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Exploring Innovation Adoption Behavior for Sustainable Development: The Case of Hungarian Food Sector

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Abstract: Innovation plays a key role in the success and sustainable development of businesses. The innovation process derives from the combination of personal skills and company resources that influence food company managers in their choices on innovation (the decision-making process). This study is an attempt to try to understand which psychological constructs affect innovation decision-making in the Hungarian food sector, using the empirical data from a 2017 survey conducted in Hungary among the largest food processing companies. Planned behavior theory (TPB) was applied to the study of factors affecting innovation decision-making. Structural Equation Modeling (SEM) was used for data analysis. The results show that the positive attitude of Hungarian food business leaders towards innovation, evaluation of innovation and the strategic intention of placing innovative products and processes on the market have a positive relationship with innovation performance; however, the lack of adequate research skills, plus specific knowledge and skills is hindering the development of the hoped for process.

Keywords: food innovation; behavioral decision-making; sustainable productions; theory of planned behavior; structural equation modeling

1. Introduction

In economic theory, innovation is one of the key tools for a company's growth, its access to new markets and its long-term sustainable development [1,2]. Companies, driven by increased competition from global markets and an unprecedented level of interest in sustainable development practices, are trying to implement more advanced sustainability practices and, at the same time, to maintain a high value of the products and services offered through rapid and constant innovation [3–6]. According to Schumpeter [7], innovations are related to the creation of a new product or new qualities of products, the introduction of a new method of production, the opening of a new market, or by introducing a new organizational structure. The entrepreneurship literature recognizes that companies that adopt and develop innovations are more likely to thrive in highly competitive environments [8]. Among these environments, the agri-food sector is certainly among those that have received less attention in the economic literature [9]. Only in the last few decades have innovations in the agri-food sector found space in the international literature [10–16], emphasizing the opportunity to improve the ability of the agri-food companies to move from a traditional production sector focused on raw materials, to an

innovative and consumer-oriented approach [17]. However, what emerges is that innovations adoption is mainly studied in large-size companies of developed economies [18], whereas innovation research on small and medium-sized companies have been substantially neglected [19]. Small and medium-sized food companies represent, in fact, the backbone of the European food industry, and play a primary role in the continent's economic growth [19]. Indeed, these companies rarely have the capability to invest in R&D activities, and heavily rely on external sources of information [20]. Therefore, in these companies, as has been widely recognized in the literature, the ability of entrepreneurs or professional managers plays a key role in companies adopting innovation and, in turn, for defining the company's competitive strategy [11,12]. This implies that, in small and medium-sized food companies, competitiveness and sustainable development requires qualified entrepreneurs, capable of achieving any corporate, environmental or social objectives, together with successful innovative products on the market so as to be able to increase the effectiveness of such innovations [3]. Entrepreneurs or professional managers' ability is considered a very valuable resource for companies because it supports them in competing with other companies in the same sector and to fulfil an effective value creation strategy [21–23]. The recognition of managerial behavior as a determinant factor for the success of companies on the market has a long history, dating back to Schumpeter's seminal work [24,25] who recognized entrepreneurs' characteristics and skills as fundamental for companies. Consequently, it is interesting to understand all the characteristics of those entrepreneurs, or professional managers, who facilitate the adoption of innovation and why some organizations can generate more innovations than others [26,27].

Among the several hypotheses raised by the research, the strategic orientation that emphasizes managerial behavior has been considered an effective way to understand the adoption of innovation by organizations [28]. Having a deeper understanding of this aspect is fundamental for those countries that are highly vulnerable to the challenges of globalization in agricultural markets as they are facing greater difficulties than others to “think outside the box”. This challenge is particularly present in some European countries, including those of Central and Eastern Europe, where the small and medium-sized food companies could play a key role in economic growth [29]. For example, the innovation activities of the Hungarian food sector are far below the stage required to be able to strengthen competitiveness, in particular at an international level [30], as evidenced by a low level of innovation policies and, as a consequence, low quantity of implementation of such innovations in food companies. This places Hungary in a position of great disadvantage [31,32] compared to other European countries [33].

