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Asghar Afshar Jahanshahi

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Asghar Afshar Jahanshahi
Department of Industrial and Systems Engineering, Pontifical Catholic University of Chile, Santiago, Chile

Abstract

Purpose – The purpose of this paper is to examine how network externalities impact on perception of environmental uncertainties.

Design/methodology/approach – The source of sample comes from the Science & Technology Parks database, a major association of corporate information of new technology ventures in Iran. The sampling frame comprises a wide range of industry segments including electronics, chemicals, agriculture, computer equipment, pharmaceuticals and medicines, telecommunication equipment, and others. The author used the conventional method of back-translation to translate the measures from English to Persian. There were 380 NTVs that the author could reach to send the survey. Among 380 NTVs, 177 entrepreneurs fully completed all the items (46 percent response rate).

Findings – The findings showed that what might decrease the state uncertainty perception, at same time it can give arise to other types of uncertainty. Thus, the result confirmed that the three types of uncertainty are differentiable.

Research limitations/implications – In the study, the author used cross-sectional self-report data, which cannot suggest causal relationships very well.

Practical implications – Investigating factors that influence the perception of environmental uncertainty may help explain why organizations, under the same environment, can behave heterogeneously.

Originality/value – By providing a clear picture about the relationship between market with network effect and perception of environmental uncertainty, this study contributes to the theoretical and empirical understanding of the emergence of environmental uncertainty perception.

Keywords Entrepreneurs, Network externality, New technology ventures, Perceived environmental uncertainty

Paper type Research paper

Introduction

The perception of environmental uncertainty has long been viewed as a central problem of organizations (Duncan, 1972; Milliken, 1987) as it affects new technology ventures (NTVs) strategy (Hitt *et al.*, 1982; Mingo, 2013), organizational structure (Koberg and Ungson, 1987) and responses (Villa and Rajwani, 2014) and economic performance (McCabe, 1990). Little is known, still, about how entrepreneurs, under the same environment, form different perception of environmental uncertainty (Brundin and Gustafsson, 2013;

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Gerloff *et al.*, 1991). While instrumental works has been done on the typology of perceived uncertainty distinguishing three types of uncertainty based on the interpretation process of management (Milliken, 1987), to date scholars do not know how different types of perceived uncertainty arise and how varying environmental factors affect those perceptions. Yet this knowledge could be useful, because understanding strategic decision making under uncertainty necessitates some understanding of factors that influence how uncertainty perception emerges.

Market with high network effects represent a set of unique challenges for entrepreneurs, e.g. the acceptance rate of NTVs new products and availability, price, quality and size of complementary products (Podoynitsyna *et al.*, 2013). These factors make the decision-making process more complex, and in compare with the market without network effects, entrepreneurs may experiences different types of environmental uncertainty (Choi, 1994).

In this study, we investigate how direct and indirect network externalities, impact on the perception of environmental uncertainty. Toward this end, we develop and test a model with data from 177 technology entrepreneurs in Iran. By providing a clear picture about the relationship between market with network effect and perception of environmental uncertainty, this study contributes to the theoretical and empirical understanding of the emergence of environmental uncertainty perception (Skinner *et al.*, 2013). Furthermore, one of major limitation of much of the previous work in the context of network externality is that it has been highly theoretical without systematic empirical testing of hypotheses. We answer the recent call of Hauser *et al.* (2006) to better understanding of how firms perceive and response to networks effects.

To that end, we answer the longstanding call of Miller and Shamsie (1999) to provide a more complete understanding of the construct of uncertainty by identifying the difference source and root of perceived environmental uncertainty (PEU). The salience of this gap, or divergence, is underscored by the fact that the uncertainties, and the managerial perception of it, are integral to organizational theories such as population ecology, resource dependence and contingency theory (Boyd *et al.*, 1993). Environmental characteristics or properties have implications for virtually all aspects of the response options of management of organizations.

