (0.029)
Entropy	8.973** (2.312)	6.238** (1.861)	0.282** (0.026)	0.901** (0.291)
Entropy $_{t-1}$		4.858** (1.219)		0.309 (0.193)
Entropy squared	−5.108** (1.426)	−4.615** (1.191)	−0.416** (0.038)	−0.828** (0.285)
Entropy squared $_{t-1}$		−2.615 (1.919)		−0.167 (0.169)
Technological resources $_{t-1}$	3.517** (0.612)	4.332** (0.563)	0.011* (0.004)	0.008 (0.005)
Innovation intensity $_{t-1}$	0.281 (0.257)	0.453* (0.258)	0.000 (0.001)	0.002 (0.002)
Innovation intensity squared $_{t-1}$	−0.000 (0.000)	−0.001* (0.000)	−0.000 (0.000)	−0.000 (0.000)
Tech.resources × innov.intensity $_{t-1}$	0.665 (0.689)	1.293* (0.703)	0.001 (0.001)	0.002 (0.003)
Marketing expenditure $_{t-1}$	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000** (0.000)
Leverage (debt ratio) $_{t-1}$	−3.688** (0.663)	−3.418** (0.669)	−0.001 (0.001)	−0.001 (0.001)
Capital intensity	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)
Export Y/N $_{t-1}$	0.206 (0.392)	0.818* (0.373)	0.021** (0.003)	0.023** (0.004)

Table 3. (Continued)

Variables	ROS		Growth of sales	
	GMM exogenous†	GMM endogenous‡	GMM exogenous†	GMM endogenous‡
Competition level	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Firm age	−0.158** (0.026)	−0.153** (0.024)	−0.001 (0.002)	−0.001 (0.002)
Economic size	−4.626** (0.147)	−4.544** (1.401)	−0.063** (0.007)	−0.065** (0.007)
Economic size squared	0.345** (0.089)	3.366** (0.086)	0.004** (0.000)	0.004** (0.000)
Labour size	−7.488** (0.154)	−8.889** (1.362)	−0.008 (0.006)	−0.004 (0.007)
Labour size squared	0.741** (0.269)	1.082** (0.247)	0.001 (0.001)	0.001 (0.001)
Private firms	9.556** (2.516)	12.37** (2.222)	0.008 (0.012)	0.008 (0.015)
Cooperatives/ Partnerships	6.948** (2.623)	0.859 (2.781)	0.01 (0.009)	0.017 (0.017)
Limited liability firms	9.245** (2.91)	13.4** (2.89)	0.003 (0.01)	0.003 (0.012)
Corporations	−1.017* (0.464)	−1.948** (0.507)	0.011 (0.008)	0.01 (0.009)
Foreign-invested firms	−1.961** (0.593)	−2.929** (0.646)	0.005 (0.011)	0.009 (0.012)
Industry dispersion	−0.003** (0.001)	−0.004** (0.001)	−0.000** (0.000)	−0.000** (0.000)
Average industry ROS	0.804* (0.471)	0.968* (0.446)	0.001 (0.001)	0.001 (0.001)
Industry concentration	2.53* (1.123)	2.991** (1.056)	0.000 (0.004)	0.001 (0.005)
Provincial dummies	$\chi^2(32)$ = 2,217**	$\chi^2(44)$ = 2,339**	$\chi^2(32)$ = 9,963**	$\chi^2(44)$ = 6,333**
Intercept	2.422 (4.592)	2.159 (3.323)	1.365 (2.085)	1.736 (1.722)
Wald χ^2	$\chi^2(69)$ = 622,000,000**	$\chi^2(71)$ = 624,000,000**	$\chi^2(69)$ = 179,432**	$\chi^2(71)$ = 71,184**

***Notes*:** **Significant at 1 percent level; *significant at 5 percent level; standard errors in parentheses. Observations: 210,312.
†The Arellano–Bover/Blundell–Bond linear dynamic GMM estimator assumes that all explanatory variables, apart from the lagged-dependent variable, are exogenous; robust standard errors are used.
‡The Arellano–Bover/Blundell–Bond linear dynamic GMM estimator assumes that the diversification index and lagged-dependent variable are endogenous; robust standard errors are used.

