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Impact of ICTs on Innovation and Performance of Firms: Do Start-ups, Regional Proximity and Skills Matter?

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Abstract: Managers need to better understand how information and communication technologies (ICTs) lead to informed decisions about the investment and advantages of such technologies. However, at best, the empirical evidence on the business value of technology is mixed in relation to small firms. A total of 43 firms satisfied the study's definition of start-ups. The final survey included 54 questions on access to and use of ICTs, innovation, firm characteristics, as well as the participants' demographics, of which 11 factors were analyzed as part of this study. We found compelling evidence to support the positive effects of ICTs on firm-level innovation and performance based on the primary survey data of 270 small and medium enterprises (SMEs) operating in an Australian regional area. Moreover, we found that ICT strategies and skills are important factors that drive innovation and the overall performance of SMEs. In addition, various conditions, such as an agile workplace culture and international trade, can help firms improve their performance. Young businesses, particularly start-ups with ICT skills, show an improved innovation capability. However, remoteness appears to influence innovation negatively for nascent firms. Thus, managers should focus on improving ICT skills, strategies, and networking that help facilitate tangible ICT investments to foster innovation and growth.

Keywords: information and communication technology; innovation; regional Australia; small and medium enterprises; start-ups

JEL Classification: D22; O31; P25

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1. Introduction

Firms need to improve their internal capabilities to cope with external changes in this era of digitalization, globalization, and COVID-19. Disruptive information and communication technologies (ICTs), such as the Internet of things, mobile technologies, big data, and artificial intelligence, continue to influence the firms' operational environments and are dramatically reshaping and transforming existing business models [1,2]. New business opportunities and models continue to emerge using ICTs [2–4]; however, not every business can leverage these opportunities via technology [5,6]. The mixed results in the business value of technology across firms are evident in the literature [7,8], which has led to an ongoing research debate.

Small and medium enterprises (SMEs) in Australia, which are classified as businesses with fewer than 20 and 21–200 employees, respectively, account for almost 99.9% of businesses. Small businesses alone account for 93.8% of all employing businesses, employ 44% of Australia's workforce, and contribute 35% of Australia's gross profit [9]. It is observed that firms are increasingly adopting digital tools across all aspects of their operations to improve their outcomes as a business, and SMEs are no exception [10–12]. Studies show that ICT can help firms integrate into global markets through reductions in border operation costs, facilitating greater access to vital innovation assets [13–15]. Yet, despite the benefits and opportunities digital technologies bring and the significant increase in uptake in recent years, many SMEs continue to lag in adoption [4,5,10,16].

During COVID-19, consumers moved dramatically toward online channels, and firms and industries have responded largely in turn. According to a recent global survey [17], firms in all sectors and regions have accelerated the digitization of their customer, supply chain interactions, and internal operations by three to four years due to the pandemic. Despite the spike in ICT adoption among firms, the performance gap persists [18,19]. Returns from ICTs have never been straightforward and are not limited to simple technological adoptions. Rather, certain confounding factors can leverage these returns, including firms' innovation behavior, skills, leadership, and workplace culture [18,20].

Despite the large body of literature, gaps in the understanding of the performance effects of ICTs on regional firms exist. The present study fills these gaps by considering the case of the Western Downs Region in Australia. SMEs' use and performance of ICTs in the Western Downs Region in Queensland represent an interesting case. The region is a local government area in Queensland, Australia, with a resident population of approximately 33,000 people and a gross regional product of AUD 3.9 billion as of June 2018 [21]. Although the accumulated economic performance of the region has improved over time, a close investigation of the data indicates that large disparities exist in terms of economic performance across different sectors, with a shrinking economic contribution from numerous sectors. This finding reflects major downsides in the region's economy. The mining boom has masked the new reality for most economic sectors, with certain ones experiencing sluggish growth. These differences have implications for the labor market, equitable income, the well-being of the population, future growth potential, and the sustainability of the regional economy.

This study contributes to the existing literature in three ways. Firstly, to the best of the authors' knowledge, the present study is the first of its kind to use firm-level survey data in the Australian regional context. Secondly, the study analyzes the differences between start-ups and established firms in terms of the effects of ICT activity on innovation. Lastly, the study explores additional channels (i.e., organizational culture and ICT skills) to leverage returns from investment in new technology.

The rest of this paper is organized as follows. The next section summarizes previous studies related to the present study and develops the research hypotheses. Section 3 describes the research methods used to analyze the data, including data sources, as well as sampling and estimation techniques. The empirical results are presented in Section 4 along with the interpretation of the results of the robustness tests. The final section concludes the study with policy recommendations and future research directions.