As far as we know, very few studies have explored the innovations of small and medium-sized enterprises in the agri-food sector of Hungary and, in particular, the entrepreneurs', or professional managers', psychological characteristics influencing the decision-making process in adopting innovations [30]. Considering the importance of the figure of entrepreneurs in innovation, this study tries to understand which psychological constructs influence the decision-making process of innovation in the Hungarian food sector. To be specific, using the theory of planned behavior—TPB [34], this study highlights how managers' attitude towards innovative products, the evaluation of innovative products and the strategic intention of placing innovative products on the market influence the adoption of the innovations by companies. The findings of this study contribute to a better understanding of the adoption of innovations in Hungarian food processing companies that face competitiveness problems on international markets, thereby enriching the discussion in the international literature relating to the propensity of small and medium-sized food companies to adopt innovations. Furthermore, knowing which psychological constructs or managers' characteristics influence food sector innovations adoption could have important practical implications for both policymakers and other stakeholders of the sector. The role of the decision-maker in regards of innovation is crucial: the greater is his/her interest in improving the company's production, processing, marketing and organization skills, the greater the desire to increase his/her knowledge about the subject intensifying the positivity of the approach used on the decisions about the implementation of innovation [35]. As a result of analyzing the behavioral factors that lie behind this kind of decision, we can uncover substantial interdependencies involved

in the process. The study is structured as follows. First, we introduce the theoretical considerations, which will be followed by the exploration of the hypotheses. The next part concerns the method applied. We then present the results and finally discuss and conclude.

2. Theoretical Framework

A company's propensity to innovate is based on its ability to resist the pressure this process entails and the control it perceives itself to have over the adoption of the innovation [36]. Since the decision to innovate requires decisions to be made based on limited and sometimes demanding tests, it is apparent that whoever has the task of getting the company to innovate may react in a number of different ways, influenced by different objective and subjective variables [37].

Among the existing studies on the innovative behavior of entrepreneurs, the degree of innovation was positively related to entrepreneur training [38], previous experience in the sector [39,40], the degree of risk that the entrepreneur can manage [41], personality traits [42] and self-esteem [43].

Moreover, Shane [44] argued that entrepreneurial innovation depends mainly on psychological factors, such as managerial self-efficacy and good self-esteem. The entrepreneur's innovative behavior is associated with a high commercial return, but also with a high commercial risk. Hence, it follows that entrepreneurs, although possessing high human capital, innovate only if they feel confident that they have what it takes to make it happen [45]. This suggests that innovative companies are led by entrepreneurs with a higher level of trust than those of imitative companies [46] and that human capital is a necessary, but not sufficient, precondition that influences the decisions of entrepreneurs in taking innovative paths. [47]. Some entrepreneurs, despite having good human capital and high opportunity costs, may not take advantage of entrepreneurial opportunities, while those who have good managerial self-efficacy are more likely to innovate [48]. Furthermore, cognitive characteristics, such as higher self-esteem, positively influence innovative behavior at the individual level [49,50].

Although the psychological factors are the ones that most affect the entrepreneur's decisions, as already mentioned, their behavior is also influenced by other factors, such as, for example, the age, education level and gender of the entrepreneur. In particular, the manager's age and years of experience in the sector influence his attitude towards innovations, since whereas new managers are more likely to acquire new technologies or products, those with a longer mandate have less desire to change their working method [51,52]. Furthermore, education appears to play a key role in managers adopting business innovation as new ideas require knowledge [53,54] and therefore educated entrepreneurs are more likely to use complex and diverse approaches [55].

Finally, the predisposition towards innovation is divergent between men and women, since the female subject tends to take on a more collaborative leadership style than their male counterparts, thus distributing the various roles to the competent figures and reducing the risks that innovation entails [56]. Indeed, it has been shown that a company that distributes decision-making responsibility across multiple figures reduces the difficulties arising from the choice to innovate, while increasing the chances of adopting an innovation [26]. In addition to all the variables listed above, most of them subjective in nature, the opportunities for entrepreneurial innovation are objectively influenced by the creation of new technologies, environmental, political and other social trends, such as the culture of a country [57,58].

