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Exploring EO strategic performance measures: value-added versus efficiency outcomes

Abstract

Purpose

Research on Entrepreneurial Orientation (EO) seeks to understand the EO-Performance relationship. However, at a strategic level, performance relates to a competitive advantage and comprises both value-added and efficiency measures. Following arguments that performance is context and strategy dependent, the paper argues that EO research needs to clarify and specify the type of performance relationship measured.

Design/methodology/approach

To explore the EO-Performance relationship, the research considers the agricultural sector where policy has traditionally encouraged the maximisation of efficiency in production and has only recently promoted entrepreneurship, providing fertile ground to explore different approaches to measuring performance. A survey collected detailed accounting records and context specific EO for 282 commercial farms. We estimate two models (Heckman selection regression and stochastic production frontier) that examine the relationships between EO and value-added / efficiency performance outcomes.

Findings

The analysis confirms the EO-value-added performance relationship, with significant positive relationships for the EO components proactiveness and innovativeness and a negative relationship for risk. No EO-efficiency performance relationship was found, despite a robust analysis of technical efficiency using detailed accounting data.

Originality/value

The paper contributes to EO theory by problematizing performance and highlighting the importance of the type of performance measured. It contributes empirically with findings relating to a mature industry, and it contributes to entrepreneurship methodology by outlining how EO-performance relationships can be measured in terms of productivity and technical efficiency.

1. Introduction

Entrepreneurial Orientation (EO) refers to a proclivity toward entrepreneurial activities (Lumpkin and Dess, 1996) manifested by "decision-making norms that emphasize proactive, innovative strategies that contain an element of risk" (Morris and Paul, 1987:249). Numerous articles eulogize the virtues of EO (Wiklund, 2006; Wang, 2008), identifying a positive relationship with performance and the various determinants and moderators of this relationship (Rauch *et al.*, 2009; Wales *et al*., 2019). However, according to management scholars, business performance measurement systems should capture measures according to the competitive advantage sought (Cui *et al*., 2018; Micheli and Manzoni, 2010; Neely, 2005). For instance, a firm competing on distinctiveness should use metrics capturing value-added measures, whilst one focusing on cost-leadership should use metrics concerned with efficiency. However, it is not known whether these performance types hold a similar relationship with EO, as performance to date in EO research has been treated as a complex concept that is captured by multi-dimensional constructs that conflate performance types (Hernández-Perlines *et al*. 2021; Covin and Ribeiro-Soriano, 2021). This has the effect of obscuring the underlying discrete EO-Performance type relationships. Some previous EO studies acknowledge this difference; for instance, a positive EO-Performance relationship appears less robust when industries focus on cost-leadership strategies (Lomberg *et al*., 2017; McKenney *et al*., 2018); leading to calls to be cautious in stating a general correlation between EO and Performance (Andersén, 2010).

By understanding the relationship with EO and these types of performance we can clarify what type of strategic performance benefits from an EO. The paper therefore derives and tests hypotheses about the relationship between EO and its components with (1) value-added and (2) technical efficiency measures of performance. Value-added is a measure of the ability of firms to add value to the sum of resources/inputs used for producing a certain output. Technical efficiency is a core economic measure to evaluate the efficient allocation of resources, being the ability of management to allocate inputs given a certain production technology, with the most efficient firms producing on the technical efficiency frontier, hence, using exactly the type and quantity of resources needed to produce the maximum output that can be produced with the given technology (Kumbhakar *et al.*, 2014).

The research contribution is threefold: we problematize the EO-Performance relationship and highlight the importance of how performance is measured; we contribute empirically with findings relating to a mature industry; and we contribute to entrepreneurship methodology by demonstrating how EO-Performance relationships can be measured in terms of value-added and technical efficiency. Initially, we distinguish between value-added and technical efficiency measures of performance, finding that neither EO nor its constituent elements independently enhance technical efficiency within firms. This suggests that EO is most effective at stimulating performance as measured through value-added metrics and has implications for how future EO research is operationalised. Secondly, this may explain previously mixed results in EO-Performance research relating to mature industries, such as agriculture. Firms seeking efficiency as a traditional strategic goal may find EO irrelevant in these contexts. However, for firms pursuing value-added strategic goals, through means such as diversification, EO has its benefits. Finally, the paper contributes to entrepreneurship methodology through the introduction of a stochastic frontier analysis efficiency model as a robust approach for estimating technical efficiency. This is an effective approach for exploring the factors that influence efficiency, offering opportunities to explore the influence of other entrepreneurial concepts on technical efficiency as a strategic goal.

The next section first conceptualizes EO, then builds upon performance management debates to problematize existing EO-Performance research by demonstrating the value of both value-added and efficiency measures of performance. The methodology section outlines the agricultural context and Delphi panel used to create a context specific version of the most well-known scale of EO (Covin and Slevin, 1989) and describes the survey used to gather responses. The data is then analysed, estimating a Heckman selection regression model (EO-Value-added) and a stochastic frontier analysis efficiency model (EO-Efficiency), before the discussion and conclusion.

2.1. Entrepreneurial Orientation

Entrepreneurial Orientation (EO) is a strategic organisational measure of a firm's orientation towards entrepreneurial action (Covin and Miller, 2014). It has been applied extensively in the entrepreneurship domain to understand the relationship between strategic actions and performance (Rauch *et al.*, 2009). A strong positive correlation between EO and business performance is expected, even after controlling for both structural and personal characteristics (Bernoster *et al*., 2018). It is argued that an EO is particularly important where a challenging business environment requires a firm to search for new ideas (Wiklund and Shepherd, 2003) and exploit fresh opportunities (Baker and Sinkula, 1999). The willingness to search for and implement new ideas in a context of uncertain outcomes, can generate a competitive advantage over others, with organisations situated on a continuum from low to high EO (Covin and Wales, 2012).