Table 4. Control for survival bias

	First stage: Probability of survival	Second stage: Profitability of survival
Entropy	1.231** (0.069)	2.214** (0.171)
Entropy squared	−1.124** (0.032)	−2.321** (0.231)
Technological resources $_{t-1}$	−0.394** (0.052)	0.331** (0.064)
Innovation intensity $_{t-1}$	0.187** (0.062)	0.082** (0.007)
Innovation intensity squared $_{t-1}$	−0.000 (0.000)	−0.000** (0.000)
Innov × tech resources $_{t-1}$	−0.072** (0.006)	0.001** (0.0004)
Leverage (debt ratio) $_{t-1}$	−0.006* (0.003)	−0.052** (0.002)
Capital intensity	0.000 (0.000)	−0.000* (0.000)
Export $_{t-1}$	0.245** (0.023)	0.017 (0.008)
Firm age	0.027** (0.000)	−0.001** (0.000)
Economic size	0.214** (0.007)	0.028** (0.003)
Economic size squared	−0.002** (0.0005)	−0.0003** (0.000)
Labour size	0.086** (0.006)	−0.051** (0.002)
Labour size squared	−0.017** (0.003)	0.003** (0.000)
Marketing expenditure $_{t-1}$	0.000** (0.000)	−0.000** (0.000)
Competition level	−0.000 (0.000)	0.000 (0.000)
Average industry ROS	0.067** (0.018)	0.002** (0.0004)
Industry size dispersion	−0.000** (0.000)	
Industry concentration	−0.152** (0.011)	−0.027** (0.002)
Provincial dummies	$\chi^2(60)$ = 12,821**	$\chi^2(60)$ = 11,032**
Ownership types	$\chi^2(5)$ = 723**	$\chi^2(5)$ = 1,852**
$\hat{\lambda}$	1.853** (0.064)	−0.321** (0.191)
$\hat{\lambda}$ × year dummies	$\chi^2(8)$ = 2,437**	$\chi^2(8)$ = 1,978.6**
Intercept	1.236** (0.134)	−1.312** (0.615)
Likelihood ratio test	$\chi^2(91)$ = 340,502.75**	
Wald		$\chi^2(91)$ = 712,055.9**
No. of observations	1,087,557	

Note: **Significant at 1 percent level; *significant at 5 percent level; standard errors in parentheses.

Both the Shapiro-Wilk *W* and the Shapiro-Francia *W* test for normality assumption of the error terms in the diversification decision equation indicate the rejection of the null normality hypothesis at the 1 percent significance level. Thus, the Heckman two-step procedure requiring the normality assumption may not be an efficient estimation method for our analysis. The signs of the estimated parameters are quite consistent across different methodological treatments although the statistical significance and magnitude seem to be stronger with the coefficients obtained from the first stage of the Semykina and Wooldridge (2010) approach. Since this approach also accounts for firm-specific effects, we interpret our results based on the Semykina and Wooldridge (2010) approach.

Regarding firm-level characteristics, significant and negative parameters of *debt ratio* indicate the absence of the leverage effect of loans on stimulating firms' diversification activities. Obviously, indebted firms will be less motivated to enter a new industry due to high risks of failure. Surprisingly, *technological resources* act as a barrier to firms' entering a new business sector. Technical employees with specialized knowledge in the core business are less willing to absorb the new knowledge and skills required for crossing firms' business boundaries, which is actually a source of change resistance in incumbent firms. However, positive and significant *innovation intensity* and its interaction with *technological resources* indicates that specialized workers might be productive and might be willing to adopt new concepts to produce different products whenever the firm invests enough in innovation activities. Firms with higher innovation investment are more likely to enter new industries. Exporting firms are more likely to undertake diversification to capture emerging demands, advanced technology and resources from foreign markets (see Xuan and Xing, 2008). Diversified firms spend significantly less on marketing expenditure than their undiversified counterparts. Inherently, when firms remain focused on their product portfolio, they need to strengthen their marketing efforts to reap the full benefits of the industry, as well as to explore new market segments for future diversification. These marketing investments will be reduced substantially when they enter new industries and enjoy emerging profitable opportunities: mainly necessary advertising efforts to increase customers' awareness regarding the new products and services offered.