The remainder of the paper will organize as follows; second section will provides a summary of the current status of empirical and theoretical research on PEU and network externality. We then will derive the main hypotheses we want to test from the literature review. Third section will present the estimation methodology, the data and empirical results. In fourth section, the data will analyze. Finally, we present the major conclusions of study.

Review of the literature

PEU

PEU describes an individual's lack of critical information about the business environment (Milliken, 1987). PEU takes environmental uncertainty as a perceptual phenomenon and thus inherently "in the eye of the be-holder" (Huber *et al.*, 1975). PEU is an important determinant of entrepreneurs behavior in both psychological decision theories and theories of human information processing (Duncan, 1972; Tushman and Nadler, 1978; Yu *et al.*, 2016).

PEU contains three major components that organizational administrators may experience as they seek to understand and respond to changes in an organization's environment (Milliken, 1987, 1990): state uncertainty, effect uncertainty and response uncertainty.

State uncertainty refers to the situation that organizational administrators do not feel confident that they understand what the major events or trends in an environment are or feel unable to accurately assign probabilities to the likelihood those particular events or changes will occur. An entrepreneur might, for example, be uncertain about whether a competitor will introduce a new product or about whether a proposed piece of legislation will pass (Milliken, 1987, 1990).

Effect uncertainty denotes to the inability to predict the nature of the effect of a future state of the environment on the organization (i.e. an understanding of cause-effect relationships). Entrepreneurs may need to resolve this uncertainty and become fairly certain that a change will affect their organization before they classify a change as a significant threat or opportunity. In terms of this research, effect certainty would have to be high for a change to be classified as a threat or opportunity (Milliken, 1987).

Response uncertainty (Milliken, 1987) characterizes an inability to predict the likely consequences of a response choice. This type of uncertainty is very similar to the uncertainty decision theorists have discussed (Conrath, 1967) and is experienced when decision makers attempt to understand the range of strategic responses open to them and evaluate the relative utility of possible options. A high degree of response uncertainty indicates that a decision maker is not confident about how to respond to some environmental change, because he or she is either not sure what the response options are or is unsure about the likely effectiveness of each possible strategy for achieving desired organizational outcomes (Conrath, 1967).

Network externality

Network externalities can be direct and indirect (Srinivasan *et al.*, 2004). Direct network externalities arise when the benefits a customer derives from using a product increase with the number of other users employing the same product, as in the case of fax machines, internet instant messaging programs, or social networks (Katz and Shapiro, 1985; Schilling, 2002). Facebook, for example, is more attractive to different people because so many other people around the world use it. Indirect network externalities arise when complementary products or services drive the value of the product, such as in the case of Blu-ray players that require movies to be in Blu-ray format, or more recently mobile devices with given operating systems and applications for them (Schilling, 2002).

The effects of network externality on customer and firm level decisions and action can be positive (Podoynitsyna *et al.*, 2013) or negative (Jiang *et al.*, 2015; Yang *et al.*, 2013). In order to handle different challenges in the market with network effect, entrepreneurs' ability to make a network with other NTVs is very important. In this way, entrepreneurs are able to motivate other NTVs in the industry to develop and produce related products and prevent the unexpected changes in the price of these products. In addition, through network and partners, entrepreneurs get opportunity to access to external resources and information. This sort of knowledge and information is essential to face effectively with different types of uncertainty that arises form network markets (Burt, 1992).

Hypothesis development

Network externality not only influence to product attributes (Basu *et al.*, 2003) and performance (Molina-Castillo *et al.*, 2011), but also its impact on entrepreneurs success (Acs *et al.*, 2016) and firms survival (Srinivasan *et al.*, 2004). Pervious works more

especially in marketing literature reveals that existence of network externality has potential to causes of fluctuations and variations in demand and makes changes the behaviors of customers (Hellofs and Jacobson, 1999), even it influence on the time of market entry decisions (Shankar and Bayus, 2003). However, Podoynitsyna *et al.* (2013) is the first one, who emphasized the network externality makes decision-making process more challenging and it's a source of uncertainty for strategic decision makers in the NTVs.