There are two distinct constructs of EO: phenomenon and domain specific (Covin and Wales, 2014). The former refers to the phenomenon of EO as '*represented by the qualities that risk taking, innovative, and proactive behaviours have in common*' (Covin and Miller, 2014:13). Risk taking implies a willingness to commit resources to ventures where outcomes are unknown, and the costs of failure may be substantial. Innovativeness refers to a tendency to engage in and implement new ideas and creative processes, departing from established practices and technologies (Upadhyay *et al.*, 2022; Wiklund and Shepherd, 2005). Proactiveness refers to a forward-looking perspective whereby firms anticipate the emerging needs and wants of buyers, potentially creating a first mover advantage (Lumpkin and Dess, 1996). The phenomenon approach assumes that EO is an overarching construct, with three elements that have a universal and positive effect on performance. The domain specific view of EO assumes that these three elements, supplemented by autonomy and competitive aggressiveness, should be '*treated as independent behavioural dimensions that define EO's conceptual space*' (Covin and Miller, 2014:13). The phenomenon based scale should register a lower score for a less entrepreneurially inclined firm and *vice-versa*, whereas the domain specific scale might display multiple dimension profiles for entrepreneurial firms (Covin and Wales, 2012). The phenomenon-based scale is thus appropriate for research into the impact of an EO and the domain based scale for research into where it is found.

Whether phenomenon and domain based EO are reflective measures (caused by the latent construct) or formative measures (creating the latent construct) has been subject to debate (Anderson *et al.*, 2015). Regarding phenomenon based EO, one suggestion is that there are behavioural dimensions (proactiveness and innovativeness) and attitudinal dimensions (attitude to risk) within a formative EO. As such, measuring only the shared variance of a phenomenon based EO may lead to type II errors where behaviours and attitudes do not covary and should be considered separately (Anderson *et al.*, 2015).

2.2 Performance Measurement

Whilst entrepreneurship scholars regard EO as an important determinant of business performance (Wiklund and Shepherd, 2003), debates remain regarding how performance should be measured (Franco-Santos *et al.*, 2007). Organisations typically measure performance for various reasons, including benchmarking a competitive position; internal and external communication; to confirm or change strategic priorities; and to motivate progress (Neely, 2002; Ittner *et al.*, 2003) and therefore use different metrics (Terjesen *et al.*, 2016).

Strategically however, performance is a measure of competitive advantage, as articulated in Porter's seminal work on competitive strategy, referring to a firm's ability to perform at a higher level than others in the same industry (Porter, 1980). Within Porter's framing, there are two ways for a firm to achieve competitive advantage, either through a differentiation/value-added strategic advantage, or through a cost-leadership/efficiency strategic advantage. A differentiation advantage occurs when a firm provides superior services or products compared to competitors, enabling a higher price-point and entrepreneurial profit; for example, First Direct banking that differentiates on superior service. A cost-leadership advantage occurs when a firm provides the same service or product as its competitors at a lower cost; for example, EasyJet competes as a cut-price airline and cuts other activities.

According to this, business performance measurement systems should capture both routes to competitive advantage, incorporating value-added and efficiency measures (Neely, 2005; Sandvik and Sandvik, 2003; Tajeddini *et al.*, 2013). Specific strategic goals should align with appropriate performance measurement, which in turn support the development of capabilities and controls necessary to achieve the determined strategic outcome (Kolehmainen, 2010). A business focused on competitive differentiation should favour marketing-oriented metrics of performance; and those pursuing a cost differentiation strategy, operationally oriented metrics (González-Benito and González-Benito, 2005).

Inconsistencies in performance measurement have been shown to be contingent upon business strategy and this has been explored through the different strategic paradigms that organisations follow at both industry and firm levels (Melnyk *et al.*, 2010). At an industry level, competitive advantage is achieved through positioning against the competition in the sector. Industries emerge based on innovation and build on resource and capability endowments. Early in an industry's development cycle there is strategic space for differentiation in a 'blue ocean' (Kim and Mauborgne, 2014) as new entrants seek out a niche. Then as an industry matures, the increasingly crowded 'red ocean' *(Ibid)* leaves less room for incremental value-added activity and, in a process of consolidation, increasing competition based on economies of scale and efficiency. Hence, at the extremes, emerging industries should tend towards differentiated/value-added, competitive strategy, whilst industries operating in hostile or mature environments will tend towards consolidation, low-cost/ efficiency strategies (Anderson *et al.*, 2014; Lomberg *et al.*, 2017).

Research establishes that the performance of enterprises within the same industry varies substantially but that there are also significant variations in rates of return across industries (Hirsch *et al.*, 2014). The Resource Based View (RBV) helps explain firm level effects, envisaging that a sustained competitive advantage occurs when a firm can execute a value-adding strategy not concurrently being employed by a competitor (Barney, 2001). It does this through manipulating the unique resources and capabilities it controls *(Ibid),* where resources deployment allows a firm to gain competitive advantage (Andersén, 2021). A firm's competitive position is therefore contingent upon the strategy that best exploits internal resources and capabilities, which can be a complex mix of interdependent assets, suggesting a multitude of competitive positions (Miao *et al.*, 2017). Research into Resource

Orchestration (RO) indicates that it is not just the resources and capabilities that matter, but how they are leveraged through mobilisation and coordination (Morrow *et al.*, 2007; Sirmon, Gove and Hitt, 2008).

To summarise, firm performance varies across an industry, with some possessing a competitive advantage, stemming either from a differentiation/value-added strategic advantage, or through a cost-leadership/efficiency strategic advantage. The success of a differentiation strategy depends on the degree to which a firm can create greater added value compared to rivals. A cost-leadership advantage occurs when a firm provides the same service or product as its competitors at a lower cost, so that it is more efficient than rivals.