As expected, firms that face more severe *competition* will have a higher motivation to diversify and exploit new opportunities in new industries.

With respect to the *size* and *age* of firms, newer firms with innovative, dynamic and adaptive capabilities are more willing to take risks regarding the expansion of their product portfolios rather than remain persistently within their core business. Larger firms have significantly stronger diversification activities than their smaller counterparts. Finally, the positive effect of *industry concentration* and the negative effect of *industry size* dispersion on firms' diversification decisions indicate that firms residing in mature (highly concentrated) industries and oligopolistic markets that are characterized by higher *concentration ratio* and smaller size standard deviation, face low profitable opportunities: Therefore, these firms have to search for opportunities in other industries to compensate for loss or poor performance in their core business. Similarly, firms in emerging industries with high profit margins will not be in a hurry to search for diversification opportunities.

As far as the estimation results from the diversification degree equation (Table 2) are concerned, we again observe consistency in the general pattern of the results obtained. We still interpret our results based on the Semykina and Wooldridge

(2010) model given its ability to control for firm-specific effects. It is worth noting that the effects of some variables – for instance, *technological resources* and *debt ratio* – in this equation contradict with their effects in the diversification decision equation above. This indicates that the factors stimulating firms to diversify do not necessarily influence their diversification degree to the same extent and vice versa. Technical employees with specialized knowledge are less willing to absorb new knowledge, especially when innovation investments are insufficient. However, once they step outside of their comfort zones and are willing to adopt new concepts to develop new products, they will be more likely to tap into their unrelated spheres of knowledge to develop radical innovations (i.e., a higher degree of diversification[12]). Similarly, although a leveraging effect does not stimulate firms to undertake diversification, those that have overcome their change resistance and tolerated failure risks will increase their involvement in areas that are possibly unrelated to their current domain of competence and corresponding opportunity set. As expected, firms' *economic size* and *labour size* positively stimulate their diversification activities. Firms possessing larger asset pools, including human resources, have more favourable conditions for diversification into a new industry. Khanna and Palepu (1997) find that large firms in emerging markets maintain substantial competitive advantage by entering new industries to set up their own self-support systems due to the low level of support systems in these countries.

Because of the vast market potential and low entry barriers of the new businesses, the risks of expanding into unrelated markets are relatively low. By moving quickly, the firm can also tap the benefit of 'first mover' advantage.[13] However, in Vietnam, relatedness diversification is still their optimal pathway given their abundant but 'asset specific' resources due to the nonlinear (decreasing to scale) effect of firm size on their diversification intensity.

We also find evidence that innovative firms with higher innovation investments are more likely to have their diversification portfolio of stronger relatedness. Consistent with Raju and Dhar (1999), we find that less diversified firms spend more on corporate marketing. Firm-level competition stimulates firms to undertake diversification but to mainly exploit their knowledge pool to explore related market opportunities. Finally, the negative relationship between *industry profitability*, *industry concentration* and firms' degree of diversification indicates that firms may want to leave their stagnant and mature industry by diversifying into a nearby industry in which they can capitalize their marketing efforts and knowledge spillovers in a related field of business. Profitable industry conditions increase a company's

[12] A higher degree of diversification index (entropy) corresponds to the higher propensity toward unrelated diversification and *vice versa*. The minimum value of zero corresponds to undiversified firms, operating in only one four-digit ISIC industry.
[13] Supporting this claim, Jiang *et al.* (2011) found an intermediate model for Chinese listed firms – that is, the level of relatedness negatively correlates with firm performance. However, their findings are limited to only 227 Chinese listed firms which are normally large, and cannot represent a vast majority of the firm population, which is normally small and micro sized in transition countries.

incentive to remain within the industry and motivates it to pursue a related diversification strategy to leverage and strengthen its competitive advantage.