In the market with direct network externality, value of product highly depends on number of users (Katz and Shapiro, 1985). In the time of launch a new product to the market with direct network externality, entrepreneurs should be aware about the quality, price, size, design of the new product in order to attract many customers. When is the best time to introduce this new product? Similarly, in the market with indirect network externality, entrepreneurs always have challenges to provide answer for this type of question, how product in the market can complements our new products?

According to literature review, both of internal and external factors are contributing to level of uncertainty perception by individuals. For instance, Ashill and Jobber (2013) showed that how individuals experience may effect to the types of uncertainty experienced by strategic decision makers. Further studies in this context reveals that, more complexity and diversity in the environment causes to perceive more uncertainty by strategic decision makers (Ashill and Jobber, 2014). In the network externality markets, entrepreneurs should take into consideration in decision-making process three main factors at the same time; characteristics of a given product, number of potential adopter or present users and the availability of compatible complementary products (Torsten, 2014). The quality, size, price or design of the product does not guarantee the success of product in these markets. Any change in complementary products, for example, has potential to damage the likely success of new products. Any unexpected change in number of users, will affect to utility of users. In the long-run may hurts the profitability of new products. All these factors have potential to create ambiguous and doubt about consequence of entrepreneurs decisions (Minniti, 2005).

The higher level of products' direct and indirect network externality, the more likely an entrepreneur will need to monitor the possible effect of dominant design emerging from third parties, and the more entrepreneur needs to interpret the effect of unexpected changes complementary products from third parties, which is almost uncertain.

In addition, the higher level of products' direct network externality requires entrepreneur to learn how to capture a large number of users. The effective response strategies to capture a large number of users are usually not clear and entrepreneurs may experience more response uncertainty. The higher level of products' indirect network externality, the more a NTV needs to have complementary products from third parties, and in such situation, a company has a larger pool of potential competitors and collaborators, and this complicates the decision responses of entrepreneurs and hence increases the response uncertainty. In line to the existing literature, in the following hypotheses, we predict that both direct and indirect network externality enhances the level of perceive state, effect and response uncertainty:

H1. The higher direct network externality, the higher the (a) state (b) effect and (c) response uncertainty.

H2. The higher indirect network externality, the higher the (a) state (b) effect and (c) response uncertainty.

Methods

Sampling

Our source of sample comes from the Science & Technology Parks database, a major association of corporate information of NTVs in Iran. The sampling frame comprises a wide range of industry segments including electronics, chemicals, agriculture, computer equipment, pharmaceuticals and medicines, telecommunication equipment, and others. Iranian NTVs provide the ideal context for this study owing to their extraordinarily high level of environmental uncertainty. The environmental uncertainty in Iran was particularly high during our study period owing to international trade, economic and financial sanctions.

Because our main measurement items were written in English, we used the conventional method of back-translation to translate the measures from English to Persian (Brislin, 1970). We also conducted five in-depth interviews with entrepreneurs in NTVs, wherein we asked them to identify ambiguity and wording format. To refine the questionnaire measures, a pre-test study with 12 entrepreneurs (not included in the main sample) was conducted using our Persian survey. To enhance the clarity of items, we asked the entrepreneurs to review the items carefully. Any confusing words were revised before we began launching the survey.

Telephone appointments were made with the entrepreneurs, and the questionnaires were personally delivered to and collected from each respondent at the scheduled time (within a week). There were 380 NTVs that we could reach to distribute our survey. To decrease the entrepreneurs tendency to make socially desirable responses in the questionnaire, the entrepreneurs were guaranteed absolute anonymity. Among 380 NTVs, 177 entrepreneurs fully completed all the items (46 percent response rate). We receive a high response rate due to short questionnaire. We chose to sample entrepreneurs since they control over information exchange within the firm (Buyl *et al.*, 2011), face the highest level of uncertainty within NTVs, and their perception of uncertainty and response actions influences firm-level strategic decisions (McMullen and Shepherd, 2006).