2.3 EO and Performance measurement

2.3.1 Composite measures of performance

Multiple methods for measuring firm performance exist, reflecting the diverse goals and stakeholders of organizations, making firm performance a multifaceted construct (Carton and Hofer, 2006). Consequently, composite constructs tend to be preferred to measure performance in EO research.

Despite a lack of consensus regarding the specific dimensions of performance to be used in these composite measures (Franco 2007), certain characteristics have been observed as common, such as: an integration of long-term strategic and operational goals; multi-perspective measurement; the capture of causal relationships; and the presence of actions and goals (Gimbert *et al.*, 2010). The balance of these measures should be dependent upon the operant business strategy, and it may be that efficiency measures are prioritised over value-added measures (Melnyk *et al.*, 2010), or that a dual approach is taken where both are pursued together. For example, dual strategic goals of radical innovation and incremental gains in efficiency would require performance measures that capture both the value-added effect of innovation and savings through efficiency (Lavie *et al.,* 2010).

Standard accounting techniques such as profit, ROI and turnover have been used as available and observable measures (Hult *et al.*, 2004). More frequently, non-financial measures have been used (Rauch *et al.*, 2009), such as number of employees (Zainol, 2013), survival (Bosma *et al.*, 2004), competitive position (Wang, 2008), and non-economic measures such as Corporate Social Responsibility (Menguc and Ozanne, 2005). These performance measures constitute a multifaceted set of metrics (Morgan *et al.*, 2003) that can combined to produce a composite construct of 'performance.'

Most EO research employs composite measures of performance (Gupta and Wales, 2017). For example, Wiklund and Shepherd (2003) use a 10-dimensional measure of performance. Such a composite approach has its advantages, as firms have heterogeneous strategies. However, this makes it difficult to generalize beyond the specific performance instrument and questions remain regarding the weighting of individual dimensions in the composite measure. As Lumpkin and Dess (1996) highlight, the outcomes of EO may be favourable on some measures of performance but not other, with sometimes poor convergence between outcomes across indicators (Murphy *et al.*, 1996). From such an approach it is impossible to understand whether an EO has a direct influence on value-added or efficiency measures of performance.

To address this problem, Figure 1 proposes a conceptual model which (a) highlights the generic EO-Performance relationship and (b) proposes a deconstructed model. We next consider value-added and efficiency measures of performance separately.

FIGURE 1 ABOUT HERE

2.3.2 Value-added as performance

The focus in much EO research is implicitly on value-added forms of performance. Lumpkin and Dess (1996) suggest EO is about taking the initiative in anticipating and pursuing future opportunities. Indeed, the original conceptualisation in Miller (1983) regarded an 'entrepreneurial firm … [to be] one that engages in product-market innovation, undertakes somewhat risky ventures, and is the first to come up with 'proactive' innovations, beating competitors to the punch.' (1983: 771).

In terms of an RBV, the EO literature equates the mobilisation and deployment of resources to an EO, on the understanding that its focus is on identifying and acting on *new market* opportunities (Chen *et al.,* 2020). This has been taken literally, with an EO being used as a proxy for the mobilising dimension of resource orchestration (Andersén, 2021; Miao *et al.,* 2017). Given a RBV and evidence relating to the implementation of differentiation-based competitive strategies (Hooley *et al.,* 1998), we expect to find that EO has a positive effect on the generation of value-added so that:

Hypothesis 1: EO is positively related to value-added performance

Considering the behavioural dimensions of proactiveness and innovation, both have been found to consistently influence performance (Hughes and Morgan, 2007; Raunch *et al.*, 2009). Within this, proactiveness has been defined as focused on mobilising *future needs* (Chirico *et al*., 2001; Andersén, 2021) and innovation conceptualized as *product and/or market* innovation (Miller, 2011) – all value-adding activities. Hence:

Hypothesis 1a: Innovation is positively related to value-added performance

Hypothesis 1b: Proactiveness is positively related to value-added performance

Considering the attitudinal dimension of risk, the relationship with performance is less certain, with a negative relationship being uncovered in resource constrained firms (Kreiser *et al.*, 2002a). This negative relationship has also been reported in instances where an industry has high levels of hostility or munificence (Kreiser *et al.,* 2002b). This may be masked in phenomenon-based EO research where the dimensions are simply aggregated and not independently reported (Andersén et al., 2015). Given the traditionally productivist focus of the agricultural sector and the slim margins of recent years we propose that:

Hypothesis 1c: Risk-taking attitude is negatively related to value-added performance

2.3.3 Efficiency as performance

Whilst analysis and measurement of performance employed within the EO literature favours capturing value-added activities as the *de facto* performance measure rather than efficiency (Covin *et al.*, 2006), there is no reason to assume that EO will not relate to efficiency as a specific aspect of performance (Imran *et al*., 2018). EO has been used to understand how resources and existing knowledge are exploited (Lin *et al.,* 2013; Boucken *et al.* 2016), specifically around the coordination of resources (Andersén, 2021; Miao *et al.*, 2017). EO may lead to improvements in a firms' efficiency by prompting reductions in waste and improving absorptive capacity (Kohtamäkia *et al.*, 2019). The ability to leverage internal resources is important and research shows a relationship between EO and resource orchestration that moderates the resource-performance relationship (Andersén, 2021). For instance, a high EO and high willingness to try new resource exploitation practices has been found to support superior performance, suggesting a link between EO and efficiency (Andersén, 2021). Given a dependence on scarce natural resources, their efficient use should be particularly salient within the agricultural sector (Dias *et* al., 2022). As such we propose:

Hypothesis 2: EO has a positive effect on an enterprise's technical efficiency

The underlying dimensions of proactivity (Aspara *et al.*, 2018; Lanz *et al*., 2014; Rivera-Torres *et al.*, 2015), innovativeness (O'Reilly and Tushman, 2004) and risk (Rauch *et al*., 2009) have all been associated with efficiency gains. Research suggests that whilst mature industries maintain positive overall EO relationships with performance, only proactivity remains significant in the component dimensions (Lombard *et al*., 2017). Nevertheless, multi-dimensional performance constructs have also captured the importance of process innovation (Wiklund and Shepherd, 2003), whilst a positive attitude to risk may encourage a firm to search and implement new working arrangements (process efficiencies), for example identifying a lower-cost base for labour and materials than rivals (Porter, 1980). In addition, research on EO in agriculture suggests that a positive relationship exists, with EO associated with the adoption of more efficient production practices (Kangogo et al., 2021),

Therefore:

Hypothesis 2a: Innovativeness is positively related to technical efficiency
Hypothesis 2b: Proactivity is positively related to technical efficiency
Hypothesis 2c: Risk-taking attitude is positively related to technical efficiency

3. Methodology

3.1 Farming as context

Production maximisation and efficiency have been the traditional foci of agricultural business strategy, but in recent years farmers have been encouraged to be entrepreneurial and seek value creation (McElwee, 2006; Fitz-Koch *et al.*, 2018). Identified entrepreneurial strategies include: on-farm and off-farm diversification (such as agri-tourism, food processing and direct marketing) (Dias *et* al., 2019); pluriactivity or portfolio income generation (Fitz-Koch *et al.* 2018); and developing more climate and financially resilient agriculture (Condor, 2020; Shingo and Yagi, 2021). Policy makers generally seek to reduce direct financial aid to farmers and reorient support toward decoupled, direct and environmental payments (Attorp and Hubbard, 2023), as well as promote more efficient input use, to minimise both financial and environmental costs (Sorrentino *et al.,* 2016). Grande *et al.* (2011) contend that EO aids the ability of farmers to successfully navigate this transition while McElwee (2006), argues that the role of farmers is changing, with an entrepreneurial mind-set essential in their adjustment to a reformed policy environment. However, Dias *et al*. (2021) highlight that the impact of EO on performance remains unclear in the farming context and warrants further research.

3.2 Sample and unit of analysis

The Farm Business Survey (FBS) is a large scale, annual, national UK Government funded survey of commercial farm accounts. It provides rich respondent data regarding: outputs, variable and fixed inputs, and farmer and farm characteristics. Data are collected directly from farms by trained enumerators. For this research, enumerators asked additional questions relating to EO whilst collecting detailed farm accounting and physical performance data.

Data collection for additional EO questions occurred in the South-West region of England[1]. The South-West region accounts for approximately one-fifth of England's farmland. It is characterised by a high proportion of grazing livestock farms (36% of farmed area), as well as cereals and dairy, accounting for 20% and 18% of the farmed area respectively (Defra, 2016). The majority of farms are family-owned and there is a greater proportion of small and very small farms and a smaller percentage of very large farms compared with England as a whole (Defra, 2016). Land types vary substantially, including large expanses that are classed as Areas of Outstanding Natural Beauty (covering 30% of the region) and Less Favoured Areas (8% of the region). Most farms in the South-West region do not have formal, written business plans and the most commonly employed risk management strategy is to seek to reduce costs (NICRE, 2022). The most common objective of farms is to maintain the viability of the business (94%) with only one-tenth seeking to build a national and/or international business (NICRE, 2022).

In total, 309 farmers answered the EO additional questions, of which 282 responded fully (response rate of 91%). The high response rate stems from the longstanding relationship between participants in the survey and the enumerators. The average length of participation in the survey is over seven-years and as a benefit for participation the farm gains a set of fully filled accounts.

3.3 Measuring EO

The EO scale used was a modified version of that proposed by Covin and Slevin (1989). This scale aims to measure the phenomenon of firm-level entrepreneurial orientation and is regarded as the most widely adopted design (Wales *et al.*, 2019). It consists of nine items, divided equally between three dimensions (innovativeness, proactiveness, risk-taking). Some studies assume that EO is unidimensional (first order model), consisting of these three independent constructs, while others assume that a multidimensional (second order) model is appropriate whereby EO is a higher-level factor which explains the relationships between the first order factors of innovativeness, proactivity, risk taking (Ruvio et al., 2014). Given this theoretical ambiguity, in the analysis we

[1] An area of the former Government Office Region of South West England, incorporating Cornwall, Devon, Dorset and Somerset, Torbay, Bournemouth and Poole.

consider both the effect of innovativeness, proactiveness, risk-taking separately (which assumes EO is unidimensional) and when EO is treated as a higher, second order factor.

The sub-dimensional questions were adjusted to be context appropriate, with the modifications agreed using a Delphi panel populated by a group of international academics and practitioners. Such modification helps contextualise the scale where careful modification has no impact on validity (Covin *et al.*, 2006). This 2-stage design reduced the potential for common-method bias (Jiang *et al.,* 2018).

3.4 Dependent variables: measuring performance

Whilst there are many measures of performance utilised in EO research, over 80% of studies use subjective measures (Rauch *et al*., 2009), which may in turn be uni- or multi-dimensional (Hult *et al.*, 2004; Wiklund and Shepherd, 2005). The limitations of subjective measures have been noted (Grande *et al.*, 2011), particularly regarding recall and common-method biases (Stam and Elfring, 2008), and the assessment of performance based on detailed production and financial records remains largely absent (İpek *et al.*, 2023). To avoid these problems, we measure performance based on FBS accounting records. Specifically, the analysis employs two dependent variables that measure performance. First, we employ total sales revenue as a dependent variable, which after controlling for input costs in the regression analysis, acts as a measure of value-added (Edwards, 1998). Secondly we estimate the technical efficiency of farms, considering that technical inefficiency is a measure of management error (Wouterse, 2010). Table 1 presents an overview of the dependent and independent variables used in the analysis.