Table 3 lists the estimation results for both static and dynamic models. The Hausman specification test indicates the preference of the ROS equation over the sales growth equation in both treatments.[14] From Table 3, we can see that the coefficients of lagged ROS and sales growth are statistically significant in both regressions, which indicates the superiority of the dynamic model with the endogenous treatment of the diversification index. Other specifications will be considered for benchmark purposes. It is plausible that ROS has a significant lag effect because firms' investment decisions in one year are contingent on their investment returns in previous years. With both ROS as the measure of profitability and growth of sales as the measure of sales performance, we find a consistent positive relationship between entropy index and firm performance. Generally, greater diversification increases firm-level profitability. In other words, positive effects occur as firms move from a single-business strategy to a diversification strategy. However, the significant parameters of the square of the entropy index indicate the nonlinear influence of diversification: the positive effects of diversification fall gradually as the firm moves further and further away from its core business. These findings support our hypothesis and are consistent with other comparable studies (c.f. Palich *et al.*, 2000).

Based on previous evidence, Palich *et al.* (2000) conclude that performance increases as firms move from single-business strategies to low-scaled diversification, but that the effect deteriorates as firms move away from the low end of related diversification to the high end of unrelated diversification. As Qian (1997) suggests, the relative costs and benefits of product diversification are likely to depend on how the different business activities of a firm are related to each other. If they are loosely linked or poorly structured, they are less likely to complement or supplement each other, and hence, synergy will not exist.

The profitability of a firm can be accelerated by increasing its innovative capabilities through its technical labour force and innovation investment. According to resource-based theory, a manufacturing firm's technical resources and innovative capabilities are valuable assets for its survival and growth. Thus, it is not surprising that both technological resources and innovation intensity (investment in innovation activities over the total annual investment) of a firm have a strong positive effect on its profitability. We find a significantly convex relationship between firm size and investment return. Larger firms realise lower returns on sales than smaller ones. The owners of large firms tend to face more challenges in allocating resources efficiently. It is worth noting that the majority of the total assets of firms in Vietnam are fixed assets, including land, machinery and equipment. Their 'asset specificity' makes transferability to other business sectors difficult (high transaction cost) and thus imposes a limitation on the diversification pay-off that diversified firms can obtain. The significance of the quadratic coefficient of economic size indicates its curvilinear

[14] GMM exogenous: $\chi^2(69) = 257^{**}$; GMM endogenous: $\chi^2(71) = 857^{**}$.

effect on performance. However, larger firms (in terms of labour size) realise higher sales growth than their smaller counterparts. While indebted firms and capital-intensive firms have lower profitability, export firms outperform their counterparts.

Regarding the effect of control variables, although private firms and limited liability firms are far more profitable than their state-owned counterparts, they underperform in terms of sales growth. Finally, firms located in growing industries of increasing profitability and competition among competitors of similar size are able to reap more surplus value from their products and services.

6. Controlling for potential survival bias

This section takes into account the potential survival bias during and after engaging in diversification activities (Table 4). If diversified firms are less likely to survive and hence exit the market more easily than other firms, we would overestimate the economic value of diversification because our sample only accounts for firms that were established before 2002 and were still surviving in 2010. As our data cover the entire population of firms in Vietnam, non-random data collection is not a cause for concern. Any firm that fails to appear in the next-year survey can be assumed to have gone bankrupt or to have been acquired by another firm.[15] In this section, we aim to address (i) whether firms engaging in diversification activities are more likely to exit the market, and (ii) whether the surviving diversified firms have higher profit margins than other firms, which is consistent with the finding above. We still apply the Semykina and Wooldridge (2010) model to control for both firm survival and the endogeneity of the diversification degree for the entire firm population in Vietnam from 2002 to 2010 (more than a million observations). We use industry size dispersion and entry rate as the exclusion restrictions in the Heckman selection model.

