

Treating firm size as an exogenous variable: a viable explanation for mixed EO-performance research findings

Gang Fan

Texas A&M International University, Laredo, Texas, USA

Mengge Li

The University of Texas at El Paso, El Paso, Texas, USA, and

Derrick D'souza

University of North Texas, Denton, Texas, USA

Abstract

Purpose – This study aims to provide a viable explanation to the mixed entrepreneurial orientation (EO)–performance findings.

Design/methodology/approach – A sample of 13,796 small, medium and large US public firms.

Findings – When firm size is treated as an exogenous variable, the shape of the EO–performance relationships is a U-shaped curve for small firms, an upward-sloping straight line for medium-sized firms, and an inverted U-shaped curve for large firms.

Originality/value – Treating firm size as an exogenous variable to split the sample into big, medium and small panels.

Keywords Entrepreneurial orientation, Firm size, Firm performance, Public firms, Compustat

Paper type Research paper

Introduction

Entrepreneurial orientation (EO) is a firm's innovative, proactive, and risk-taking processes (Covin & Slevin, 1989; Miller, 1983). Scholars consider EO as a firm's resources and capabilities that help to gain competitive advantages and, in turn, higher firm performance (Barney, 1991; Newbert, 2007; Wiklund & Shepherd, 2011). While scholars have confirmed that EO influences firm performance (Putniņš & Sauka, 2020; Rauch, Wiklund, Lumpkin, & Frese, 2009; Soares & Perin, 2020), however, the mixed empirical findings suggest that questions remain about the specific nature of the EO–performance relationship (i.e., the shape of the EO–performance curve). We posit that the mixed findings could have been driven by conceptual and methodological constraints. Conceptually, all EO–performance empirical studies include firm size as a control variable or an endogenous variable. This “isomorphic” approach of firm size is at odds with that discussed in Penrose (1959). Specifically, Penrose (1959) analogously



compared small and large firms to caterpillars and butterflies, suggesting that different-sized firms represent distinct species of firms. If Penrose is right, scholars need to treat firm size as an exogenous variable. In other words, scholars shall only examine the EO–performance relationship with a sample of similarly sized firms.

Methodologically, most of the studies reviewed by [Rauch et al. \(2009\)](#) and [Putniņš & Sauka \(2020\)](#) were restricted to small sample sizes and tended to focus on small and medium-sized enterprises (SMEs). Furthermore, scholars used the mathematical models (e.g., the regression analysis) to test for a linear (first-order) relationship between EO and performance. To garner a better understanding of the trajectory of research since these studies, we replicated the approach of [Soares & Perin \(2020\)](#) and investigated studies conducted during the most recent four-year period (2019–2023). Our review identified 36 empirical studies that assessed the EO–performance relationship. Thirty-three of these studies used a first-order statistical model to test the relationship. The average sample size across these studies was 257. Thus, scholarly investigations continue to opt for small sample sizes and rely on linear assumptions of EO–performance relationships. That being said, over the past 14 years, there have been at least four studies that have challenged the linear assumption of the EO–performance relationship. Three of these studies use small sample sizes, and one uses a large sample ([Calic & Shevchenko, 2020](#); [Kohtamäki, Heimonen, & Parida, 2019](#); [Su, Xie, & Li, 2011](#); [Tang, Tang, Marino, Zhang, & Li, 2008](#)).

In sum, the lack of coalescence around a dominant view of the shape of the EO–performance relationship has hampered progress in the field ([Kohtamäki et al., 2019](#); [Tang et al., 2008](#); [Wales, 2016](#)). We posit that a different conceptualization of firm size with an improved methodology could offer a viable explanation for the mixed findings found in the EO–performance literature ([Anderson, Schuele, Baum, Wales, & Gupta, 2022](#); [Rauch et al., 2009](#)). Thus, we begin by posing two research questions (RQs). Our first RQ is prompted by the recognition that prior work reflects an undue focus on SMEs. Hence, our research question aims to extend the extant EO–performance scholarship with a sample of public firms and an assumption of a curvilinear relationship, and we treat firm size as a control variable, thus:

RQ1. If we treat firm size as a control variable or an endogenous variable, what does the shape of the EO–performance curve look like for a sample of US-listed public firms?

Our second research question adopts [Penrose's \(1959\)](#) conceptualization of firm size as an exogenous variable. Put simply, we first use firm size to split the sample of all public firms into small, medium, and large firms. Next, we test the EO–performance relationships, thus:

RQ2. If we treat firm size as an exogenous variable, will the shape of the EO–performance curve be the same for small, medium and large firms (as implicitly assumed in prior research), or will it be different?

To answer these research questions, we tailored our research design to address the above-discussed conceptual and methodological concerns. With a comprehensive data set of 13,796 small, medium, and large US-listed firms from 1998 to 2022, we found that the EO–performance relationship is best depicted as an inverted U-shaped curve when firm size is treated as a control variable. However, when firm size is treated as an exogenous variable, the shape of the EO–performance relationships shifts from a U-shaped curve for small firms to an upward-sloping straight line for medium-sized firms and an inverted U-shaped curve for large firms.