A comparison of the NTVs age and size (using archival data) of responding NTVs with those of no responding NTVs revealed no significant differences. In order to know is there any significant common variance, we conducted a Harman (1976) one-factor test for all variables. The first factor explaining, 23 percent. Thus, no single factor emerged, nor did single factor account for majority of variance (Podsakoff, 1986). Furthermore, the order of the measurement items was randomize (Chang *et al.*, 2010) to avoid common-method variance. We also find no significant differences in the control variables between early- and late-responding NTVs. The average NTVs age is 8.55 years (SD = 3.13), and the average age of respondent (entrepreneurs) is 42 (SD = 7.7). In all, 84.7 percent of respondent hold an academic degrees and the majority of them are man (71.6 percent).

Measurements

Dependent variable. Perceived environmental uncertainty. We assessed perceived state, effect and response uncertainties using nine items (Ashill and Jobber, 2009). Examples of items includes "You have the information to understand how your business environment will change in the future" (state uncertainty); "You fully understand the effect of the environment factor on your decision-making" (effect uncertainty); and "You can accurately anticipate the consequences/outcomes of making decisions before

making them" (response uncertainty). The coefficient α reliability estimate of the state, effect and response uncertainties was $\alpha = 0.823$, 0.712, 0.855, respectively. The scales are provided in Table AI.

Independent variable. Network externality. We assessed direct and indirect network externality based on (Katz and Shapiro, 1985; Podoynitsyna *et al.*, 2013). The two items was "the values of our product to customers depends on the number of people who use the products" and "the price customers are willing to pay for a product increases as more people adopt the product." Indirect network externality was measured by one item "How important is the availability of complementary products and/or services for success of your products and/or services" (Schilling, 2002).

Control variables. In the present study we used four individual demographic variables (age and education, gender and experience), four NTVs' demographic characteristics (NTVs size, age, availability of slack resources and past performance). We included entrepreneurs age and education as a control variable, because the younger entrepreneurs have more the ability to tolerate ambiguity and more effectively respond to internal and external changes (Jahanshahi *et al.*, 2014; Wiersema and Bantel, 1992). The higher educational level of Entrepreneurs, more access to information, more ability to manage unexpected changes, may perceive less uncertainty in compare to less educated entrepreneurs. As gender of entrepreneurs partially related to level of their risk taking behaviors and how face with uncertainty (Richard *et al.*, 2004), we included entrepreneurs gender as control variable and its was measured as a dichotomous variable (1 = Female and 2 = Male) (Jahanshahi *et al.*, 2013). Individuals experience play important role in perceiving various types of environmental uncertainty (Ashill and Jobber, 2013). So, we included three items (prior management, marketing and technology experiences) to measure the prior experience of entrepreneurs (Gruber *et al.*, 2008).

We control for the size (logarithm of number of employees) and age (logarithm of years of operation) of NTVs because the level of uncertainty perceive by entrepreneurs may also be a function of their NTV-specific characteristics (Hambrick and Fukutomi, 1991; Li and Atuahene-Gima, 2001). For example, older and bigger NTVs may have more strong networks with customers, supplier and partner, or higher ability to scan environment and receive novel information, which influence to level of uncertainty perception due to network effects. Furthermore, amount of available slack resource influences entrepreneurs' perceptual processes (Chattopadhyay *et al.*, 2001) and organizational strategic responses to a given issue (Plambeck and Weber, 2009). More slack resource provided Entrepreneurs a greater flexibility in decision-making processes (Sharfman and Dean, 1997). Since, entrepreneurs in more successful NTVs are in better position to attract more customers and make network with other companies. We asked entrepreneurs to rate their companies' performance comparing with the main competitors in last three years according to three factor: sales growth, return on assets and return on investment (Wiklund and Shepherd, 2003; Zahra and Garvis, 2000).