The significant Mills ratio $\hat{\lambda}$ indicates the presence of survival bias in the whole firm population at the 1 percent significance level. Thus, our estimation results above with the 9-year balance panel sample might have overestimated the economic value of diversification. Nevertheless, looking through the estimation from the two stages (survival and performance), we found consistency in the patterns of results. Some noteworthy findings include the following: first, diversification not only stimulates firm profitability significantly but is also critical for firm survival. Firms operating in multi-related business sectors are less likely to exit the market than other firms. Second, stronger technological resources, proxied by the interaction between the rate of technical personnel and innovation intensity, cannot help firms to prevent the risk of bankruptcy but do stimulate their profitability once they are able to survive. Third, while innovative firms (with high innovation intensity) are more likely to survive and generate higher profit, highly leveraged firms have higher failure rates and lower profit margins. Fourth, although firms with heavy investment in

[15] Unfortunately, we cannot control for the latter possibility with our current dataset.

marketing activities have a higher propensity for survival, they appear to be less profitable given their high sunk costs. Fifth, we found statistical evidence to support the positive relationship between a firm's size and age and its survival probability.

However, although large incumbent firms played a crucial role in leading technological progress and regulating the emerging market in transition countries, their dominant market position begins to be gradually taken over by their emerging private counterparts. They are no longer profitable compared to their smaller peers, and finally, firms residing in growing industries (high average ROS) have plenty of entrepreneurial opportunities to exploit and are, thus, more likely to survive than those residing in mature industries which are dominated by large-sized firms. This is also supported by the negative effect of industry size dispersion, proxied for the maturity of industry and industry concentration.

7. Conclusions

Rather than focusing on the determinants, previous research tended to focus on the performance outcomes of the types and degrees of diversification activities (Doving and Gooderham, 2008; Hoskisson and Hitt, 1990). Thus, despite a common consensus among researchers that diversification deploys surplus resources and cash flows, they did not account for the antecedents of resource deployment and, in turn, of the diversification decision. Various approaches justify divergent relationships based on differing assumptions which converge in dealing with the conflicting demands of synergies and responsiveness with respect to diversification. The investigation of such assumptions has enabled us to understand whether diversification has a positive or negative effect on firm performance. The empirical results are consistent with a resource- (or competence-) based view, which maintains that a positive relationship between diversification and profitability depends on the relatedness of diversified activities. However, as the driving forces of diversification decisions and their profitable pay-offs are resources or prior competences, it is still not clear which factors determine firms' decisions to diversify and to what degree.

This paper pioneers the investigation of firm diversification in a transition country in three interrelated and consecutive stages: decision, degree and outcome. Controlling for individual-level, firm-level and industry-level characteristics, we find that the factors stimulating firms to undertake diversification decisions do not necessarily influence their diversification degree in the same direction and to the same magnitude. The following are some of the main findings:

(i) Diversification has a curvilinear effect on firm-level profitability: product diversification improves firms' profit up to a point, after which a further increase in diversification is associated with declining performance.
(ii) The impact of technical employees on firms' diversification activities is controversial, and innovation intensity does stimulate firms to diversify and

undertake the stable and safe related pathway. These two factors are positively associated with firm performance.

(iii) Firms with higher debt ratios are less diversified; however, once they diversify, they are more likely to adopt risky unrelated options, thereby leading to lower profitability.

(iv) Less diversified firms spend more and benefit more from marketing investment. Marketing-intensive firms are generally more focused on their main business fields.