The conceptual and methodological changes introduced in this study enable us to offer theoretical, methodological, and practical contributions. Theoretically, we confirm the existence of

an inverted U-shaped relationship between EO and firm performance when firm size is controlled endogenously. However, when firm size is treated as an exogenous variable, we found that the shape of the EO–performance relationships differs for firms of varied sizes. In other words, treating firm size as an exogenous variable provides a viable explanation for the mixed findings in the EO–performance relationship. Methodologically, our study is one of the first to use a large and comprehensive data set of 13,796 US firms. Furthermore, we operationalized all variables with objective data. We addressed endogeneity issues and undertook comprehensive robustness tests to confirm the reliability of our findings. The methodological approach and analytical rigor employed in this study not only make the results generalizable and replicable but also increase the ability of future research to build on this study and eventually draw causal inferences (Anderson et al., 2022; Gentry, Dibrell, & Kim, 2016; Titus & Anderson, 2018).

Practically, our study suggests that the shape of the EO and performance relationships is unique for each group of firms that is classified by its size. This finding has significant implications for how managers should leverage EO to boost firm performance. The possibility of leveraging a parabolic and positive relationship of the curve should encourage managers of small and medium firms to get past the early inflection point and then strategically employ higher levels of EO to significantly enhance firm performance. On the other hand, managers of large firms face an inverted U-shaped curve. They must carefully manage EO to avoid potentially negative performance effects at higher levels of EO.

Literature review and hypothesis development

Conceptual constraint of firm size

As a normative practice, strategy and entrepreneurship scholars have included firm size as a control variable (Atinc, Simmering, & Kroll, 2012) such that the influences of firm size are neutralized rather than highlighted. Put differently, the statistical manipulation of firm size as an endogenous control variable is that different-sized firms come from the same “species” and hence reflect the same underlying EO–performance mechanisms. We argue that there is a need to investigate the veracity of this conceptualization. First, Penrose (1959) states that the differences between a small firm and a large firm are similar to those between a caterpillar and a butterfly. These differences are manifested in organizational structure (Chan & Chen, 1991), competitive actions (Chen & Hambrick, 1995), resource allocation (Wong, Wong, & Boonitt, 2020), innovation approaches (Bjerke & Johansson, 2015) and others. Later, Miller (1983, 2011) echoed the view that firm size should be treated as an exogenous variable when he found that small firms had “simple” configurations and large firms had “planning” configurations.

We posit that there is a need for a unifying theoretical explanation for small, medium and large firms that adequately reflects the EO–performance relationship. It suggests that scholars may need to rethink and reinterpret prior EO–performance research findings and appropriately redirect future research on this phenomenon.

Resource-based theory

We borrow from the resource-based theory (RBT) of the firm to develop two sets of hypotheses that help bring new insights into the EO–performance relationship. Our first hypothesis aims to extend the extant EO–performance literature by examining the relationship with a large sample of publicly listed firms. Our second set of hypotheses projects the expected shape of the EO–performance curve for small, medium, and large firms, respectively. In the second hypothesis, we essentially treat the firm size as an exogenous variable.

The RBT has its roots in [Penrose \(1959\)](#), where a firm was defined as the bundle of its resources. [Wernerfelt \(1984\)](#) coined the term resource-based view by arguing that competitive advantage was from resources rather than products. [Barney \(1991\)](#) offered the core tenets of the RBT. In this seminal work, he states that valuable and rare resources, both tangible and intangible, help create competitive advantage, and in turn, positively influence performance. Furthermore, to gain a sustainable competitive advantage and performance, those valuable and rare resources also need to be inimitable and nonsubstitutable (VRIN). Later, as a reply to the critiques of the status nature of resources, [Barney \(2002\)](#) introduced the VRIO model (valuable, rare, inimitable and organization). It states that firms also need processes, routines or capabilities to organize those VRIN resources. In sum, the RBT view is different from the traditional industry organization (IO) perspective. While the IO school states that firms can collect economic rents through identifying perfect market positions, the RBT argues that sustainable performance can only be achieved through developing a firm's unique VRIO resources.

Recently, scholars have leveraged the RBT to develop the knowledge-based view, the dynamic capability theory, and the resource orchestration perspective ([Grant, 1996](#); [Teece, Pisano, & Shuen, 1997](#); [Sirmon, Hitt, Ireland, & Gilbert, 2011](#)). In the next section, we argue that EO is a firm's VRIO resources that help improve firm performance. At the same time, given the experimental nature of EO, its positive influence also has a price tag ([Wiklund & Shepherd, 2011](#)).