Results

Table I presents descriptive statistics and correlations for all the variables in the study. In order to test the hypothesized relationships meaningfully, it was first necessary to establish that the types of uncertainty were, in fact, differentiable. An exploratory

Table I.
Descriptive statistics and correlations

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Firm age	8.55	3.13	1.00														
2. Firm size	36.35	25.14	0.209**	1.00													
3. Firm performance	3.07	0.67	−0.07	0.02	1.00												
4. Slack resource	4.04	1.07	0.08	0.04	0.02	1.00											
5. Gender	1.72	0.45	−0.10	−0.09	0.10	−0.02	1.00										
6. Education	3.97	1.73	0.03	0.05	−0.07	0.09	0.03	1.00									
7. Entrepreneur age	42.00	7.66	−0.09	−0.02	0.190*	0.01	0.222**	0.01	1.00								
8. Manag. experience	3.18	1.08	−0.07	−0.11	0.223**	0.01	0.08	−0.14	0.501**	1.00							
9. Market. experience	3.09	1.28	0.00	−0.02	0.317**	−0.01	0.10	−0.03	0.546**	0.616**	1.00						
10. Tech. experience	3.00	1.35	0.14	0.193**	−0.04	0.01	−0.13	0.12	0.07	−0.02	−0.02	1.00					
11. Direct network	3.72	1.55	−0.10	0.01	−0.02	−0.03	−0.189*	0.11	−0.07	−0.154*	−0.12	−0.02	1.00				
12. Indirect network	4.06	1.78	0.00	0.290**	−0.172*	0.03	−0.13	0.13	−0.06	−0.15	−0.06	0.09	0.462**	1.00			
13. State uncer.	3.01	1.20	−0.05	−0.03	0.163*	−0.04	0.01	0.00	0.166*	0.176*	0.284**	−0.04	−0.348**	−0.176*	1.00		
14. Effect uncer.	3.11	1.02	−0.01	0.00	0.11	0.08	−0.488**	−0.03	0.01	0.06	0.04	−0.09	0.327**	0.168*	0.05	1.00	
15. Response uncer.	2.958	1.2399	−0.04	0.0643	−0.208**	0.0234	−0.232**	0.1023	−0.474**	−0.513**	−0.585**	0.03849	0.431**	0.236**	−0.508**	0.266**	1

Notes: *,**Correlations are significant at the 0.05 and 0.01 level (two-tailed), respectively

factor analysis revealed the factors grouped themselves according to the theory (Kaiser-Meyer-Olkin = 0.71; Bartlett's = 0.000).

In order to reduce non-essential multicollinearity, first we mean-centered the independents variables, and then we run the multicollinearity diagnostics. The result indicated that all variance inflation factors (VIF) values were below 5 (highest VIF = 1.95), so multicollinearity was not a significant issue in our study (Cohen *et al.*, 2013).

To test the hypotheses of study we run hierarchical multiple regression. In the first step, we entered control variables with state, effect and response uncertainty as dependent variables separately. In the second and third steps of each regression equation, we entered independent variables (direct and indirect network externality) (Table II).

In contrast with our prediction in the *H1a* and *H2a*, direct ($\beta = -0.302$; $p < 0.001$) and indirect ($\beta = -0.113$; $p < 0.05$) network externality negatively related to perceive state uncertainty, not supporting our *H1a* and *H2a*. Consist with *H1b* and *H2b*, we found that entrepreneurs in the market with higher direct ($\beta = 0.169$; $p < 0.001$) and indirect ($\beta = 0.101$; $p < 0.05$) network externality, perceive more effect uncertainty. Regarding *H1c* and *H2c*, we found that, high direct ($\beta = 0.288$; $p < 0.001$) and indirect ($\beta = 0.108$; $p < 0.01$) network externality positively related to perceive response uncertainty. Among the control variables, surprisingly, technology experience positively related to perceive state uncertainty ($\beta = 0.205$; $p < 0.05$) in both direct and indirect network externality markets. In the market with direct network externality, entrepreneurs age ($\beta = -0.023$; $p < 0.05$) and education ($\beta = -0.288$; $p < 0.001$) negatively associated with perceive effect uncertainty. All three types of experiences and entrepreneurs education reduce significantly the level of response uncertainty.