Given this theoretical view, it is quite complex to identify the behavioral motivations and psychological drivers of food industry decision-makers. Several psychological models have been applied to explain the entrepreneur's decision-making process [59].

In this context, Planned Behavior Theory (TPB) was chosen because, among all the models proposed by the literature, it seemed to us the most complete tool for studying the behavior of entrepreneurs [60]. More specifically, in 1998, Chan [61] proposed a similar TPB model that can be applied collectively, thereby predicting the result of a company adopting innovation. However, he explained that this analogous model must ensure that all critical parameters and the interrelationships parameter are respected. We believe that the model developed for the aforementioned study meets these criteria since

in the literature there are other constructs used at an organizational level, which correspond to those within the TPB and which have been shown to influence the adoption of innovation [34]. The TPB has been widely supported in multiple disciplines [62–65] and has been shown to be suitable for the study of small businesses, as their small-scale decisions tend to be the domain of a single individual [66]; this is the case with the Hungarian agri-food sector, which is characterized by small and medium-sized enterprises. Using the TPB, we investigated the factors that influence the decisions of the subjects of the food industry about their intention to innovate. Indeed, the theory of planned behavior [34] said that attitude represents the most effective predictor of entrepreneurial intention, followed by subjective norms and then perceived behavioral control. Indeed, positive attitude is the belief in one's own ability to perform a given task [67], subjective rules act as a self-regulating mechanism that determines whether individuals will initiate actions [68] and behavioral control is instrumental in determining what individuals do with the capacities and skills they possess [69].

Based on such knowledge, we formulated four hypotheses:

Hypothesis 1. *The positive attitude towards innovative activities positively influences the intention to carry it out.*

Hypothesis 2. *Subjective rules have a positive effect on the intention of innovation.*

Hypothesis 3. *The behavioral control of the business decision maker helps the intention and realization of innovation.*

Hypothesis 4. *The greater the intention to innovate, the greater the innovation.*

3. Research Methods

The needs of the market require Hungarian food processing companies, which want to remain competitive, to continuously develop their dynamic skills for innovation. Companies must continually adopt new strategies and reconfigure their activities based on changing market needs. This way of acting is in line with the preconditions for innovation.

Consequently, we used the data of a survey carried out among Hungarian food processing companies, and in particular, relating to their innovation characteristics (including their behavioral approach to innovation), obtained thanks to a four-year research project which has studied the resilience of the Hungarian food industry.

We wrote an official letter to the managers of 297 food companies, asking them to take part in our survey. We received 152 positive answers out of them. Either the manager him/herself (in case of smaller companies) or a responsible person (who was authorized to provide data from the company) supplied the answers. After the data clearing, 151 companies remained in the sample. Table 1 shows the age and managerial experience of the managers.

Table 1. Summary statistics of age and managerial experiences of managers (years).

	Obs.	Mean	St. Dev.	Min.	Max.
Age of manager	151	53.27	9.49	32	81
Managerial experience of manager	151	18.75	8.76	1	41

Managerial decisions are also influenced by management culture. In this respect it is important to know whether the Hungarian food companies are isolated from the international management culture. For this reason, we have also counted the firms with foreign ownership in the sample (Table 2).

Table 2. Ownership structure of companies.

	Freq.	Percent
Hungarian ownership	117	77.48
Foreign ownership	34	22.52
Total	151	100.00

We can see that almost one-quarter of the firms has foreign owners. This share is rather high (Table 3). As a result, we can suppose that the Hungarian food company managers are influenced by—and align with—international manager standards, including the decision-making process.

Table 3. Summary statistics of foreign ownership (%).

	Obs.	Mean	St. Dev.	Min.	Max.
Foreign ownership share	25 *	86.36	31.38	1	100

* 9 companies out of 34 did not report foreign ownership percentage.

The average turnover of the companies involved was around seven million euros, with an average of 195 employees, in 2016. We have quite high representativeness in the categories of food companies examined (Table 4).