EO and firm performance when firm size is treated as an endogenous variable

Scholars conceptualize EO as a dynamic capability or high-level dynamic managerial capability that drives a firm's VRIN resources, both tangible and intangible, to pursue innovative, proactive, and risk-taking activities for competitive advantages, and in turn, better performance ([D'Souza & Fan, 2022](#); [Newbert, 2007](#)). From the EO-as-advantage view, based on the RBT, EO helps to reduce the rivalry competitive pressure and increase the survival rate of a firm. Conversely, based on the organization learning theory ([March, 1991](#)), the EO-as-experimentation perspective states that firms with high levels of EO will emphasize explorative projects that venture into new products or markets ([Wiklund & Shepherd, 2011](#)). Now we adopt a cost-benefit analysis to develop a curvilinear relationship for the EO–performance relationship, given that we believe that a linear EO–performance assumption reflects an oversimplification of reality. As discussed before, we use a large sample of publicly listed firms and include firm size as a control variable in our first hypothesis. If we include firm size as an endogenous variable, we will not discuss how firm size influences the EO–performance relationship.

Meta-analysis confirms the positive EO–performance relationship with adjusted $r = 0.24$ in [Rauch et al. \(2009\)](#). Recently, [Anderson & Eshima \(2013\)](#) viewed EO as a firm's resource orchestration capability that helps structure, bundle and leverage VRIN resources, and in turn, improve firm performance. Separately, a recent meta-analysis by [Crook, Ketchen, Combs, & Todd \(2008\)](#) confirmed the positive relationship between all resources and performance. Furthermore, they found that VRIN resources have higher positive impacts. Thus, we expect the initial positive linear relationship between EO and performance. And we argue that this positive EO effect will plateau when the costs of EO catch up. Here, we offer several potential costs when leveraging EO for high performance. First, the nature of EO is experimentation. It means that there is no guaranteed return from exploring innovative projects, which also means potentially large sunk costs from failed projects. Second, innovative and risk-taking projects require new combinations of resources. In other words, while exploitative projects increase productivity and efficiency through honing as-is

processes such that the costs can be minimized or controlled, the costs of new processes associated with exploring projects are difficult to estimate or manage. Those new process costs will involve not only resource redeployment but also internal and external communications. Third, too many EO-driven projects might create unrelated diversification or overdiversification and, in turn, decrease firm performance (Palich, Cardinal, & Miller, 2000). In sum, the EO costs can be engendered from failed projects, new processes, improper diversification and others. Thus, when the costs of EO become higher than the benefits of EO, firm performance starts to decrease. In sum:

H1. When firm size is treated as an endogenous variable, the EO–performance relationship will follow an inverted U-shaped curve.

EO and firm performance when firm size is treated as an exogenous variable

H1 suggests an inverted U-shaped curve for the EO–performance relationship when firm size is an endogenous variable. In *H2*, we treat firm size as an exogenous variable and use firm size to split our sample into small, medium, and large firms. Then, with the same RBT and the same cost-benefit analysis, we develop separate hypotheses for firms of different sizes.

First, for small firms, we argue that their EO–performance curve will be U-shaped. The common features of small firms include limited resources and limited capabilities manifested by their processes and routines. Researchers have argued that small firms often do not enjoy significant economies of scale. To fight for survival, they often choose to pursue innovative and high-risk exploitative projects that involve resource consumption (Audretsch, Prince, & Thurik, 1999). Thus, given the experimental nature of EO, the performance driven by EO will dip first. During this performance-decreasing period, small firms start to learn and build their capability associated with resource new combination, efficient communication and others. And there is evidence that those newly built capabilities can help small firms improve performance and enhance their growth trajectory (Baker & Nelson, 2005).

Second, for medium-sized firms, they have slack and routines for EO practices. Because of their sizes, they are not bound by the rigid organizational structure, and they are also not too diversified. Thus, they can enjoy the full benefits of EO, and we expect a positive linear EO–performance relationship. Finally, for large firms, as discussed in *H1*, they might suffer from the strategic resource paradox discussed in Miller & Le Breton–Miller (2021). Notably, large firms’ abundant slack might create vulnerabilities, turning them from a competitive strength to a potential weakness. Thus, we hypothesize an inverted U-shaped curve for large firms. In sum:

H2a. For small firms, the EO–performance relationship will follow a U-shaped curve.

H2b. For small firms, the EO–performance relationship will follow a positive linear curve.

H2c. For large firms, the EO–performance relationship will follow an inverted U-shaped curve.

Method

Methodological constraints

Sample size. As identified in recent meta-analyses, scholars continue to assume, hypothesize and test for a positive and linear relationship between EO and firm performance. While a recent meta-analysis confirmed the positive EO–performance relationship (Soares & Perin, 2020), the effect sizes of studies included in this meta-analysis ranged from –0.33 to 0.69.

These widespread effect sizes could imply that a curvilinear shape might better reflect the nature of the EO–performance relationship (Covin & Wales, 2019). But the small sample size of most studies has restricted the testing of curvilinear relationships. For example, the 51 studies Rauch et al. (2009) investigated displayed an average sample size of 280. Small sample sizes trigger concerns about statistical power, too. In sum, there is a need for studies that use larger sample sizes to enable the investigation of higher-order relationships.