Discussion and implications

Discriminating the three types of uncertainty based on Milliken's typology challenges many theoretical assumptions, as the three types carry differential, often opposite and sometimes counterintuitive, implications, to new product introduction (Miller and Shamsie, 1999), strategy formulation (Aragón-Correa and Sharma, 2003), marketing information systems (Ashill and Jobber, 2009), entrepreneurial actions (McKelvie *et al.*, 2011; McMullen and Shepherd, 2006), etc. However, fewer researches have focus on exploring the likely antecedents of perceived environmental uncertainty. Perceived uncertainty is central issue in entrepreneurship context. It is crucial for scholars to reveal as much as possible about the root and nature of perceived uncertainty (York and Venkataraman, 2010).

The fundamental purpose of this research was to investigate what triggers the perceived uncertainty in the mind of entrepreneurs. Particularly, the study sought to investigate how environmental characteristics, specifically network externalities, influence entrepreneur's perception of environmental uncertainty. The results suggest that network externalities significant shape how entrepreneur perceives uncertainty. Investigating factors that influence the perception of uncertainty may ultimately lead to a better understanding of why organizations, under the same environment, can behave differentially.

Network externalities in the perception process can act both negative and positive role (Cohen and Winn, 2007). We found a negative relationship between network externality and perceive state uncertainty. This is surprising, because in line with the literature (Podoynitsyna *et al.*, 2013), we hypothesized that the higher direct and indirect network

Table II.
Hierarchical multiple regression analysis

	State			Effect			Response		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
NTV age (log)	−0.003	−0.010	−0.006	0.000	0.004	0.003	−0.015†	−0.009	−0.012
NTV size (log)	−0.055	−0.005	0.067	0.003	−0.025	−0.110	0.069	0.022	−0.046
Past performance	0.192	0.230****	0.142	0.199****	0.178****	0.239	−0.099	−0.135	−0.047
Slack resource	−0.044	−0.029	−0.035	0.078	0.069	0.067	0.019	0.004	0.011
Ent. Age (log)	−0.012	−0.016	−0.012	−0.025**	−0.023*	−0.026	0.007	0.010	0.007
Education	−0.035	−0.090****	−0.046	−0.319***	−0.288***	−0.306	−0.103*	−0.050	−0.095*
Gender	0.078	0.235	0.122	0.017	−0.071	−0.011	0.100	−0.049	0.051
Management experience	0.052	0.064	0.057	0.107	0.100	0.100	−0.174*	−0.185**	−0.177*
Marketing experience	−0.002	−0.036	−0.020	−0.018	0.001	0.021	−0.196**	−0.163**	−0.179**
Technology experience	0.195*	0.171*	0.205*	−0.025	−0.011	−0.037	−0.334***	−0.311***	−0.342***
Direct network		−0.302***			0.169***			0.288***	
Indirect network			−0.113*			0.101*			0.108**
F	1.646****	4.127***	1.862*	6.671***	7.827***	6.516***	13.440***	19.043***	12.948***
R^2	0.094	0.224	0.116	0.297	0.354	0.315	0.460	0.572	0.477
ΔR^2	0.094	0.224	0.116	0.297	0.354	0.315	0.460	0.572	0.477
Adj. R^2	0.037	0.170	0.054	0.252	0.309	0.267	0.425	0.542	0.440

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.10$

externality would be associated with higher perceive state uncertainty. As Milliken proposed, state uncertainty arises from lack of information about unexpected changes in main events and trends in the environment. Such key events in the market with direct and indirect network externality would be the number of potential users for new product and availability of compatible complementary products. The finding reveals that, critical information about these factors is not fuzzy and strategic decision makers are almost able to predict the unexpected changes in these factors.

Furthermore, I found a positive relationship between network externality and perceive effect and response uncertainty. These findings showed that what might decrease the state uncertainty perception, at same time it can give arise to other types of uncertainty. Thus, our result confirmed that the three types of uncertainty are completely differentiable (Milliken, 1987). Entrepreneurs can experience multiple types of uncertainty to different levels. One implication of these findings for researchers is that aggregating uncertainty scores into a global measure of perceived environmental uncertainty may led to a numerous of inconsistent research finding.