Table 4. Representativeness of the sample.

Total Number of Food Companies in Hungary, 20–250 Employees, 2016 *	803
Company number in sample, 20–250 employees, 2016	132
Representativeness of (20–250) employee category	16%
Total number of food companies in Hungary, 50–250 employees, 2016 *	320
Company number in sample, 50–250 employees, 2016	127
Representativeness of (50–250) employee category	40%

* Source: <http://statinfo.ksh.hu/Statinfo>.

The whole Hungarian food industry consists of rather micro-, small- and medium-sized companies with very few exceptions (Table 5). The micro category is not covered in this research, because the food produced in this category is devoted mainly for self- and local consumption and the innovation usually is not a result of strategic thinking, but much more that of a contingent action.

Table 5. Number of companies with regard their employees *.

Year	Total	Number of Employees					
		1–4	5–9	10–19	20–49	50–249	>250
2014	6638	4256	841	679	486	309	67
2015	6668	4226	881	678	499	322	62
2016	6622	4208	892	660	483	320	59
2017	6459	4122	861	607	504	302	63

* Source: <http://statinfo.ksh.hu/Statinfo>.

The number of companies with more than 250 employees is less than one percent. Regarding these circumstances, the innovation decisions are within the very close reach of the general managers, therefore the behavioral characters of the decision-making process are of high importance.

The methodology involved the development of SEM, using Stata 15. SEM is a widely used multivariate multiple dependence technique and one of its main advantages is that it is used to study the relationships between latent constructs (such as attitude, subjective regulations, behavioral control,

intention and innovation) which are indicated by several measures. The model consists in verifying the hypotheses through the multivariate analysis of the structural theory, which identifies the causal relationships between several variables [70].

It is based on multiple regression and integrates path analysis and factor analysis, through two fundamental characteristics:

- (a) creates models of causal processes, through a series of regression equations;
- (b) creates the possibility of using latent variables and takes into account the measurement error.

In line with this, the SEM process focuses on two phases:

- (1) validation of the measurement model—carried out through confirmatory factorial analysis
- (2) adaptation of the structural model—realized through the analysis of the path with latent variables.

In our case, this measurement model was used to identify the factors that create appropriate constructs for “attitude”, “subjective norm”, “behavioral control”, “intention” and “innovation”. We then used the latent variables.

The constructs were verified through Cronbach’s alpha.

4. Results

4.1. Results—Latent Constructs

Following the methodological design, we developed the latent constructs (Table 6) from the individual variables analyzed. The individual items in the construct were questioned during the survey. All questions of each latent construct were constructed according to Aizen’s methodological recommendations [34]. Following his guide proved to be rather efficient because we have experienced unusually high alpha values.

Table 6. Latent constructs.

LC1: Attitude Towards Innovation	
Item	Alpha
It is part of our business policy that we place at least one innovative food product on the market	0.97
For our firm it is desirable to place at least one innovative food product on the market	0.96
To place at least one innovative food product on the market has got an intrinsic value for us	0.96
For us it is profitable to place at least one innovative food product on the market	0.96
To introduce at least one innovative food product on the market is exciting professional challenge for our company	0.97
Test scale	0.97
LC2: Subjective norm of performing innovation.	
Item	Alpha
My colleagues whose opinion is important for me think that we need to place at least one innovative food product on the market	0.99
The market requires the introduction of new innovative food product continuously	0.99
My colleagues whose opinion is respected by me think positively about introducing a new innovative food product on the market	0.99
Our most important partners place at least one innovative food product on the market	0.99
The market always awards the introduction of innovative food product on the market	0.99
It is important for me that our company introduces at least one innovative food product on the market for the specific nutrition people	0.99
Our most important competitors introduce at least one innovative food product on the market	0.99

Table 6. Cont.