Size of sampled firms. EO is present in every firm regardless of its size (Covin & Slevin, 1989). However, our investigation reveals that most empirical investigations of the EO–performance relationships have focused on SMEs. Thus, the past 30 years of accumulated EO–performance knowledge might apply primarily to SMEs. Furthermore, the unique contextual characteristics of each SEM study make replications difficult, given that most SMEs do not report their financial performance. In other words, there is a need to test the EO–performance relationship with large public firms that are legally required to disclose their financial statements.

Data collection techniques. Scholars have adopted three approaches to operationalize EO: scale, content analysis and archival financial data. Different EO operationalizations require different data collection methods. Specifically, the survey method is used alongside EO scales, computer-aided text analysis is appropriate for content analysis, and publicly available archived data like Compustat is appropriate when objective measures are selected. Schweiger, Stettler, Baldauf, & Zamudio (2019) argued that the survey method exacerbated common method bias and inflated effect sizes. McKenny, Short, Ketchen, Payne, & Moss (2018) contend that content analysis works well only to capture the dispositional component of the EO construct. Since financial data is subject to strict regulatory monitoring, scholars see value in examining the EO–performance relationship with archived data. Given that most empirical studies on the EO–performance relationship have relied on survey data, there is a need for more research that uses financial data to investigate the EO–performance relationship.

Sample

We leveraged the Compustat database to test our hypotheses and constructed a data set at the “firm-year” level. Scholars have used Compustat data for entrepreneurship research (Gentry et al., 2016; Keil et al., 2017; Kresier et al., 2020; Titus & Anderson, 2018). We started with the Compustat North American Fundamentals Annual database. This data set consists of all publicly traded firms listed on the US stock markets, including the New York Stock Exchange, NASDAQ and NYSE Amex. The temporal window was 25 years (1998–2022). Firms in the financial services, insurance, banking and public services sectors were excluded because of the widely varied reporting standards used by these firms (McGahan & Porter, 1997). Firms that report missing annual sales were removed from the sample since financial ratios will be used to operationalize individual items of EO, where annual sales are used as denominators in calculating certain ratios. After removing observations with missing data on other key financials, the final sample includes over 100,000 observations from 13,796 firms over 25 years.

Dependent variable

Firm performance is a multidimensional construct. Research suggests four dimensions of performance: profitability, liquidity, market-based performance and growth (Hamann, Schiemann, Bellora, & Guenther, 2013). We used a measure of profitability (i.e. net income) as the primary dependent variable. In the robustness test, we used the other three dimensions of firm performance.

Independent variable

We adopted the three-item EO conceptualization and measured EO with archival financial indicators discussed in [Miller & Le Breton-Miller \(2011\)](#). Specifically, the innovativeness dimension is operationalized as the ratio of R&D expenses to sales. The proactiveness is measured as the ratio of annual earnings reinvested within the company. And the risk-taking is calculated as unsystematic risk, where unsystematic risk is defined as the risk of a price change in a firm's market value due to firm-specific circumstances. In our study, we followed up the literature and we measure the innovativeness dimension as R&D intensity (a firm's annual R&D expenses divided by its total sales), the proactiveness as the retention ratio (net income less dividends divided by net income) and the risk-taking as the ratio of debt to equity ([Anderson et al. 2015](#); [Kreiser, Anderson, Kuratko, & Marino, 2020](#)). The overall EO is the mean of three dimensions.

Control variable

We included multiple firm-level control variables in our estimation model. We controlled for recoverable slack as the mean of three indicators: the ratio of accounts receivable to sales, the ratio of selling, general and administrative expenses to sales and the ratio of inventory to sales. Recoverable slack is an essential antecedent to EO ([Kreiser et al., 2020](#)). We controlled for available slack, measured as cash and marketable securities, less current liabilities, divided by total revenue ([Bourgeois & Singh, 1983](#)). Available slack represents liquid assets available to a firm, which may confound EO measures. We controlled for the ratio of earnings/share and total assets (in billions of dollars) given that it correlates of market-based performance. We controlled for firm size using the number of employees and sales, and we also controlled for firm age. We used years-since-IPO as a proxy for firm age to circumvent missing years of foundation data.

In addition to firm-level control variables, we also have three control variables at the industry level. First, our model controlled for industry hostility. We measured industry hostility as the inverse of the industry munificence, and we used a five-year average industry sales growth to operationalize the munificence ([Keats & Hitt, 1988](#)). In addition, our model controlled for industry dynamism and complexity. Industry dynamism reflects the volatility and unpredictability of change ([Dess & Beard, 1984](#)). Adopting [Keats & Hitt \(1988\)](#) approach, we regressed the natural logarithm of industry sales, with years as the independent variable in five-year moving windows. The antilog of the standard error of the year regression coefficient was then used as an indicator of industry dynamism. Finally, environmental complexity reflects the degree of concentration of an industry, which was measured as Herfindahl's index of all firms' market share in an industry in a year.

Analysis

For the primary analysis, we included year dummies and used a firm-level fixed-effect model estimated with OLS and clustered standard errors at the firm level (the xtreg procedure with fe and vce (robust) option in Stata 18). The fixed-effects model can effectively address endogeneity concerns in multilevel data ([Antonakis, Bendahan, Jacquart, & Lalive, 2010](#)). We did not apply transformations, and we winsorized all variables at the 1st and 99th percentiles to exclude extreme values.