2. Literature Review

2.1. The Resource-Based View (RBV) Framework

The resource-based view (RBV) posits that some tangible (capital, assets, ICT, equipment) and intangible (entrepreneurial abilities, skills, patents, R&D activities) resources have certain qualities that help firms acquire a unique competitive advantage. Many scholars have applied the RBV across different organizational settings to indicate how the theory drives competitive advantage for firms [22–24]. For example, although start-ups face liabilities of newness, smallness, and are pandemic prone [25,26], the ones with a well-endowed stock of tangible and intangible resources can expand their product lines into new industries [27].

RBV has emerged as an influential theory of firms' strategic choices to attain and sustain competitive advantage in a dynamic market. Studies show that RBV supports firms that face serious competition for their products and resources [22,28]. Although RBV has been applied across different organizational levels, the use of RBV in start-up studies has been gaining pace [29–31]. Given the resource limitations that often plague start-up firms, the RBV has been considered a useful framework for analyzing their resources that may offer them some competitive advantage [32]. The application of RBV in entrepreneurial firms has solely focused extensively on strategic positioning, economic growth, and internationalization of operations [33].

RBV is crucial for a firm's growth, as it emphasizes the need for heterogeneity in the firm's capability and resources. Studies indicate that proper alignment and rational use of critical resources impact a firm's performance in terms of its growth, expansion, and survival [27,34]. Start-ups and nascent firms with better resource endowments have greater success rates. For example, with regard to US start-ups, the presence of higher start-up capital, better entrepreneurial skills in the form of education, and prior experience contribute positively toward firm survival, leading to higher competitive advantage outcomes [35]. Caseiro and Coelho [34] also explored the effects of business intelligence on start-ups' performance in Europe. The study concludes that business intelligence capacities significantly impact start-ups' network learning, innovativeness, and performance [34]. Such findings confirm that start-ups need a sufficient endowment of resources to survive and thrive.

However, to date, much of the research on RBV as a strategic advantage choice for growth has focused almost entirely on large incumbent firms [22,24]. Adding to this, the existing literature on RBV that does examine ICT as an innovation strategy for start-ups does not explore other important channels, such as organizational culture and ICT skills, through which returns from investment in new technology can be leveraged. Furthermore, there has been a lack of firm-level data that allow rigorous analysis of how ICT affects innovation in start-ups, particularly from a regional context. We, therefore, draw upon the RBV and start-ups literature to build the hypothesis of the study.

2.2. ICT, Innovation, and Firm Performance

Despite certain disagreements, firm-level studies generally provide compelling evidence of the strong positive effect of ICTs on performance [1,36–38]. The effect of ICTs on the improvement of external and internal communication plays a major role in the innovation performance of SMEs [39,40]. Furthermore, the use of broadband internet has been found to have a positive impact on innovation among SMEs [41,42]. Several studies have reported that ICT assists small businesses in increasing productivity, efficiency, and performance [37,43–45]. For example, Taştan and Gönel [46] observed a positive impact of ICT on firm-level productivity in Turkey using a novel longitudinal data set. Similarly, in a sample of Australian firms, Leviäkangas et al. [47] found a positive impact of ICTs on firm productivity.

In the context of the COVID-19 outbreak, much research has suggested that the adoption of digital technologies plays an important role in crisis responses, particularly among SMEs [48–51]. Guo [49] used a data set from a survey with 518 Chinese SMEs to examine the relationship between SMEs' digitalization and their public crisis responses. The empirical results show that digitalization has enabled SMEs to respond effectively to the public crisis by making use of their dynamic capabilities. Elsewhere, Akpan et al. [50] shared that the absence and non-adoption of digital technologies in SMEs explain why business activities in most developing regions remained shut during the outbreak of SARS-CoV-2 and the community lockdown to contain the COVID-19 pandemic. The study suggests that strategies to survive the 'new normal' imposed by COVID-19 and fierce global competition includes a successful adoption of advanced technologies.

The development of the business or strategic networks by start-up enterprises appears to facilitate activity toward important resources that are inclined to result in a strong

commitment to organizational innovation, thereby increasing a firm's performance [34,52]. Developing a strategic network, for instance, is equally valuable for small and large businesses [53]. Here, SMEs, especially nascent firms, may not always possess the resources they need to pursue innovation. Acquiring new knowledge that is offered through networking helps augment the knowledge gaps of existing SMEs through RBV, such that engaging in upstream and downstream networks may significantly lift a nascent firm's performance [54]. That is, network connections enable new relational platforms for firms, thus harnessing innovation via learning and knowledge acquisitions [55–58].