(v) Newer and larger firms are more likely to engage in diversification.

(vi) Low industry profitability and highly concentrated and mature industries significantly stimulate firms to diversify into other business sectors and do have a significant impact on their overall performance.

We take into account the sample selection and endogeneity issues from correlated disturbances by applying different parametric and semi-parametric estimation methods for both static and dynamic treatments of firm-level panel data. Initially, sample selectivity will be tested and corrected by four estimation approaches: the standard Heckman's two-stage method; the Vella (1998) and Wooldridge (1995) parametric approach; the Semykina and Wooldridge (2010) model, correcting for both endogeneity and selectivity; and the Heckman *et al.* (1998) kernel-based matching in a binary choice selection equation. Conditional on a firm's diversification decision, we observe its diversification degree (the extent of relatedness to the firm's core business) and its subsequent profitability. Then endogeneity of diversification degree is controlled by the IV-GMM and Blundell and Bond (1998) difference GMM estimation approach for both static and dynamic treatment. We perform our analysis on the dataset of the whole population of firms in Vietnam.

From a policy perspective, it is important to ascertain the level and degree of product diversification. SMEs with limited resources to sustain large-scale R&D operations might need support for adopting a 'deep niche' strategy by concentrating resources on a few specialized products and services (Qian, 2002, p. 612). Large firms with complex multidivisional structures might need to rely on highly skilled workers or managerial competences to overcome those constraints in terms of organizational efficiency and corporate governance, which represent the primary challenge impeding firms' diversification degree or product scope.

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Appendix A.

Descriptive statistics of adopted variables

Indicators	Variables	Measure	Mean	SD	Min	Max
Firm performance (Accounting measures)	ROS: Return on sales	$ROS = \frac{Operating\ profit}{Total\ sales}$	0.0174	0.2307	−1	1
	Growth of sales	$\frac{Sales_t - Sales_{t-1}}{1/2 \times (Sales_t - Sales_{t-1})}$	0.0171	0.1897	−2	2
Diversification	Diversification dummy	The dummy attains 1 if the firm diversifies, 0 otherwise	0.1241	0.3297	0	1
	Entropy index	$Entropy = \sum_i^n S_i \ln(1/S_i)$ where S_i is the share of segment i in the firm's sales, and ln $1/S_i$is the weight for each segment i	0.0602	0.1923	0	1.587
Innovation	Innovation intensity	The proportion of innovation investment in the total annual investment	0.1172	0.1489	0	1
	Technical human resources	The proportion of technical personnel in total firm labour force	0.0583	0.1597	0	1
	Technological resources	The interaction between innovation intensity and technical human resources	0.0059	0.0633	0	1
Firm size	Labour size	Natural logarithm of the number of total employees	3.1585	1.6141	0	11.216
	Economic size	Natural logarithm of total assets	8.498	1.95	0	19.281
Firm age	Firm age	Number of years firm has been operating	9.614	7.445	0	85
Firm export	Export	The dummy attains 1 if the firm exports, 0 otherwise	0.0722	0.2589	0	1
Financial leverage	Debt ratio	$Debt\ ratio = \frac{Total\ debt}{Total\ assests}$	0.424	0.42	0	40.78
Capital intensiveness	Capital intensity	$Capital\ intensity = \frac{Fixed\ assests}{Number\ of\ employees}$	618.42	16,196	0	78,700,000
Marketing	Marketing expenditure	The expenditure of marketing activities	36,814	366,151	0	70,300,000

Appendix A. (Continued)

