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Entrepreneurial Cognition and Innovation Productivity: The moderating role of Knowledge Intensity

Abstract

Using a longitudinal dataset from 202 innovative New Zealand SMEs, this paper investigates the effect of adaptive metacognition of the CEO on innovation productivity. Previous research has shown the importance of entrepreneurial cognition – as part of the entrepreneurial human capital - as well as the importance of external and internal knowledge sources in pursuing innovation. This study shows that the higher levels of adaptive metacognition of the CEO are associated with an increased capability of the venture to turn innovation inputs into innovation outcomes. The relationship is weaker in knowledge intensive industries since entrepreneurs have to synthesise and enact new knowledge.

Background and hypotheses

How entrepreneurs make decisions to adapt to external pressures from their uncertain business environment has been a longstanding concern of entrepreneurship scholars (Shepherd et al., 2015; Hitt et al. 1998). Recently, the cognitive perspective has become more prominent to examine how entrepreneurs make sense of such uncertain environments and use knowledge structures (heuristic or scripted) for innovation decisions (Mitchell et al., 2007). The aim of this research is to explore how the cognitive adaptability of CEOs of New Zealand small-and-medium sized companies (SMEs) influences innovation productivity in SMEs, and whether this relationship is moderated by family ownership. Entrepreneurs employ different types of cognitive strategies to process new information and make decisions (Haynie et al., 2010). This variation makes it all the more essential to understand how the cognitive adaptability of CEOs, conceived as a process-orientated decision performance measure particularly suitable in dynamic and uncertain environments, influences both decision-making processes in general and the innovation productivity of their SMEs in particular – yet such understanding is still far from settled (Haynie and Shepard, 2009).

Haynie et al. (2012) define cognitive adaptability as: *The ability to effectively and appropriately evolve or adapt decision policies (i.e., to learn) given feedback (inputs) from the environmental context in which cognitive processing is embedded* (p. 238). In that context, leveraging one's prior entrepreneurial knowledge is one important ability in adapting to change in the business environment (Haynie et al. 2010). Building on Haynie and Shepard (2009), we empirically explore how the cognitive adaptability of the CEO affects innovation productivity, by looking at two theoretical dimensions: metacognitive knowledge, and metacognitive experience.

Metacognitive knowledge relates to the CEO's conscious knowledge of themselves, people, tasks and strategy (Flavell, 1987). On the one hand it therefore concerns internal knowledge, including how individuals think about themselves and their awareness of their values and preferences as well as awareness of their own capabilities and limitations. (For example, a CEO may recognise that they are more competent at analytical than people skills). On the other hand, metacognitive knowledge also relates to external knowledge about the CEOs' stakeholders, the changing firm environment, and certain tasks (Haynie and Shepard, 2009). For example, metacognitive knowledge of tasks reflects how and when individuals utilise information in different situations (Haynie et al. 2012). Haynie et al. (2010) give the example of someone reviewing a business plan. If the person reviews a business plan for a potential strategic partnership, they may invest more time in the task than if they review a business plan as a judge in a competition for university students, and they will require different levels of information for each of these tasks. Overall, metacognitive knowledge describes the extent to which CEOs utilise their internal and external knowledge when

generating various decision-making frameworks aimed at an envisaged goal – such as pursuing incremental or radical innovation – within a changing environment (Haynie and Shepard, 2009).

Entrepreneurship literature suggests that a higher degree of metacognitive knowledge will be associated with higher levels of innovation productivity. In this vein, successful innovation is often linked to activation of entrepreneurial knowledge in the pursuit of opportunities (Companys and Mullen, 2007; Tang et al., 2012). For example, Shane (2000) found that entrepreneurs discover new opportunities based on knowledge they have acquired in the past. This knowledge can again relate to external factors about customers, technology and markets (Venkataraman, 1997; Wiklund and Shepherd, 2003), or equally to internal factors, such as how the entrepreneurs assess their own personal capabilities (Chen et al., 1998). Applying this to CEO leads us to formulate H1a:

H1a: A higher extent of metacognitive knowledge on the part of the CEO will be associated with higher levels of innovation productivity in SMEs

Metacognitive experience refers to how individuals draw on experience and recollections, intuitions and feelings when they are confronted with a difficult-to comprehend decision problem (Haynie and Shepard, 2009; Flavell, 1987). Past experience, emotions and intuitions might all shape how entrepreneurs respond to a new decision problem that is nevertheless related, at a metacognitive level, to old ones (Haynie and Shepard, 2009). For example, Baron (2008) argues that feelings and moods affect entrepreneurial cognition in several ways influencing the entrepreneurs' decision-making process and behavior. Thus, metacognitive experiences are an important second dimension informing how far CEOs rely on their experiences, recollections, intuitions and feelings when generating potential multiple decision-making frameworks in order to both make sense of, and take control of, a changing and complex environment (Haynie and Shepard, 2009).