Innovative capacity appears to be important to the success of family firms because it fosters entrepreneurial activities that can enhance profitability [58–60]. However, despite strong evidence of the positive link between innovation and firm performance, not all research is supportive of this conclusion [61,62]. This is because while some start-up firms quickly develop their product offerings, other nascent SMEs may need significant time developing their innovation and ICT skills, e.g., technology-driven intervention to create a new product, process, and business model [63,64]. Additionally, some nascent firms are business incubators and accelerators in protective intellectual property environments that depend on strategic networking and trust [65,66], given that different types of network participation, such as formal industry networks [67] and informal social interactions [68], take longer to develop [64] and to culminate in higher performance.

Moreover, the literature argues that SMEs are likely to boost their performance through improved internationalization because they have the advantage of economies of scale, competitiveness, improved resource utilization, better services, and a variety of government incentives [69,70]. There are also comparative advantage claims that SMEs with international exports are more likely to have improved performance than those without internationalization [71]. However, SMEs face a liability of foreignness when competing in international markets owing to information scarcity, lack of expertise, and managerial incompetence, thereby suffering from scale and resource disadvantages [72–74]. In addition, a number of studies have determined the positive contributions of an agile and flexible organizational culture on a firm's performance [75–77]. This finding is consistent with previous studies that found firms obtain a competitive advantage through the implementation of innovative strategies to exploit opportunities. For instance, the more ambidextrous and nascent SMEs—firms that can simultaneously exploit existing knowledge while exploring new knowledge and ideas [78,79]—could be expected to foster increased innovation capabilities through the production, promotion, and implementation of new products and services. Recent studies have found that IT systems strongly influence ambidexterity performance when the right IT mechanisms are enabled [80] and that to fully leverage IT capability, SMEs need to invest in managerial and technical capabilities [81].

Recent Australian studies have claimed that inequalities exist in ICT activities in less technologically advanced communities compared with their metropolitan counterparts [82–85]. Taken together, these studies confirmed that demographic, political, and socioeconomic factors account for such a disparity. ICT inequality is evident between SMEs and large firms in rural Australia compared with those in major metropolitan cities [86,87]. ICT activity in metropolitan and other areas in Australia shows improvement, but compared to the situation elsewhere, inequalities in the access to ICTs in rural and remote areas continue to exist [88,89]. We believe this is particularly alarming within a regional context and should be reversed through relevant policy settings by implementing industry and government initiatives, and by giving greater prominence to the role of ICT or technology-driven innovation. For instance, recent research shows that innovation outcomes, e.g., new exploration and SME performance, can be directly attributed to how SMEs acquire and use ICT applications, such as cloud services [90], while a positive influence has been found between SMEs' strategic networks offline (in person) knowledge sharing among managers representing networked organizational actors and performance [58].

2.3. Start-ups, Innovation, and Performance

In light of COVID-19's far-reaching impact on all areas of life, and especially on the economy and business sector, studies have indicated that some firms have thrived and even accelerated, while others, such as small businesses and start-ups, face significant decline [26]. Start-ups tend to be more concentrated in sectors that have been directly affected by the COVID-19 response measures and are typically more credit constrained than larger businesses [91]. However, studies show that the epidemic and the resulting lockdowns have accelerated and magnified the impact that technology can have on some organizations' business models, particularly start-ups [26,27].

In regional economies, despite the threats posed by the COVID-19 pandemic, start-up enterprises are assumed as sources of innovation, job creation, and economic development [92,93]. Start-up enterprises have emerged as a driving force of change and are regarded as an engine for economic growth [94,95]. Furthermore, while innovation is an important driver for the advancement and survival of start-ups, established firms perceive innovation as a continuous action within their business model due to the ICT disruptions and threats [96]. In this regard, the higher the variety in the combination of ICTs in a region, the higher the number of innovative start-up enterprises [97]. Therefore, the diffusion of ICT creates an environment where start-ups can boost their innovation activities. However, research that explores the innovation practices of start-ups with those of mature firms is limited. Studies that have undertaken this comparison have mostly focused their arguments on the effects of a firm's age on its innovativeness [98–100]. For example, one study explored how the relationship between knowledge maturity and innovation value depends on firm age and size and found that mature and larger firms have greater capability to outperform younger ones by employing mature knowledge to be more innovative [100]. The differences between start-ups and established firms in terms of the impact of ICT on innovation have not yet been unveiled, particularly from a regional perspective.