[Table 1](#) presents the summary statistics. [Table 2](#) presents correlations of all variables. The variance inflation factors of study variables range from 1.02 to 3.83, suggesting minimal multicollinearity concerns. [Table 3](#) presents the results of *H1*. Column (1) includes control variables only, Column (2) shows the linear effects of EO on profitability, and Column (3)

Table 1. Summary statistics

Variables	Count	Mean	p50	SD	p25	p75
EO	155,882	0.2711468	0.2980684	0.226927	0.0034979	0.5
Profitability	155,882	0.1337514	0.001474	0.5907562	-0.008471	0.048647
Sales	155,881	3.01659	0.198801	14.76094	0.025526	1.208556
Recoverable slack	130,668	0.2254851	0.1899085	0.141219	0.1255096	0.290703
Available slack	153,297	0.6239178	-0.1178141	8.088979	-0.2644143	0.0765461
Debt-to-equity	155,882	1.540091	0.668392	3.219868	0.2076574	1.484965
Earnings per share	147,714	-3.829097	0.08	27.40133	-0.59	1.02
Total assets	155,831	3.484597	0.262038	10.39714	0.040468	1.648442
Employees	137,583	10.26814	0.882	44.84511	0.135	5
Years since IPO	155,882	9.855128	8	8.382866	3	15
Hostility	155,840	-0.0573454	-0.0535739	0.0934488	-0.1043691	-0.0088852
Dynamism	155,840	0.0049545	0.0024602	0.0074134	0.0010617	0.005576
Complexity	155,882	0.2289172	0.1656733	0.2010941	0.0891065	0.2802384

shows the curvilinear effects of EO on profitability. All models included firm fixed-effects and year fixed-effects.

Hypotheses testing

H1 proposes an inverted U-shape relationship between EO and firm performance. Column (3) indicates that the coefficient of EO squared is negative and significant ($b = -3.905$, $p < 0.001$), suggesting the existence of an inverted U-shaped effect of EO on performance. [Haans, Pieters, & He \(2016\)](#) note that three conditions must be met to confirm an inverted U-shaped relationship. First, the regression coefficient of the squared term must be negative and significant. Second, the slope of the inverted U-shaped curve must be sufficiently steep at both ends of the sample data range (positive at the lower end and negative at the upper end). Third, the inflection point of the inverted U-shaped curve must be well within the sample data range. We followed [Lind & Mehlum \(2010\)](#) approach, and our results show that the inverted U-shaped relationships met the three necessary conditions. Thus, *H1* is confirmed. [Figure 1](#) provides a plot of the curvilinear effects of EO on profitability when firm size is treated as an endogenous variable.

H2 proposed that the EO–performance relationship will follow different patterns for groups of small, medium, and large firms when firm size is treated as an exogenous variable. To test this hypothesis, the first question is how to operationalize firm size. Put differently, what criteria should we use to split our sample into small, medium, and large firms? Academically, scholars use both objective and subjective indicators to measure firm size. Most objective criteria include assets, number of employees, and sales revenue ([Camisón-Zornoza, Lapedra-Alcamí, Segarra-Ciprés, & Boronat-Navarro, 2004](#); [Galbreath, Lucianetti, Thomas, & Tisch, 2020](#); [Miller & Le Breton-Miller, 2011](#)). Separately, the subjective opinion of firm size is collected through surveys ([McGee & Peterson, 2019](#)). Practically, managers use Gartner’s sales-anchored definition (www.gartner.com) of firm size to classify firms as small, medium, and large.

In this study, we decided to use sales turnover to operationalize firm size ([Miller & Le Breton-Miller, 2011](#)). After choosing the measurement method of firm size, the next question is how to split the sample into small, medium, and large firms. Given that our sample is listed firms, we decided to borrow common panel splitting methods in financial econometrics and split our sample based on quantiles ([Canay, 2011](#)). Specifically, we split

Table 2. Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
EO	1.00												
Profitability	0.13***	1.00											
Sales	0.01***	0.60***	1.00										
Recoverable slack	-0.08***	-0.13***	-0.12***	1.00									
Available slack	0.13***	-0.03***	-0.02***	0.09***	1.00								
Debt-to-equity	-0.10***	-0.01*	0.03***	-0.09***	-0.04***	1.00							
Earnings per share	0.09***	0.10***	0.05***	-0.15***	-0.04***	-0.01***	1.00						
Total assets	-0.01*	0.75***	0.69***	-0.15***	-0.03***	0.04***	0.06***	1.00					
Employees	0.02***	0.45***	0.69***	-0.12***	-0.02***	0.04***	0.05***	0.52***	1.00				
Years since IPO	-0.00	0.17***	0.14***	-0.05***	-0.04***	-0.01***	0.05***	0.21***	0.11***	1.00			
Hostility	-0.08***	0.02***	0.02***	-0.04***	-0.06***	0.01***	0.02***	0.06***	0.03***	0.21***	1.00		
Dynamism	-0.04***	-0.03***	-0.01***	-0.11***	-0.05***	0.03***	0.03***	-0.03***	-0.02***	0.02***	0.12***	1.00	
Complexity	0.01***	0.01***	0.03***	-0.02***	-0.02***	0.01***	0.03***	-0.02***	0.05***	0.13***	0.05***	0.43***	1.00
Note(s): * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$													