Metacognitive experience may improve innovation productivity. Kickul et al. (2009) found that entrepreneurs with a cognitive preference to rely on intuition over analysis are more confident in their capability to recognise new opportunities, which suggests that they are more productive with regard to innovation. In addition, Mitchell et al. (2005) point out that intuition might be associated with innovation. Furthermore, a study by Baron and Tang (2011) found that positive emotions among founding entrepreneurs were associated with greater innovation at the firm level, in particular in firms operating in a dynamic environment. This leads to H1b:

H1b A higher extent of metacognitive experience on the part of the CEO will be associated with higher levels of innovation productivity in SMEs

The moderating effect of industry knowledge intensity

The relationship between adaptive metacognition and innovation productivity will be affected by the knowledge intensity of the industry through two mechanism. Knowledge intensive industries typically require more refinement of the knowledge base and the synthesis of at times incomplete or conflicting information, which makes the entrepreneurial endeavour more complex (Miller, 2007). For instance, Hmieleski and Baron (2009), studied the effects of environmental dynamism on the relationship between entrepreneurial experience, optimism and venture growth. They found that environmental dynamism reduces the effect of entrepreneur specific variables on performance. Moreover, knowledge intensive industries are also more prone to technological disruption and faster rates of innovation. Baron and Tang (2011) argue that dynamic environments require more innovation and entrepreneurs

need to address this need to innovate strategically. Overall, the research on the relationship between entrepreneurs specifically and new venture performance will be affected by the knowledge intensity of the industry. Applied to our study, this means that knowledge intensity will affect how both adaptive metacognitive knowledge and experience affect the innovation productivity of SMEs.

First, the effects of metacognitive knowledge on innovation productivity will be reduced as entrepreneurs will need to activate more prior knowledge and networks to make sense of the ambiguous innovation that surrounds innovation in these environments. Knowledge of the environment reduces uncertainty which means that the availability of multiple knowledge frames increases the chances to succeed. Chandler et al. (2005) have shown that the composition and dynamics of entrepreneurial teams can reduce the effects of environmental uncertainty on a venture. Applied to the context of the study of entrepreneurial cognition, this means that succeeding in uncertain environments will require higher levels of adaptive cognition when entrepreneurs draw on knowledge for alternative decision frameworks in identifying and exploiting opportunities (Garrett & Holland, 2015). Hence, higher levels of adaptive metacognition knowledge will be less effective in promoting innovation productivity as the knowledge intensity increases.

Second, the effect of knowledge intensity on the relationship between metacognitive experience and innovation productivity follows a similar logic. Higher levels of change and complexity of knowledge will increase the demands to use intuition (Blume, 2011), which will render metacognitive experience of the entrepreneur. Moreover, knowledge intensity will also increase the demands on entrepreneurial optimism and emotional resilience require that more information to be processed. Hence the benefits of metacognitive knowledge decrease with higher knowledge intensity. This leads us to formulate our second hypothesis.

H2a/b The relationship between adaptive metacognition (a) knowledge/ (b) experience and innovation productivity will be moderated by the knowledge intensity of the industry, in that the effect of adaptive meta-cognition on innovation productivity will be weaker in more knowledge intensive industries.

Method and results

To examine how the different dimensions of cognitive adaptability of the CEO influences the innovation productivity of SMEs, we collected data on NZ small-and medium sized companies on two levels, the individual level of the CEO and the firm level. The two surveys were conducted 4 years apart. Of the 314 businesses that responded to both surveys, 202 business had introduced an innovation between the two waves. To estimate innovation productivity, we conducted a Data Envelopment Analysis (DEA) to establish best practice amongst innovative business (Alperovych et al., 2015). As inputs, we used previous turnover; the investment in internal capability development for innovation, measured by assets (Wang et al., 2011); and the external information search strategy, measured by the number of sources of information for innovation (Freel and Robson, 2017). All these variables were measured in the first survey. As outputs, we used sales in innovative products and a factor measuring innovative performance relative to competition ($\alpha=.84$) developed by (Lynn and Akgün, 2003). Hence, the DEA analysis allowed us to combine objective and subjective measures of innovation performance.

In the second step, we regressed the innovation efficiency score obtained from the DEA analysis on the two factors of adaptive metacognition, namely metacognitive knowledge ($\alpha=.819$), metacognitive experience ($\alpha=.824$). The results are shown in Table 1 below.