To summarize, previous studies have investigated the impact of ICTs on innovation and firm performance. However, no study has examined the difference between start-ups and established firms concerning the effects of ICT activities on innovation and firm performance in a regional context. That is, variations in regional areas have not received due attention on this topic in the literature. Therefore, a comparative study between start-ups and established firms on the impact of ICTs on innovation and firm performance, with a specific focus on regional Australia, is significant. In addition, this research contributes to the extant literature by exploring additional factors (e.g., culture of an organization and ICT skills), which may assist in leveraging returns from the investment in new technology.

3. Research Method

3.1. Data and Sample

The data were collected from SMEs operating in the Western Downs Region of Queensland, as illustrated in Figure 1, which is a regional local government area in Australia. Start-up enterprises were defined in this study as those with an age of five years or less, with six or fewer employees and the potential to scale up in the future. The rest of the sample was treated as established firms. From a population of over 2000 businesses in the region, 1000 businesses were initially selected at random from four local areas, namely, Chinchilla, Dalby, Murilla–Wandoan, and Tara. The survey instrument was pre-tested on 20 participants from the study area to check the validity and appropriateness of the wording, format, and question sequence. The questions were refined based on the pilot outcomes. The final survey included 54 questions on access to and use of ICTs, innovation, firm characteristics, as well as the participants' demographics, of which 11 factors were analyzed as part of this study.

Figure 1. Study area map. Source: Western Downs Regional Council, Queensland, Australia.

The SMEs were contacted by telephone and asked whether they were prepared to answer the survey over the telephone, by mail, online, or in person. A total of 270 (90%) surveys from the 297 participating businesses (29.7% response rate) were retained for the final analysis. Among the survey, 67% was carried out via telephone interviews, approximately 30% was answered via mail and in-person visits, and approximately 3% was completed online. A total of 27 surveys out of the 297 was discarded owing to missing/unavailable data. The owner, general manager, or the ICT manager of the surveyed SMEs was asked to complete the questionnaire. A total of 43 firms satisfied the study's definition of start-ups, which represented nearly 16% of the entire sample. The constructs measured in the survey are discussed in the following section.

3.2. Methods

The existing studies have confirmed that ICTs promote a firm's productivity [36,38]. Furthermore, ICTs enhance innovation by improving the firms' responsiveness to market changes and by assisting in the introduction of new products and services [101–103]. Melville et al. [104] aligned previous studies with dynamic capability theory and claimed that ICTs enhance the efficiency and innovation of a firm with dynamic capabilities, while

within the RBV framework, strategic networks are an important factor in building ICT and innovative capability more generally [57,58]. However, an ICT alone cannot augment organizational performance if it is not applied innovatively (Brynjolfsson and Saunders, 2010). That is, following the proposition of innovation translation theory, an ICT cannot augment the performance of a firm if organizational resources and work processes are not improved or altered accordingly [105,106].

Two measures of firm performance were used in the present study: (i) innovation and (ii) a composite measurement of overall financial performance consisting of profitability and the relative performance of a firm. The two models were hypothesized to relate firm innovation and performance to ICT skills, workplace culture, international activity, and remoteness. The rationale behind the selection of these variables was rooted in the theoretical framework of the study (Section 2.1) and the existing literature (Sections 2.2 and 2.3). Table 1 lists the existing literature on the basis of which the respective variables were selected. Based on the discussions in the preceding paragraph and on the review of literature, two estimation equations were developed by using the probit regression as follows:

$$\begin{aligned}\text{Innovation}_i = {} & \beta_0 + \beta_1\ \text{Firm performance}_i + \beta_2\ \text{ICT skills}_i + \beta_3\ \text{Culture}_i \\ & + \beta_4\ \text{Internationalization}_i + \beta_5\ \text{Remoteness}_i + \beta_6\ \text{Start-up}_i + \beta_7\ (\text{Start-up} \times \text{ICT skills}_i) + \beta_8\ \text{ICT Strategy}_i + \varepsilon_i\end{aligned} \quad (1)$$

$$\begin{aligned}\text{Firm performance}_i = {} & \beta_0 + \beta_1\ \text{Innovation}_i + \beta_2\ \text{ICT skills}_i + \beta_3\ \text{Culture}_i \\ & + \beta_4\ \text{Internationalization}_i + \beta_5\ \text{Remoteness}_i + \beta_6\ \text{No of employees} + \varepsilon_i.\end{aligned} \quad (2)$$