Table 3. Effects of EO on profitability

Variables	(1) Profitability	(2) Profitability	(3) Profitability
EO		0.037*** (0.002)	0.060*** (0.002)
EO # EO			-0.010*** (0.000)
Sale	0.006*** (0.001)	0.005*** (0.001)	0.005*** (0.001)
Recoverable slack	-0.200*** (0.018)	-0.181*** (0.017)	-0.146*** (0.017)
Available slack	0.001*** (0.000)	0.001*** (0.000)	0.000* (0.000)
Earnings per share	0.002*** (0.000)	0.002*** (0.000)	0.001*** (0.000)
Total assets	0.027*** (0.002)	0.027*** (0.002)	0.027*** (0.002)
Employees	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)
Years since IPO	0.004 (0.003)	0.003 (0.003)	0.005 (0.003)
Hostility	-0.260*** (0.025)	-0.241*** (0.024)	-0.221*** (0.024)
Dynamism	-1.355*** (0.295)	-1.367*** (0.295)	-1.300*** (0.292)
Complexity	0.055* (0.025)	0.060* (0.025)	0.060* (0.025)
Constant	0.025** (0.010)	0.018 ⁺ (0.010)	0.025** (0.009)
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	111,336	111,336	111,336
No. of firms	13,796	13,796	13,796
F-statistic	39.007	43.740	46.413
R-squared	0.585***	0.589***	0.591***

Note(s): Standard errors in parentheses. ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

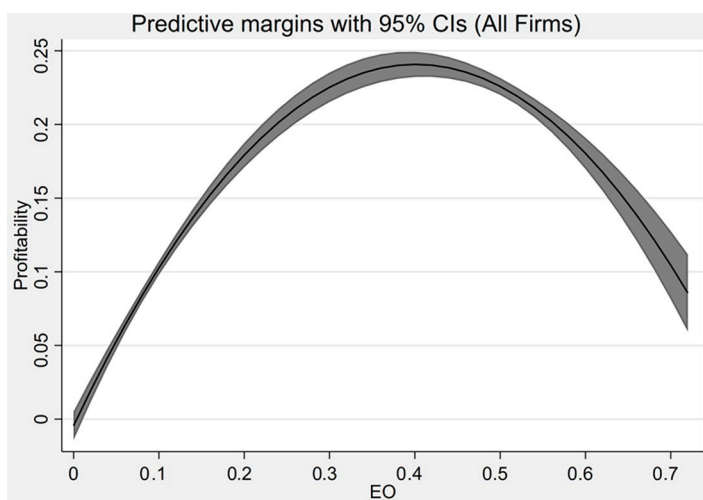


Figure 1. Plots of EO on profitability

our sample into four quantiles. We label the lower 25% as small firms, the middle 50% as medium firms and the upper 25% as large firms.

In sum, we use profitability to proxy firm size and we adopt quantiles method to create three panels for small, medium, and large firms. To test *H2*, we run separate fixed-effects regressions for small, medium and large firms. The regression results are

presented in Table 4, and the plots are provided in Figure 2. Details of our findings are provided below.

Model 1 in Table 4 represents our findings for small firms. The coefficient of EO was negative ($b = -0.024, p < 0.001$), and the coefficient of EO*EO was positive ($b = 0.063, p < 0.001$). Thus, H2a is supported. The results of Model 1 suggest that, because of diseconomies of scale/scope and their liability of newness, small firms need to be prepared to accept low-performance outcomes when EO levels are low. However, that should not discourage them. The positive nature of the squared term in Model 1 suggests that small firms should actively push to elevate the EO level because this will eventually result in significant performance increases, as indicated by the upward slope of the U-shaped curve for small firms provided in Figure 2.

Model 2 in Table 4 represents our findings for medium-sized firms. We found the EO coefficient to be positive ($b = 0.162, p < 0.001$) but the EO*EO coefficient to be insignificant. The shape of the curve for medium-sized firms in Figure 2 bears this out. It presents an upward-sloping EO-performance curve that is linear. This finding is in line with prior research conducted on these firms. Thus, H2b is supported.

Model 3 in Table 4 represents our results for large firms. We found the EO coefficient to be positive ($b = 3.356, p < 0.001$) and the EO*EO coefficient to be negative ($b = -3.905, p < 0.001$). These results are reflected in the inverted U-shaped curve for large firms in Figure 2. Thus, H2c is supported.