TABLE 1 ABOUT HERE

3.5 Measuring EO and its characteristics

EO was measured using a modified version of the scale of Covin and Slevin (1989). For each item, respondents were given two opposite statements and asked to position themselves between them on a scale of 1-7. Reliability analysis for the EO scale, as well as for the sub-scales of innovativeness, proactiveness and risk-taking exceeded the usual threshold of .70 for Cronbach alpha coefficients (Hair *et al.*, 2010) (see *Supplementary-materials* for details).

To further explore the characteristics of EO, we conducted an initial Exploratory Factor Analysis (EFA), including all nine items measuring EO, using the maximum-likelihood approach for factor extraction. This yielded a three-factor solution in keeping with the theoretical framework. There were generally high loadings within factors, and no major cross-loadings between factors (see *Supplementary-materials* for details). The Kaiser-Meyer-Olkin Measure of Sampling Adequacy of 0.902 and significant Bartlett's Test of Sphericity denote that the data are suitable for EFA. Given the sample size, recognised thresholds for convergent validity are met (Hair *et al.*, 2010).

An examination of the factor correlation matrix indicates that the correlations between Factors 1 and 2, 1 and 3, and 2 and 3 are 0.649, 0.707 and 0.756 respectively. These correlations imply a high degree of shared variance, particularly between factors 2 and 3. A high degree of shared variance may be expected where factors are part of an overarching, second order factor, as assumed to be the case theoretically by some (Veidal and Korneliussen, 2013).

Subsequently, Confirmatory Factor Analysis (CFA) confirmed the factor structure extracted from the EFA. A second order factor (EO) was included in the model. The goodness-of-fit indicators were: CFI= 0.966, NFI= 0.952, RMSEA = .006, CMIN/DF= 2.89, p=.000. The standardized factor loadings were higher than .70 and significant (p<.01) (Brown, 2006). Convergent validity was assessed by considering Average Variance Extracted (AVE) estimates with scores ranging from 0.61 to 0.72. Composite reliabilities ranged from 0.82 to 0.89 (exceeding the 0.70 threshold). Following Kumbhakar *et al.* (2014), we include in the regression analysis a single measure of EO derived from the second-order factor analysis as an independent variable (composite imputed factor score), as well as rerunning the regression analysis including the factor scores for the three innovation, proactiveness and risk taking as separate variables.

3.6 Measuring the other independent variables

We control for various demographic and structural characteristics, as detailed in Table 1. This includes the gender of the lead farmer, education, age, and if they farm part-time. Farm size is measured in terms of the FBS standard classification, based on labour requirements, which distinguishes between small, medium, large, and very large sized farms (Defra, 2016). Farm type, draws on a Defra classification based on the identifying the important standard outputs that contribute to the total value of farm outputs (Defra, 2016). A Herfindahl index, modified from studies of market concentration, captures the degree to which a farm is specialised or has a diverse range of income sources (Theriault and Smale, 2021). It measures the number of activities and their contribution to total farm revenue, so that the index is the sum of squared shares of revenue accounted for by different production activities (Wuepper *et al.,* 2018). As ecological conditions vary, we include dummy variables if the farm is in a

Disadvantaged (DA) or Severely Disadvantaged (SD) area. Finally, the analysis includes a measure of subsidies in the form of direct payments, which are largely decoupled from production.

3.7 Value-added and technical efficiency analyses

To empirically investigate the effects of EO on value-added and technical efficiency at the farm level, we estimate two models: (1) a Heckman selection regression, and (2) a stochastic production frontier.

3.7.1 Model 1 – Value-added

Participation in the FBS is voluntary and a farmer's choice to take part in the survey relates to unobservable reasons. Hence, bias according to sample selection and survey related issues is possible. To address potential sample selection bias, we estimate a Heckman selection regression. Heckman's two-stage sample selection model copes with such a selection problem by assuming that the individual farmer makes two judgements regarding whether to participate in the FBS and then separately, the structure and level of production, each of which is determined by a set of explanatory variables (see Heckman, 1979). Technical details for model 1 are given in *Supplementary materials.*

To address the likely problem of small sample bias as well as heteroscedasticity, we estimate the robust covariance matrix using the Huber-White sandwich estimator (White, 1980). To examine the validity of the final model specifications, we test for group wise insignificance of the parameters by a common generalized likelihood ratio testing procedure. Finally, we check for remaining heteroscedasticity (*Ibid*). To test for small-sample bias we investigate the robustness of our estimates obtained by applying a stochastic re-sampling procedure based on bootstrapping techniques (Efron and Tibshirani, 1993).

3.7.2 Model 2 – Technical efficiency

In the second model, we estimate the impact of EO on farms' production efficiency using a frontier specification of the production model outlined in the previous section. We estimate the technical efficiency of individual farms by simultaneously measuring the efficiency effect of various potential factors related to individual, farm and environment related characteristics. The EO of the individual farm is also tested for its impact on farms' technical efficiency. The corresponding likelihood function and efficiency derivations are given in Kumbhakar and Lovell (2000). Technical details for Model 2 are given in *Supplementary materials*. Finally, we further investigate the robustness of our estimates by applying a simple stochastic re-sampling procedure based on bootstrapping techniques as with Model 1.