The dependent variable in Equation (1) was a dichotomous or binary outcome variable. In Equation (1), innovation was considered to be determined by a firm's performance, ICT skills, agile management culture, internationalization, remoteness, start-up status, ICT strategy, and industry dummies. In addition, the models based on Equation (1) were estimated by using the probit estimation method, given the dichotomous characteristics of the data. The outcome variable is defined following a two-step procedure. Firstly, a composite index was formulated to measure the level of innovation activities in an enterprise. Principal component analysis (PCA) is used to develop a composite measure of innovation using four indicators reflecting the business's level of involvement in the product, process, marketing, and organizational innovation. Each of the innovation indicators was gauged by the perception of the respondents on respective innovation actions (5-point scale from 1 = 'greatly decreased' to 5 = 'greatly increased'). In the second step, an enterprise is labeled as being innovative if the composite score of innovation index is greater than the mean value (0.6863), and as not innovative otherwise. The overall financial performance of firms was proxied with a composite indicator that consisted of two indicators, namely, profitability and relative performance. Principal component analysis (PCA) was used to construct a composite index to define the overall financial performance of a firm. PCA is used to address potential multicollinearity issues in multiple linear regression models when the covariates are potentially correlated with one another [107]. Moreover, building a composite index is a more comprehensive approach than modeling equations with single indicators because it inherits the aggregate effect of all the indicators [108]. In the current study, ICT skills refer to the level of digital skills of employees required to perform day-to-day tasks at the workplace. A business enterprise is labeled as a start-up firm if the firm remained in the business for 5 years with employees of fewer than 6 persons.

The models based on Equation (2) were estimated by using seemingly unrelated regressions (SUR). The SUR is a suitable method for assessing the impact of an explanatory variable that has a possibility of jointly determined decisions with one another [109]. This situation may occur in the present study, as innovation and performance may influence each other simultaneously. Thus, the estimation of the SUR model can potentially solve this endogeneity problem [110].

The summary statistics (i.e., mean and standard deviations) are reported in Table 1 for an overview of the cross-sectional characteristics of the data. Table 1 indicates that the firms' mean value of innovation (0.5148) was much lower than their profitability score (0.7682, if

rescaled from 0 to 1). This finding may indicate the problem of regional enterprises with innovation. The average value of the ICT skills of employees was below the moderate level, with a mean score of 2.9259. A simple tabulation showed that a significant portion, 43.33% of the staff, had a low level of ICT skills (i.e., scoring below 3 on a scale of 5). The mean score for ICT strategy was 0.2222, thereby indicating the low profile of regional SMEs. Furthermore, the data indicated that the majority of the firms (74.07%) operated their businesses from remote locations. Accordingly, the mean value for remoteness was high, at 0.7407.

Table 1. The definition of variables, summary statistics, and rationale for selection.

Variable	Definition	Mean	Std. Dev.	Reference
Innovation	A dummy variable indicating whether a firm is innovative (1) or not (0).	0.5148	0.5007	Gërguri-Rashiti, Ramadani [37], Yunis, El-Kassar [38]
Profitability	A multinominal categorical variable indicating the profitability of a firm (3-point scale from 1 = 'unprofitable' to 3 = 'above average profitable').	2.2556	0.5567	Huang, Lai [111], Steinfield- et al. [112]
Relative performance	A multinominal categorical variable indicating (3-point scale from 1 = 'worse' to 3 = 'better').	2.4000	0.5936	Steinfield et al. [112]
Financial performance	A composite index developed to measure the level of overall financial performance of a firm using PCA. It is a composite measure of two indicators: (i) profitability and (ii) relative performance. The outcome of PCA is the composite indicator—the overall financial performance of a firm (3-point scale from 1 = 'bad' to 3 = 'good').	2.3278	0.4572	Huang, Lai [111], Steinfield et al. [112]
ICT skills	A multinominal variable indicates the extensity of ICT skills of employees required to conduct day-to-day business activities (5-point scale from 1 = 'very low' to 5 = 'very high').	2.9259	1.3990	Yunis et al. [38]
Agile management culture	Agile management culture is measured on 5-point Likert scale questions. The item is based on 'Our work environment is a positive and friendly place to be' (5-point scale from 1 = 'not true at all' to 5 = 'very true').	3.5185	0.8696	Naranjo-Valencia et al. [113]
Internationalization	A multinominal variable indicates the share of revenue of a firm from international export activities.	2.0370	0.7847	Loth and Parks [114], Pangarkar [115]
Remoteness	A dummy variable indicating whether a firm is located in rural and remote areas (1), namely, Miles, Moraby, Cardamine, Wandoan, Cockatoo, Tara, Goranba, Teelba, Glenmorgan, Dillham, and Lenaubyn, or in major town centers (0).	0.7407	0.4390	Stockdale and Standing [116]
Start-up	A dummy variable indicating whether a firm has remained in the business for 5 years with employees of fewer than 6 persons (1) or not (0).	0.1593	0.3666	Colombelli, Krafft [117], Katila and Shane [118], Criscuolo, Nicolaou [119]
ICT strategy	A dummy variable indicating whether a firm has an ICT strategy (1) or not (0).	0.2222	0.4165	Gërguri-Rashiti, Ramadani [37], Yunis, El-Kassar [38]
Number of employees	Number of employees currently working in the enterprise.	8.2963	16.6153	Gërguri-Rashiti et al. [37]