Robustness tests

We run robustness tests for both hypotheses. For the first hypothesis, we followed Anderson *et al.*'s (2022) causality and endogeneity recommendations and conducted a thorough

Table 4. Effects of EO on profitability (split samples by sales at p0-p25, p25-p75, and p75-p100)

Variables	(1) Small firms Profitability	(2) Medium firms Profitability	(3) Large firms Profitability
EO	-0.024*** (0.007)	0.162*** (0.022)	3.356*** (0.199)
EO # EO	0.063*** (0.013)	-0.051 (0.039)	-3.905*** (0.359)
Sales	-0.018 (0.045)	0.119*** (0.020)	0.004*** (0.001)
Recoverable slack	-0.014*** (0.002)	-0.034* (0.014)	-1.640*** (0.255)
Available slack	0.000 ⁺ (0.000)	0.001*** (0.000)	0.013*** (0.003)
Debt-to-equity	-0.000** (0.000)	-0.001*** (0.000)	-0.003 (0.002)
Earnings per share	0.000*** (0.000)	0.001*** (0.000)	0.009*** (0.002)
Total assets	-0.112*** (0.016)	-0.011* (0.005)	0.025*** (0.002)
Employees	-0.003 (0.002)	-0.004** (0.001)	-0.000 (0.000)
Years since IPO	0.002* (0.001)	0.008*** (0.002)	0.008 (0.008)
Hostility	-0.006** (0.002)	-0.032*** (0.008)	-0.428*** (0.078)
Dynamism	-0.001 (0.017)	0.045 (0.101)	-3.680*** (0.912)
Complexity	0.005** (0.002)	0.042*** (0.009)	0.112 (0.086)
Constant	0.000 (0.001)	-0.056*** (0.005)	-0.242*** (0.055)
Firm fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes
Observations	23,911	59,702	27,723
N_g	4,408.000	7,335.000	2,053.000
F	16.057	46.169	49.554
r ² _o	0.200	0.121	0.584
P	0.000	0.000	0.000

Note(s): Standard errors in parentheses. ⁺ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

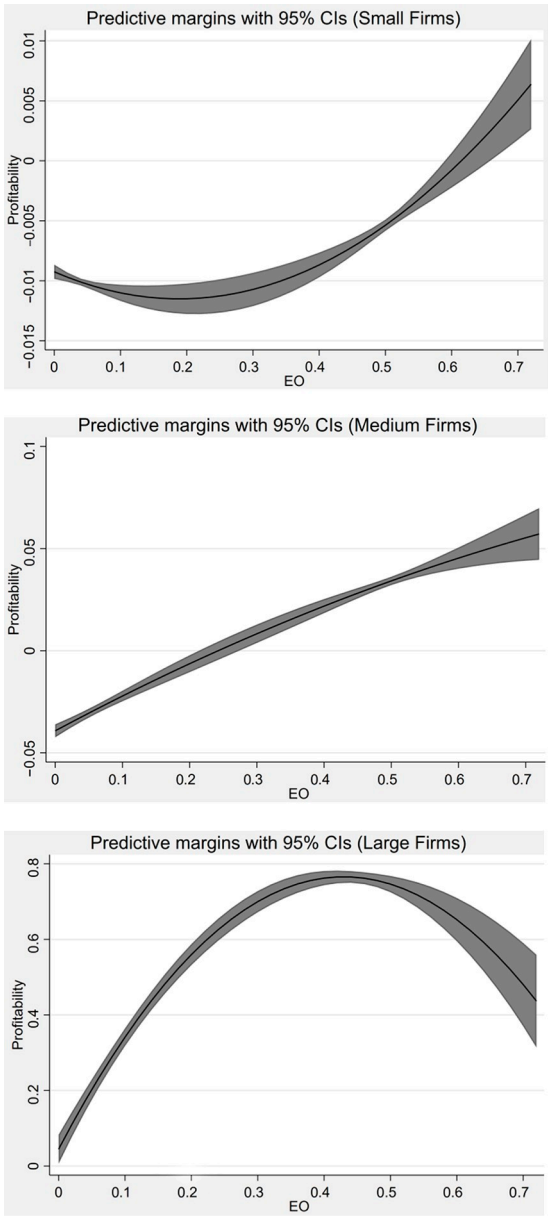


Figure 2. Plots of EO on profitability based on firm size

robustness analysis of *H1*, including lagged EO by one to three years, a dynamic panel model, the impact threshold of a confounding variable (ITCV), and alternative performance measures. For the set of *H2*, we use Gartner's criteria to split our sample. Respectively, small firms are those with average sales less than \$50m, medium \$50m to \$1bn, and large over \$1bn. We found support for both hypotheses.

Discussion

Our study is motivated by the mixed findings in the EO–performance literature. We developed two hypotheses derived from two research questions. With a sample of US-listed firms, we found support for both hypotheses. Specifically, when firm size is included as an endogenous variable, the EO–performance relationship can best be represented as an inverted U-shaped curve. Separately, when firm size is treated as an exogenous variable, the EO–performance curves reflect different characteristics. That is, the relationship between EO and firm performance is operationally (and mathematically) different for each of the three groups of firms.