4. Empirical results

4.1 Descriptive results

The sample characteristics reflect an industry bias towards male farmers (96%) with a relatively high mean age (57 years). The mean sales revenue per farm is £44,505 (circa $57,325) and the mean level of subsidy per farm is £31,366 (circa $40,401). Farms operate across nine broad categories, with livestock and dairy accounting for 65% of the sample. Farm sizes are classified according to a measure of standard output based on the total value of output over a 5-year average, with 62% in the small and medium category. In total, 20% of farms operate in disadvantaged or severely disadvantaged areas; being areas where agricultural production is restricted for various reasons (see *Supplementary materials* for details).

4.2 Econometric modelling results

Tables 2 and 3 summarise the results for the estimated models. The diagnostic tests indicated that the estimated model specifications hold a satisfactory level of statistical significance, with no signs of misspecification. Tests for endogeneity between explanatory variables and collinearity between regressors were also conducted.

Table 2 presents the estimates of the Heckman selection regression models, with two versions – one which treats EO as a second order construct, and the other assumes that EO is unidimensional so that innovativeness, proactivity, risk taking enter the model as separate, independent variables. The results for both indicate the expected significant, positive relationships between total sales revenue and several control variables, including machinery running cost, intermediate inputs, assets, farm size, diversity, level of subsidies, and the interaction of labour and machinery. Likewise, significant negative relationships were observed with farmer's age, and the interactions between labour and intermediate inputs, and intermediate inputs and machinery. Within the sample investigated, environmental disadvantage has no significant relationship.

TABLE 2 ABOUT HERE

Focusing on the effect of EO, where EO is treated as a second order construct, there was no statistically significant relationship with total sales revenue, after controlling for inputs, indicating that Hypothesis H1a is not supported. However, in the model treating the three dimensions of EO as separate variables, both proactiveness and innovativeness had a statistically significant, positive effect, whilst risk taking had a statistically significant, negative effect on total sales revenue – hence we find support for hypotheses 1c and 1d but not 1b.

Table 3 presents the results of the stochastic production frontier model that was specified to estimate the impact of EO on farms' technical efficiency. We present two versions of the model– one which treats EO as a second order construct while the other assumes that EO is unidimensional, treating innovativeness, proactivity, and risk taking as separate independent variables. Statistically significant variables with a negative sign in the technical inefficiency part of the model, imply a positive effect on efficiency, whilst those with a positive sign imply a negative effect. The results show that farm size and specialisation have a significant, positive effect on efficiency, whilst farmers' age has a significant negative effect on efficiency. The findings regarding the relationships between farm size and farmers' age with technical efficiency mirror those of earlier research using FBS data in the UK (Hadley, 2006).[2] Unlike Kumbhakar *et al.* (2014), who found a weak, negative impact of farmers' EO on technical efficiency, we find that within both models, neither the second order EO factor nor risk taking, innovativeness or proactiveness dimensions separately have any effect on technical efficiency, hence Hypotheses 2a, 2b and 2c are rejected.

TABLE 3 ABOUT HERE

5. Discussion

With performance recognized as a complex and multifaceted concept in previous EO research, research to date has focused on composite measures of performance. Whilst this acknowledges the heterogeneous competitive strategies of the firm, it makes generalization beyond specific measurement instruments difficult. This is problematic as EO may have a positive effect on performance for some measures and a different effect on others. The research considered two key measures of performance: value-added and technical efficiency. Figure 2 updates the conceptual model and confirms a relationship between EO and value-added as performance, finding no relationship between EO and technical efficiency.

FIGURE 2 ABOUT HERE

Regarding the value-added measure of performance, we found significant positive relationships between innovativeness and proactiveness (hypotheses 1a and 1b), and a negative relationship for risk taking (hypothesis 1c). This is consistent with the findings of Hughes and Morgan (2007) where the components of EO were observed to behave independently – with innovativeness relating to product or market innovation (such as on and off farm diversification), and proactiveness relating to mobilising for future needs (such as developing more climate and

[2] Hadley (2006) did not consider diversity (Herfindahl index) as a determinant of technical efficiency.

financially resilient agriculture) (Andersén, 2021). The negative relationship found between attitude to risk and value-added performance confirms previously observed negative relationships found in resource-constrained firms (Kreiser *et al*., 2002b). Given the sectoral focus of our sample within agriculture, this is potentially a reflection of a risk averse attitude in a mature industry, confirming findings by Lomberg *et al.* (2017).

Regarding technical efficiency, no relationship was found, echoing the only previous empirical study that considers the relationship between EO and technical efficiency which reports a weak negative relationship (Kumbhakar *et al.*, 2014). A key question to consider therefore is why there is no statistically significant positive relationship between EO and efficiency, given the previously articulated potential efficiency gains associated with risk taking, innovation and proactivity (Aspara *et al.*, 2018; Cui *et al.,* 2018; Rauch *et al*., 2009). Efficiency is analysed within the context of a set of firms with a comparable set of potential inputs and output – a benchmarking exercise where some firms do things better than others in terms of their relationships between inputs and output. However, a core tenet of entrepreneurship relates to the entrepreneur doing something different from what others are doing currently (Wiklund and Shepherd, 2003). Often when actors innovate, they are inefficient at first, and over-time processes are refined and improved. As such, the mind-set between efficiency and value-added may be completely different.

These findings confirm that EO enhances value-added performance but not efficiency performance. This may explain previously mixed results in EO-Performance research exploring mature industries more focused on efficiency strategies (Lomberg *et al*., 2017; McKenney *et al*., 2018). These results suggest that EO is only reliable in improving performance when considered in terms of value-added rather than efficiency objectives.

Within mature industries such as agriculture, this suggests that adopting an EO when a firm is strategically targeting value-added activities, such as diversification, may be beneficial. For instance, Grande *et al.* (2011) found a positive relationship between EO and performance in farms 'engaged in innovative ventures' (2011:89). Adopting an EO when diversifying into direct marketing, agri-tourism or off-farm new ventures (Dias *et al*., 2019) may increase value-added performance. However, for commodity-based production, where technical efficiency is a key measure of performance, EO may be superfluous.