4. Empirical Results

4.1. Drivers of Innovation

Table 2 demonstrates the probit regression estimates of the determinants of the firms' likelihood to implement innovation. Three alternative models are estimated. Model 1 is the basic model and includes the industry dummies. Model 2 is estimated by the inclusion of the industry dummies, while Model 3 includes additional controls, such as ICT strategy, start-ups, and an interaction term between start-ups and ICT skills. The results are discussed below.

Table 2. The determinants of firms' propensity to implement innovation.

Dependent Variable: Innovation	**Models**					
	1		**2**		**3**	
	Coef.	**SE**	**Coef.**	**SE**	**Coef.**	**SE**
Financial performance	0.6989 *	0.1873	0.6618 *	0.1909	0.6500 *	0.1911
ICT skills	0.2644 *	0.0608	0.2577 *	0.0616	0.2109 *	0.0706
Agile management culture	0.1720 ***	0.0946	0.1776 ***	0.0956	0.1991 **	0.0973
Internationalization	0.1417	0.1105	0.1467	0.1127	0.1403	0.1118
Remoteness	−0.4161 **	0.1899	−0.4289	0.1946	−0.4657 **	0.1929
Start-up					−0.1953 ***	0.5126
Start-up × ICT skills					0.0728 ***	0.1635
ICT strategy					0.4746 **	0.2181
Industry agriculture			−0.2996	0.3401		
Industry manufacturing			0.5625 **	0.3333		
Industry services			0.1921	0.3046		
Constant	−2.9466 *	0.5097	−2.5832 *	0.6449	−2.8330 *	0.5768
LR chi-squared	53.1000 *		57.1400 *		57.9600 *	
Pseudo R-squared	0.1419		0.1528		0.1594	
N	270		270		270	

Notes: Coef. = Coefficient, SE = Standard error. *, ** and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The financial performance of the firms is consistently found to drive innovation, as the relevant estimates are significant at the 1% level in all three models. Among the different drivers of innovation, ICT skills and agile management culture are found to be highly positively significant (at the 1% level). This finding is consistent with previous studies [13,14]. Remoteness is found to have a negative association with innovation, thereby indicating that firms operating in remote areas are less innovative than those operating in town centers. The result is plausible, given the context that remote businesses have predominantly relied on traditional sectors, such as agriculture, which are less innovative compared with other sectors, such as manufacturing and services (see estimates of Model 2). However, the positive effect of internationalization is found to be statistically insignificant across all specifications. In Model 3, the coefficient related to start-ups is found to be negative and significant at the 10% level. The results indicate that start-ups are less likely than mature businesses to be innovative in regional areas. This may partly be explained by the age and experience of mature firms. That is, more mature firms are more likely to engage in collaboration in respect of ICT innovations, given that they already understand the importance of sharing resources and/or learning from other more established businesses through observation and experience [64,120]. However, the interaction effect of ICT skills and start-ups is found to drive innovation in firms positively.

Table 3 reports the SUR estimates of the drivers of firm innovation. The results from the SUR estimation remain consistent with the probit estimations populated in Table 2. The estimates in Table 3 reveal that profitable firms with ICT-skilled staff and operating businesses in regional town centers with better workplace cultures are likely to implement innovation. The SUR estimates corroborate the baseline findings, thereby indicating that remoteness negatively affects the innovation performance of start-up enterprises.

Table 3. The determinants of innovation using SUR.

Variables	Dependent Variable: Innovation	
	Coef.	**Robust SE**
Financial performance	0.4593 *	0.0613
ICT skills	0.0849 *	0.0205
Agile management culture	0.0443 *	0.0337
Internationalization	0.0320	0.0358
Remoteness	−0.1806 *	0.0651
Start-up	−0.0156 **	0.0774
Constant	−0.8927	0.1791
Chi-squared	101.0000 *	
R-squared	0.1452	
N	270	

Note: * and ** at the 1% and 5%, respectively.