INSERT TABLE 1 ABOUT HERE

We find support for H1a in higher levels of metacognitive knowledge are associated with higher levels of innovation productivity. Yet we do not find support the H1b, which tested the relationship between metacognitive experience and innovation productivity. Finally, we tested H2a/b, by inserting the interaction terms with knowledge intensity of the industry based on the OECD Oslo Manual. The F change for the addition of these terms is significant, which suggest support for H2a for metacognitive experience.

Discussion and Conclusion

We draw on the work of Haynie and Shepherd (2009) providing empirical evidence on how the metacognitive knowledge and experience of the entrepreneur impacts on innovation productivity of SMEs.

The paper makes two theoretical contribution to the strategy literature. First, the paper provides empirical evidence that the metacognitive knowledge of the entrepreneur as the key decision-maker impacts on the innovation productivity of the firm level. While there are strong bodies of literature on both, the importance of CEO's entrepreneurial human capital and different knowledge sources for innovation, the topics have mostly been treated separately.

Here, our study shows how the CEOs entrepreneurial human capital can be a conduit for innovation performance as CEOs use innovation inputs more frugally. In particular, the innovation productivity will depend on how well the CEO can activate past knowledge and experience (Shane, 2000) and draw on positive emotions and feelings (Baron and Tang, 2011) when generating multiple potential decision-making frameworks. Hence CEOs wanting to grow their business may need to start building their personal metacognitive abilities along with firm capabilities in the pursuit of new opportunities to innovate. Interestingly, while the ability to generate multiple frameworks is positively associated

Finally, the study also contributes to our understanding of the role of context in entrepreneurship as it shows that technology intensity is an important condition that affects the effectiveness of entrepreneurial human capital. That is, knowledge intensity if an industry increases the demands on the entrepreneurial human capital in the pursuit of innovation.

Word count: 1972

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Table 1: Innovation productivity on adaptive metacognition of the CEOs

	(1)	(2)	(3)	(4)	(5)
9-16 years	-0.0268 (0.0696)	-0.0433 (0.0690)	-0.0484 (0.0675)	-0.0346 (0.0698)	-0.0428 (0.0675)
17-35 years	-0.0525 (0.0641)	-0.0606 (0.0636)	-0.0547 (0.0622)	-0.0565 (0.0644)	-0.0444 (0.0625)
Older than 35 years	-0.111 (0.0660)	-0.107 (0.0652)	-0.106 (0.0638)	-0.108 (0.0662)	-0.0952 (0.0641)
CEO Age	0.00453*** (0.00134)	0.00442** (0.00133)	0.00438*** (0.00130)	0.00433** (0.00135)	0.00438*** (0.00130)
Years of industry	0.00226 (0.0281)	-0.00220 (0.0279)	-0.00108 (0.0272)	-0.00163 (0.0282)	-0.00222 (0.0272)
Experience					
Number of previous start-ups	-0.0384 (0.0302)	-0.0443 (0.0304)	-0.0467 (0.0294)	-0.0466 (0.0308)	-0.0431 (0.0297)
Background in Engineering	-0.0178 (0.0278)	-0.0159 (0.0279)	-0.0255 (0.0274)	-0.0190 (0.0285)	-0.0209 (0.0276)
Background in marketing	-0.00677 (0.0300)	-0.0117 (0.0299)	-0.00952 (0.0292)	-0.0115 (0.0304)	-0.0139 (0.0294)
Background in HR	-0.0433 (0.0300)	-0.0477 (0.0297)	-0.0448 (0.0291)	-0.0438 (0.0300)	-0.0437 (0.0291)
Background in international business	0.0129 (0.0375)	0.00931 (0.0372)	0.00456 (0.0364)	0.00860 (0.0381)	0.0153 (0.0370)
High-tech		0.0181 (0.0250)	0.0210 (0.0244)	0.0169 (0.0253)	0.0242 (0.0245)
Metacognitive knowledge (H1a)		0.0379* (0.0173)	0.0747*** (0.0182)		0.0889*** (0.0227)
Metacognitive experience (H1b)		0.000402 (0.0167)		0.0272 (0.0171)	-0.0216 (0.0207)
Metacognitive knowledge * High-tech (H2a)			-0.0783** (0.0265)		-0.113** (0.0344)
Metacognitive experience * High-tech (H2b)				-0.0113 (0.0272)	0.0549 (0.0342)
_cons	0.314*** (0.0908)	0.336*** (0.0907)	0.331*** (0.0880)	0.339*** (0.0919)	0.323*** (0.0888)
<i>N</i>	208	208	208	208	208
<i>R</i> ²	6.18	8.57	12.55	6.37	12.81
<i>F</i>	2.14***	2.29***	2.98***	1.94***	2.79***

Note. All models contain dummies measuring the knowledge intensity of a sector and dummies that control for the prior functional experience of the CEO.

Standard errors in parentheses

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