6. Conclusion

EO is widely regarded as positively affecting business performance in all contexts. However, this study suggests such confidence is misplaced. Whilst numerous studies identify the importance of the EO-Performance relationship, they often rely on composite and subjective measures of performance, so that the relationship with technical efficiency, a key measure of performance, is under investigated. Consequently, we distinguish between value-added and efficiency measures of performance and hypothesize their relationships with EO. To empirically test these relationships, a survey collected detailed accounting records and context specific EO from 282 commercial farms. Data were used to estimate two models to examine the relationships between EO and (a) value-added and (b) technical efficiency measures of performance. We found a relationship between components of EO and value-added performance, but no evidence of a relationship between EO and technical efficiency. The sector considered here is one with various path dependencies and unique institutional arrangements and the EO-technical efficiency relationship maybe stronger in other sectors.

The contribution of this paper is threefold: it problematizes the EO-Performance relationship and highlights the importance of how performance is measured; contributes empirically with findings relating to a mature industry; and it contributes to entrepreneurship methodology by asking how EO-Performance relationships can be measured in terms of value-added and technical efficiency.

Our research shows that an EO is not always appropriate, and, in terms of practice, firms should only adopt an EO when they have clearly articulated value-added performance goals. Adopting an EO with efficiency goals may be a waste of time and resource. We also suggest that practitioners should distinguish between value-added and efficiency outcome metrics, and carefully consider which is more important for their business, rather than relying on a composite or subjective measure of performance

We consider this paper a starting point in demonstrating that performance type matters when studying the EO-Performance relationship. We suggest that future EO research considers multiple, separate measures of performance. This also provides a next step for research that has hitherto not found the expected positive relationship between EO and performance – distinguishing between value-added and efficiency types of performance can generate a more accurate picture of the effects of EO on business success.

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Table 1: Description of the dependent, focal independent, and control variables included in the analysis

Variable	**Description**
Dependent variables	
Total sales revenue	Total sales of all agricultural outputs, measured in £
Technical efficiency	Technical efficiency based on estimation of a second-order, flexible translog type production function
Focal Independent variables	
2nd Order EO	2nd order factor of EO based on Covin and Slevin (1989).
Risk taking	Risk taking dimension of EO based on Covin and Slevin (1989).
Proactiveness	Proactiveness dimension of EO based on Covin and Slevin (1989).
Innovativeness	Innovativeness dimension of EO based on Covin and Slevin (1989).
Control variables	
Gender	Dummy variable, 1= man, 5 = woman
Education	Highest level of education achieved 1= school, 2 A level, 3 = college / Higher National Diploma, 4 = undergraduate degree, 5 = postgraduate qualification
Age	Measured in years
Part-time	If farmer is 1= full-time or 2 = part-time
Farm size	Based on Defra classification of farm size by standard output: 1= small, 2 = medium, 3= large, 4=very large
Farm type	Classification of farms by Defra, where 1 = cereals, 2 = dairy, 3 = general cropping, 4 = horticulture, 5 Less Favoured Area grassland, 6 = lowland grazing livestock, 7 = mixed, 8 = pigs and 9 =poultry
Diversity (Herfindahl)	The degree of diversification is measured using the Herfindahl Index: $H = (1 - \sum_k r_k^2)$ where r is defined as the ratio of each of k income sources to the total farm income
DA area	Dummy for disadvantaged area =1 otherwise = 0
SD area	Dummy for severely disadvantaged area = 1, otherwise = 0
Subsidies	Amount of direct payments received by farm (£)

Table 2: Heckman models for analysis of the effect of EO on value-added

DV: Total Sales Revenue	EO as 2nd Order factor		EO as 1st Order constructs	
Variable	Coef.	Std. Err.	Coef.	Std. Err.
Co-efficient	-0.391	1.958	-0.319	1.935
Labour	0.196	0.469	0.093	0.464
Intermediate inputs	0.466*	0.269	0.475*	0.266
Machinery running cost	1.131***	0.330	1.123***	0.327
$Labour^2$	-0.017	0.031	-0.026	0.031
Intermediate $inputs^2$	0.049***	0.013	0.047***	0.013
Machinery running $cost^2$	0.018	0.020	0.017	0.020
Assets	0.068***	0.019	0.071***	0.018
Farm size - medium	0.205***	0.049	0.204***	0.048
Farm size - large	0.476***	0.062	0.487***	0.061
Diversity (Herfindahl index)	1.049***	0.299	0.966***	0.295
Subsidies	0.000***	0.000	0.000***	0.000
SD area	0.077	0.070	0.058	0.069
DA area	0.014	0.056	0.000	0.055
Farmer's education	0.003	0.010	0.003	0.010
Farmer age	-0.004**	0.002	-0.004***	0.002
Part-time	0.077	0.058	0.083	0.056
Interaction effects				
Labour X Intermediates	-0.104***	0.030	-0.099***	0.030
Labour X Machinery	0.109***	0.046	0.116***	0.046
Intermediates X Machinery	-0.124***	0.020	-0.122***	0.019
Entrepreneurial Orientation				
2nd Order EO	0.004	0.014	-	-
1^{st} Order components				
Risk taking	-		-0.031**	0.014
Proactiveness	-		0.022**	0.011
Innovativeness	-		0.033**	0.015
N	399			399
Wald	3384.690			3573.130
Prob > chi2 = 0.0000			Prob > chi2 = 0.0000	

*,**,***, p < 0.05, 0.01, 0.001

Table 3: Stochastic frontier analysis of the effect of EO on technical efficiency