Implication of these finding especially for NTVs and other types of firms that operate in the market with high direct and indirect network externality is considering individuals who have high ability to tolerate extreme levels of ambiguity associated with such environment.

Since the market with network effect increase the level of ambiguity and complexity for strategic decision makers, the another implication is that especially for NTVs and other types of firms which recruit top managers for work in the market with high direct and indirect network externality, tolerance for ambiguity and complexity should be included as a major selection criterion.

The possibility of having opposite (positive and negative) relationship of entrepreneurs technological experiences with their state and response uncertainty perception is another surprising finding. Examining the possible role of individuals' work-related experience in perception of uncertainty poses an important area of future research.

Conclusions

Strategic decision making in management and especially entrepreneurship is clouded by uncertainty (Lanivich, 2015). However, how the various types of environmental uncertainty perception emerge remain elusive. Milliken (1987) article utilized a framework to sight the uncertainty perception from multiple levels. The second step in this framework has taken by Ashill and Jobber (2009), Miller and Shamsie (1999), and Milliken (1990) to explore how these types of uncertainty interact together. The third step in this literature have taken by Miller and Shamsie (1999) to identify the major outcomes of perceived environmental uncertainty in organizational level. There has been limited research that directly examines how perceived uncertainty propagate among entrepreneurs (McKelvie *et al.*, 2011; McMullen and Shepherd, 2006). This study takes another step (Sund, 2013), by introducing network externality as a antecedent construct into this stream of research. The paper highlights the importance of the both direct and indirect network externality in forming three types of uncertainty introduced by Milliken (1987).

To that end, the paper answer the recent call of Hauser *et al.* (2006) to better understanding of how firms perceive and response to networks effects. Our research is one of very few that has highlights the effects of network externality on forming different types of perception by entrepreneurs. It is also perhaps the first to test this relationship in developing countries such as Iran.

Limitation of study

However, the paper suffers from several limitations. First, as in most studies published on uncertainty perception (Ashill and Jobber, 2009; Gerloff *et al.*, 1991; Miller and Shamsie, 1999; Milliken, 1990), our research includes cross-sectional relationships, so full pattern relations between network externalities and three types of uncertainty cannot be extracted in exact terms. Our hypotheses could be examined with longitudinal and panel data to make exact causes on three types of uncertainty appear.

Second, the respondents providing the measure of the network externality and perception are the same person (entrepreneur), may causes of common source bias (Podsakoff *et al.*, 2003). I used some statistical methods to rule out this concern. Future studies may include measures from different persons to fully rule out this concern.

Third, our finding concern young and high technology-based ventures, which may limit their applicability to other sectors. It might be worthwhile to consider firms in low-technology environments and older firms to reinforce the generalizability of our findings.

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Further reading

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(The Appendix follows overleaf.)

Appendix. Survey measures

	Factor loading
Perceived environmental state uncertainty (adapted from Ashill and Jobber, 2009)	
How often do you feel and believe:	
You have the information to understand how your business environment will change in the future	0.793
Your information about your business environment is adequate for your decision making	0.727
You are unable to get the necessary information about your business environment for your decision making (R)	0.707
Perceived environmental effect uncertainty (adapted from Ashill and Jobber, 2009)	
How often do you feel and believe:	
You are unable to predict the impact of your business environment on your project (R)	0.532
You fully understand the effect of the business environment factors on your decision making	0.643
Please indicate your "sureness" (level of certainty) as to how each business environmental factor affects your decision making? (not at all sure about how it will affect my decision making/completely sure about how it will affect my decision making)	0.805
Perceived environmental response uncertainty (Adapted from Ashill and Jobber, 2009)	
How often do you feel and believe:	
You can accurately anticipate the consequences/outcomes of making decisions before making them	0.859
You know how to respond to changes in the external environment	0.666
You are able to determine what the response options should be in light of changes in the external environment	0.716

Table AI. Perceived environmental uncertainty

Corresponding author
Asghar Afshar Jahanshahi can be contacted at: afsharasghar@gmail.com