Indicators	Variables	Measure	Mean	SD	Min	Max
Competition	Firm-level competition	$COMP_{it} = \sum_{j \neq i} SIC_{ij} Sale_{jt}$, where $SIC_{ij} = \frac{s_i s'_j}{(S_i S'_i)^{\frac{1}{2}}(S_j S'_j)^{\frac{1}{2}}}$, S_i is the average share of sales of firm i in the four digit industry across all years	3,449.9	76,582	0	33,500,000
Control variables	Ownership type	Dummy variables for six ownership types: (1) State-owned firms; (2) Cooperatives and Partnership; (3) Private firms; (4) Limited liability firms; (5) Joint stock firms; (6) Foreign-invested firms				
	Region	64 dummy variables to control for 64 provinces in Vietnam				
	Industry size dispersion	The standard deviation of firm size from the average firm size of four digit industry	109.4	566.5	0	73,379.6
	Indusry profitability (industry ROS)	$\frac{1}{n}\sum_i^n \frac{operating\ profit_i}{Totalsales_i}$ (n firms in the industry)	0.0262	0.3807	−61.961	0.8917
	Industry concentration	The market share of the top four companies in the four digit industry	0.2613	0.1897	0.034	1

***Note*:** N = 236,601 observations.

Appendix B.

Correlation matrix of dependent and independent variables

	ROS	*Sales growth*	*Entropy*	*Debt ratio*	*Capital intensi*	*Export*	*Firm age*	*Innov intensi*	*Techni empl*	*Market expens*	*Compe*	*Labour size*	*Econo size*	*Ind ROS*	*Ind size di*	*Ind conce*
ROS	1.00															
Sales growth	0.000	1.000														
Entropy	0.000	0.000	1.000													
Debt ratio	0.001	0.006*	0.063*	1.000												
Capital intensity	−0.01*	0.0001	−0.0008	−0.0021	1.000											
Export	0.0006	0.0008	−0.001	0.082*	−0.0003	1.000										
Firm age	−0.002	0.0015	0.1025*	0.0948*	0.002	−0.043*	1.000									
Innovation intensity	0.0002	−0.0004	−0.0037	−0.009*	−0.0001	−0.0004	−0.013*	1.000								
Technical employee	0.0006	0.0057*	0.0134*	0.071*	−0.0006	0.0847*	−0.055*	−0.004	1.000							
Marketing expenditure	−0.01*	0.0053*	0.0133*	0.0475*	0.0096*	0.03*	0.0686*	−0.002	0.019*	1.000						
Competition	0.0001	0.0000	−0.002	0.011*	−0.0001	0.0139*	0.0139*	−0.000	0.007*	0.0603*	1.000					
Labour size	0.0027	0.0033	0.2417*	0.282*	−0.0029	0.2187*	0.2655*	−0.014*	0.061*	0.1756*	0.0222*	1.000				
Economic size	−0.01*	0.0129*	0.2028*	0.349*	0.0143*	0.2066*	0.2627*	−0.012*	0.074*	0.2045*	0.027*	0.7366*	1.000			
Industry ROS	−0.001	0.0006	−0.008*	0.003	0.0012	−0.005*	0.006*	−0.0005	0.007*	0.0028	0.004	0.0033	0.0059*	1.000		
Ind size dispersion	0.0004	0.0004	0.0508*	0.07*	−0.0004	0.086*	0.119*	−0.0028	−0.003	0.2381*	0.0287*	0.3614*	0.2737*	0.0029	1.00	
Concentration	0.0002	0.0064*	−0.0231	−0.036*	0.0002	0.0848*	0.0795*	0.0024	0.047*	0.0572*	0.0543*	−0.0013	0.0366	−0.000	0.0453*	1.00

***Notes*:** N = 236,601 observations.
*Significant at 1 percent level.
SIC industries at four-digit level are treated as industry segments; at two-digit level are treated as industry group

Appendix C.