The above results indicate that innovation is endogenously determined by financial performance, skills, and culture. Financially capable firms, therefore, show a better capacity (e.g., in terms of resource allocation) to innovate. Consistent with the theory of dynamic capability, the results support the view of investment in human-capacity-building activities (e.g., ICTs skills), as this can positively influence the innovation performance of firms [12,104]. Investment in ICT skills is particularly important for the start-ups struggling with innovation performance in remote and regional areas.

4.2. Drivers of Performance

The SUR estimates of the drivers of firms' financial performance are populated in Table 4. Firm innovation and workplace culture appear as significant drivers of improved performance. This finding is congruent with that of previous studies [6,12]. In terms of the impact of the firms' international activities on their performance, the results reveal that international activities appear to have an insignificant impact on the overall financial performance of a firm. Though the results from most studies confirmed a positive impact of internationalization on business performance, scholars urged that the association between these two variables is more complex within the context of SMEs, especially within early internationalized enterprises [121,122]. This non-existence of any association between internationalization and business performance could be explained by virtue of how we defined internationalization in our study. Internationalization consists of both structural (number of countries where a business operates, number of international franchises, proportion of foreign suppliers, etc.) and performance indicators (export income, share of export revenue, and liabilities of foreign suppliers, etc.) [123]. However, in the current study, we defined internationalization only in terms of performance indicators. In addition, regional proximity is found to play a key role in driving improved firm performance among regional SMEs, given that firms operating in major towns perform better than those in rural and remote areas. The size of a firm, which is measured by the number of employees, is found to have a significant positive association with the overall financial performance and indicates that large firms are better placed to exploit new technologies and have a large availability of resources as well as an increased ability to benefit from economies of scale. ICT-skilled

staff do not influence firm performance significantly, but an agile management culture does. Investment in ICTs is therefore found to spur the financial performance of firms indirectly through the channel of innovation.

Table 4. The determinants of firms' overall financial performance using SUR.

Variables	Dependent Variable: Financial Performance	
	Coef.	SE
Innovation	0.4066 *	0.0542
ICT skills	0.0099	0.0202
Agile management culture	0.0421 **	0.0316
Internationalization	0.0193	0.0341
Remoteness	0.1875 *	0.0615
Start-up	−0.0877	0.0728
No of employees	0.0025 ***	0.0016
Constant	1.8147 *	0.1343
Chi-squared	83.8200 *	
R-squared	0.0978	
N	270	

Note: *, ** and *** indicate statistical significance at the 1% and 5%, respectively.

4.3. Robustness Checks

This study employs fully observed recursive mixed-process models in addition to SUR estimation, which are appropriate for two broad types of estimation situations: (i) one in which a truly recursive data-generating process is hypothesized and fully modeled; and (ii) one in which simultaneity exists and instruments allow a structure with a recursive set of equations, such as the two-stage least squares. The simultaneous estimation of the innovation and performance equations is enumerated by using conditional mixed-process models to address the potential endogeneity problem. The empirical results are recorded in Table 5, and the results are consistent with those of the probit and SUR estimations.

Table 5. Simultaneous estimation of innovation and overall financial performance using CMP model.

Variables	Dependent Variable: Innovation	
	Coef.	SE
Financial performance	0.6968 *	0.1880
ICT skills	0.2638 *	0.0610
Agile management culture	0.1743 ***	0.0960
Internationalization	0.1408	0.1107
Remoteness	−0.4134 **	0.1909
Start-up	−0.0313	0.2293
Constant	−2.9430 *	0.5664
Variables	**Dependent variable: Financial performance**	
	Coef.	**SE**
Innovation	0.2141 *	0.0556
ICT skills	0.0091	0.0203
Agile management culture	0.0572 ***	0.0317
Internationalization	0.0290	0.0342
Remoteness	0.1651 *	0.0615
Start-up	−0.0935	0.0729
No of employees	0.0027 ***	0.0017
Constant	1.8007	0.1343
Log likelihood	−154.5615	
LR chi-squared	39.5400 *	
N	270	

Note: *, ** and *** indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

5. Conclusions and Recommendations

The aim of this study was to examine the effects of ICTs use on firm-level innovation and performance based on primary survey data of 270 small and medium enterprises (SMEs) within a regional area of Australia. The study found that ICT strategies and skills are important factors that drive innovation and the overall performance of SMEs where financial performance consistently drives innovation. Here, the key resources included ICT-skilled staff and agile management culture. The remoteness of SMEs was found to have a negative association with innovation when compared to town centers, perhaps highlighting the preference for agricultural over manufacturing innovation in the more remote regional areas. Moreover, this finding also lends support to existing research that a one-size-fits-all approach to the study of innovation in SMEs may not be appropriate [64,102] and that SME size favors more medium-sized innovative businesses than smaller or nascent businesses due to the increased networking capability and experiences of these firms [123–125].