	EO as 2nd Order		EO as 1st order constructs	
	Coef.	Std. Err.	Coef.	Std. Err.
Stochastic Production Frontier				
Constant	7.698***	2.664	7.821***	2.679
Labour	0.319	0.533	0.326	0.535
Intermediate inputs	-0.390	0.299	-0.406	0.302
Machinery running cost	0.458	0.402	0.452	0.401
$Labour^2$	0.069***	0.026	0.069***	0.026
Intermediate $inputs^2$	0.087***	0.012	0.087***	0.012
Machinery running $cost^2$	0.051***	0.021	0.051***	0.021
Labour X Intermediates	-0.040	0.034	-0.041	0.034
Labour X Machinery	0.015	0.047	0.016	0.047
Intermediates X Machinery	-0.114***	0.025	-0.113***	0.025
Assets	0.089***	0.019	0.090***	0.019
Technical inefficiency model				
Constant	5.429*	3.308	5.129*	3.388
Farm size – medium	-1.361***	0.529	-1.390***	0.521
Farm size – large	-8.267	8.614	-7.580	5.847
Gender	-0.526	0.709	-0.459	0.714
Education	-0.059	0.109	-0.067	0.110
Age	0.038**	0.019	0.037**	0.019
Part-time	-0.167	0.484	-0.182	0.475
Diversity (Herfindahl)	-10.362**	3.348	-9.962***	3.513
Farm type: cereals	-1.311	1.321	-1.225	1.238
Farm type: dairy	0.496	1.021	0.564	1.012
Farm type: cropping	-2.929	2.615	-2.869	2.562
Farm type: horticulture	0.154	1.014	0.215	1.015
Farm type: LFA grazing	2.367	2.070	2.373	2.026
Farm type: low grazing	0.129	0.730	0.122	0.730
SD area	-2.381	2.168	-2.353	2.141
DA area	-1.712	2.157	-1.701	2.099
Entrepreneurial Orientation				
2nd Order EO	-0.075	0.150	-	-
Risk taking	-	-	-0.013	0.167
Proactiveness	-	-	-0.066	0.117
Innovativeness	-	-	-0.020	0.170
Variance				
sigma_v	0.219	0.014	0.218	0.014
Insig2v	-3.039	0.124	-3.048	0.128

*,**,***, $p < 0.05, 0.01, 0.001$

Figure 1 Conceptual model

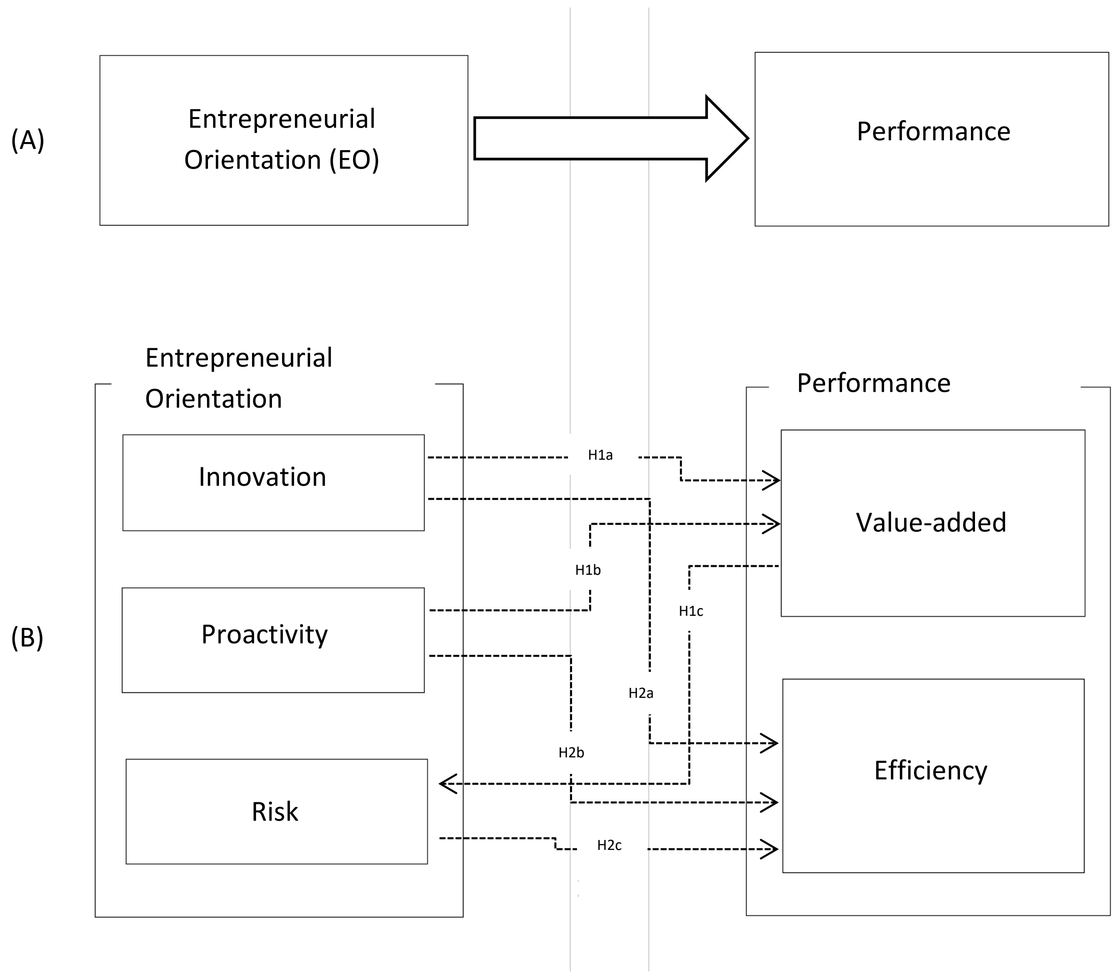

Figure 2 Empirical model