Robustness check: excluding the 2007–2010 period

Variables	ROS		Growth of sales	
	GMM exogenous†	GMM endogenous‡	GMM exogenous†	GMM endogenous‡
ROS $_{t-1}$ / Growth of sales $_{t-1}$	0.474** (0.045)	0.046** (0.015)	−0.014* (0.007)	−0.098** (0.013)
Entropy	0.257* (0.185)	1.886* (0.861)	0.197** (0.011)	1.711** (0.551)
Entropy $_{t-1}$		0.647 (0.739)		0.736* (0.361)
Entropy squared	−0.981 (1.224)	−1.134* (0.491)	−0.305** (0.014)	−1.676** (0.416)
Entropy squared $_{t-1}$		−0.176 (0.29)		−0.612** (0.221)
Technological resources $_{t-1}$	0.772 (0.612)	1.499* (0.631)	0.099 (0.241)	0.125 (0.335)
Innovation intensity $_{t-1}$	0.287 (0.139)	0.651* (0.288)	0.000 (0.001)	0.0004 (0.001)
Innovation intensity squared $_{t-1}$	−0.000(0.000)	−0.001 (0.003)	−0.000 (0.000)	−0.000 (0.000)
Tech.resources × innov.intensity $_{t-1}$	0.343 (0.389)	0.693* (0.203)	0.000 (0.001)	0.001 (0.007)
Marketing expenditure $_{t-1}$	0.000* (0.000)	0.000 (0.000)	0.000** (0.000)	0.000** (0.000)
Leverage (debt ratio) $_{t-1}$	−3.127** (0.663)	−2.218** (0.769)	−0.001 (0.001)	−0.001 (0.002)
Capital intensity	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)	−0.000** (0.000)
Export Y/N $_{t-1}$	0.381 (0.372)	0.718* (0.323)	0.006** (0.002)	0.009** (0.003)
Competition level	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000* (0.000)
Firm age	−0.279 (0.324)	−0.053* (0.018)	−0.000 (0.000)	−0.000 (0.000)
Economic size	−4.492** (0.788)	−3.244* (1.451)	−0.062** (0.005)	−0.068** (0.007)
Economic size squared	0.420** (0.051)	2.366** (0.096)	0.004** (0.000)	0.005** (0.000)
Labour size	−1.448** (0.676)	−5.789** (1.232)	−0.008 (0.004)	−0.002 (0.007)
Labour size squared	0.551* (0.269)	0.823** (0.227)	0.001* (0.000)	0.001 (0.001)
Industry dispersion	−0.001 (0.008)	−0.003 (0.004)	−0.000** (0.000)	−0.000** (0.000)
Average industry ROS	0.895 (1.621)	0.546* (0.246)	0.001 (0.001)	0.005 (0.01)
Industry concentration	0.274 (1.813)	1.934 (1.659)	0.008 (0.005)	0.003 (0.008)
Ownership types	$\chi^2(5)$ = 123**	$\chi^2(5)$ = 245**	$\chi^2(5)$ = 117.92**	$\chi^2(5)$ = 74.03**
Provincial dummies	$\chi^2(32)$ = 136.5**	$\chi^2(44)$ = 1,387**	$\chi^2(32)$ = 450.8**	$\chi^2(44)$ = 2,471**
Intercept	3.144* (1.592)	1.159 (2.123)	1.38** (0.111)	0.711** (0.115)
Wald χ^2	$\chi^2(69)$ = 878,088**	$\chi^2(71)$ = 21,300,000**	$\chi^2(69)$ = 329,258**	$\chi^2(71)$ = 164,969**

***Notes*:** **Significant at 1 percent level; *significant at 5 percent level; standard errors in parentheses. Observations: 104,987.

†The Arellano–Bover/Blundell–Bond linear dynamic GMM estimator assumes that all explanatory variables, apart from the lagged-dependent variable, are exogenous; robust standard errors are used.

‡The Arellano–Bover/Blundell–Bond linear dynamic GMM estimator assumes that the diversification index and lagged-dependent variable are endogenous; robust standard errors are used.

The 2007–2010 period stands for not only Vietnam's WTO membership, but also the global financial crisis's contagion to Vietnam. The results despite being less significant show consistent findings with the previous full-sample 9-year regression (Table 3).