This study confirms existing research and makes several new novel contributions to the SME innovation literature. First, start-up and nascent SMEs lag behind their larger counterparts regarding the introduction of innovation, suggesting that enterprises with ICT-skilled staff are more likely to facilitate and implement innovation. This is perhaps not surprising, given that nascent and early incubator firms are still in their infancy and have not established the necessary resources and ICT skills and processes required for technology-led innovation. Second, and in support of existing research, SME size was found to have a significant positive association with the overall financial performance, suggesting that larger firms are better placed to exploit new technologies based on the available resources and economies of scale. Third, the study makes an important contribution to policy and to the existing literature about Australian regional SMEs that may also be appropriate for SMEs of other global regions. Given that start-ups are less likely to embrace innovative activities compared with established firms, capability development measures and incentives from regional development agencies are required to assist SMEs to build ICT skills that can help facilitate innovation in relatively new businesses. Specifically, policies that promote ICT skills and processes can positively impact and drive innovation among start-ups. Therefore, the Australian government should recast its policies to encourage start-up enterprises in regional areas, particularly firms in remote areas that are operating in the early stages of their life cycle. To this extent, our findings support the view that start-up businesses or SME nascent firms, including early incubators, lack the necessary economic, social, and structural resources to be innovative. Since start-ups in rural and regional areas are generally inclined to suffer from a lack of managerial competencies, finances, and ICT-driven innovation, connecting them to a variety of organizations, such as innovation hubs and educational as well as financial institutions, can ensure that those in regional areas receive the required skills and adequate financial support they require.

Fourth, government and local regional industry should search for ways to establish inter-organizational collaboration across a network of regional partners where prior research has indicated strong innovation outcomes [125–127], much of which could originate from government and industry funding. For instance, in the current paper, we started by explaining how SMEs could benefit from the resource-based view. Here, firm tangible assets refer to all assets, processes, capabilities, firm attributes, information, knowledge controlled by a firm to increase efficiency and effectiveness [128], while intangible assets relate to knowledge, information, and ideas [129,130]. While the latter was not the focus of the current research specifically, linking nascent firms to larger firms and/or larger SMEs to broader networks can foster innovation, resulting in higher performance for the emerging nascent firms. Similarly, intangible assets related to knowledge and information are called knowledge-sharing routines (KSRs) [131,132]. Accordingly, policy settings in regional areas should indicate how to connect disparate actors, given that strategic networking potentially advances both RSAs and KSRs across innovating firms, both nascent and larger SMEs. Using an RBV logic suggests that SMEs can achieve above-average rents through complementarity and heterogeneous resources that create a resource-based advantage [126].

More specifically, we see inter-organizational collaboration within a network of partners as an important driver of innovation performance, consistent with previous research [124,125], including linking ICT and technology-driven innovative ideas, products, and processes, particularly in small nascent SMEs.

6. Implications for Future Research

This study has certain limitations that should be an avenue for future research. Firstly, further research should consider a large sample across different regions to verify the assessment of ICT activity and innovation among start-up enterprises, while future studies might consider all interaction effects in the estimation equations used in the model. Secondly, this study did not attempt to measure the influence of different types of innovation in a regional context, which could be considered in future research. For instance, scholars have followed various techniques to foster innovation, such as design-driven [132], market-driven [131], technology-driven [133], social- or employee-driven [131,132], and open innovation [134,135], among others. Open innovation [135], as an example, may be particularly relevant for both nascent and developing SMEs to larger more established entities, since it provides practice for accessing external knowledge from a diverse typology of sources and actors [135]. Open innovation has been defined as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model [135]. Therefore, future studies might explore how open innovation together with technology-driven innovation facilitate strategic networks of complementary RSAs and KSRs. Taken together, future research might shed light on the relationship between ICT activity, different types of innovation and the performance of SMEs. Lastly, an examination of the effect of the adoption of ICT on the innovation and performance of SMEs in different industry sectors would be useful.

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