Our research findings offer new and thought-provoking insights. First, while our identification of an inverted U-shaped EO–performance relationship might not be exciting, it is based on a more robust methodology to address the methodological concerns highlighted by research scholars. These findings would be useful in EO–performance studies where firm size is not a significant variable of interest. One such scenario could be studies conducted at the national level, e.g. initiatives that stimulate national economic growth with innovation incubators.

Second, when we split our sample into groups based on firm size, we discovered an interesting shape-shifting phenomenon. Because the shapes of the curves are significantly different for small, medium and large firms, we can conclude that the EO–performance relationship for each group “moves to the beat of a different drum,” much like [Penrose \(1959\)](#) had predicted, and it suggests that empirical research on each of these groups needs to be conducted separately. We believe that those findings would suggest three distinct streams of EO–performance research for each firm size: small, medium and large. Those findings also imply that controlling for firm size endogenously in prior EO–performance research was methodologically inappropriate and may have been a reason for the mixed findings in the literature. Further, scholars should test whether theoretical developments on the role of antecedents, mediators and moderators associated with the EO–performance relationship, identified in prior studies (which predominantly sampled SMEs), still hold for large firms. If the new findings suggest that differences exist between SMEs and large firms, more research on the underlying mechanisms that drive and generate these differences is warranted.

There is a need for more work that explores the underlying mechanisms that drive the shape-shifting characteristics of the EO–performance curve. For example, could differences in organizational resources and capabilities, organizational structure organizational design, or market power resulting from different firm sizes explain the differing underlying mechanisms that drive the shape-shifting phenomena of the EO–performance relationship? Alternatively, could the strategic positioning lens offered by [Miles, Snow, Meyer, & Coleman \(1978\)](#) provide another approach to investigating the underlying mechanism that drives the shape-shifting phenomenon? Finally, are bricolage theory ([Duymedjian & Rüling, 2010](#)) or competitive positioning theory ([Porter, 1989](#)) appropriate lenses to uncover underlying mechanisms that explain the shapeshifting phenomenon? Our research findings open opportunities for new streams of scholarly thought and action that could help us better understand the shape-shifting characteristics of the EO–performance relationship.

Overall contributions

Our study offers a theoretical refinement of the current understanding of the EO–performance relationship. Our investigation suggests that firms of different sizes could exhibit differently shaped EO–performance relationships. We recommend that future research on the EO–performance relationship should treat firm size as an exogenous variable and develop independent streams of research on firm behavior in three well-accepted firm size categories. Separately, our study also complements the scholarly discussion on EO-as-experimentation vs EO-as-advantage (Wiklund & Shepherd, 2011).

Methodologically, we contribute by using comprehensive data to examine the EO–performance relationship (Anderson et al., 2022; Miller, 2011). We depart from traditional approaches that use subjective measures (e.g. surveys or content analysis) to operationalize the study variables. We use objective data by tapping into the Compustat database. Our study design (sampling techniques and variables’ operationalizations) enabled us to mitigate potential limitations found in prior research. We hope that our efforts will encourage other scholars to follow similar methodological approaches.

Practically, our study suggests that managers need to be cognizant of the size of their firms when they leverage EO to boost performance. Managers of small firms should be ready to accept early performance dips when EO is low. For medium-sized firms, managers are encouraged to promote EO aggressively, given the positive linear relationship. For large firms, managers must seek information on the inflection point of the EO–performance curve that is representative of firms in their industry. Recognizing where this point lies could help them make informed decisions about increasing EO past the inflection point where they run the risk of facing diminishing returns.

Limitations

While it is encouraging to confirm the inverted U-shaped relationship between EO and firm performance with a sample of publicly listed firms of all sizes, we would like to alert the reader to the study’s potential limitations. First, one possible limitation could be endogeneity, given that we use the same data set to measure the independent and dependent variables. Thus, using separate data sets to operationalize the dependent and independent variables would be ideal.

Second, our study was conducted on listed firms in the USA. Thus, we encourage scholars to test our findings in other countries and confirm generalizability. We were heartened to note that in the past five years, there has been an increase in EO–performance research conducted in multiple national contexts (e.g. Algeria, Argentina, Bangladesh, Brazil, Italy, Japan, Malaysia, Mexico, South Africa, Taiwan, and the UAE). We hope to see more research in other countries. Third, scholars are encouraged to replicate our findings with private firms. The Global Entrepreneurship Monitor (Kelley, Singer, & Herrington, 2016) might be one such source for information on private SMEs.

Conclusion

Our study was motivated by mixed EO–performance findings found in the literature. We first offer evidence of an inverted U-shaped curvilinear relationship between EO and firm performance when firm size is treated as an endogenous variable. However, when firm size is treated as an exogenous variable, i.e. when we split our sample based on firm size, the shape of the EO–performance curve displays differing characteristics. Our findings offer support for conceptualizing firm size as an exogenous variable in the EO–performance relationship, which suggests that the underlying mechanisms that drive the EO–performance relationship could be different for different-sized firms. Our “discovery” offers multiple off-ramps for future research streams that could reshape our understanding of the EO–performance relationship.

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Corresponding author

Gang Fan can be contacted at: gang.fan@tamiu.edu