LC2: Subjective norm of performing innovation.	
Item	Alpha
Our management think that we have to place at least one innovative food product on the market	0.99
Our management evaluates positively if we introduce at least one innovative food product on the market	0.99
Some specific nutrition people (flour sensitive, high blood sugar, etc.) need to have innovative food products on the market	0.99
Test scale	0.99
LC3: Behavioural control of performing innovation	
Item	Alpha
We do have enough resources as well as research capacities in order to place at least one innovative food product on the market	0.97
Our company is able to place at least one innovative food product on the market without any difficulties	0.95
We do have enough specific knowledge and skills in order to place at least one innovative food product on the market	0.95
We do have enough external R&D capacities in order to introduce at least one innovative food product on the market	0.97
LC4: Intention of carrying out innovation.	
Item	Alpha
For the future we plan to place at least one innovative food product on the market	0.98
We intend to place at least one innovative food product on the market a year	0.97
Next year we try to introduce at least one innovative food product on the market	0.97
Test scale	0.98

The high values of Cronbach's alpha both at item and scale level seem to show the high reliability of our items and scales.

4.2. Results—Structural Model

The structural model created highlights the relationship between attitude to innovation, subjective norm of performing innovation, behavioral control of performing innovation and Intention to achieve Innovation.

From Figure 1, we can see that the relationship created is quite complicated: based on the standardized parameters we experience high level of correlation between attitude and subjective norm (0.98), subjective norm and behavioral control (0.84), but there is also a strong connection between attitude and behavioral control (0.85) as well. This is a specific feature of the SEM because it allows the explanatory variables to be correlated in the model. The solution procedure of SEM is that each regression model is solved simultaneously, so the correlation between the variables does not lead to biased results. The standardized parameters confirm that all latent variables (attitude, behavioral norm, behavioral control and intention to innovation) significantly influence the innovation process—each of them is significant at 1% level. In particular, the Attitude variable positively influences the intention, and the same applies in the subjective norm and intention relation. Behavioral control has a double direct influence on intention and innovation. However, the direction of these two effects is exactly the opposite, as while the control abilities of enterprises directly help to formulate innovation, there is an effect that hinders the intention.

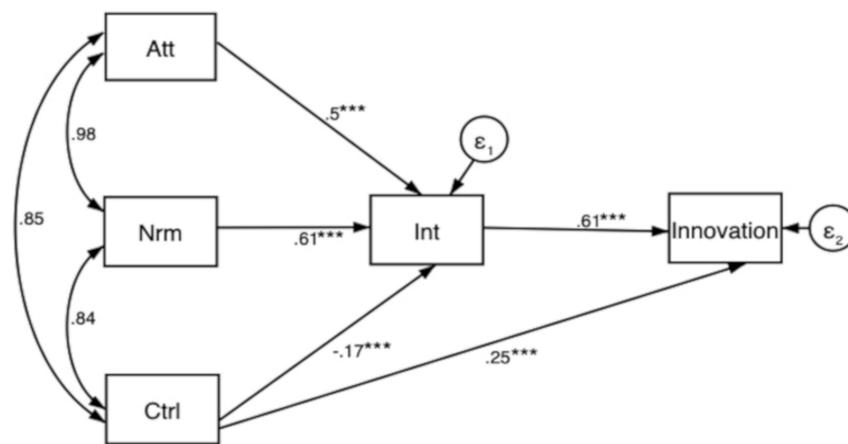


Figure 1. Structure and parameters of TPB. *** Significant at 1% level.

Table 7 shows the fit statistics of the SEM model.

Table 7. Fit statistics of the SEM.

Fit Statistic	Value	Description
Likelihood ratio		
chi2_ms(2)	2.729	Model vs. saturated
$p > \text{chi}^2$	0.256	
chi2_bs(7)	572.74	Baseline vs. saturated
$p > \text{chi}^2$	0	
Population error		
RMSEA	0.049	Root mean squared error of approximation
90% CI, lower bound	0	
upper bound	0.177	
pclose	0.379	Probability RMSEA \leq 0.05
Information criteria		
AIC	1601.9	Akaike’s information criterion
BIC	1656.2	Bayesian information criterion
Baseline comparison		
CFI	0.999	Comparative fit index
TLI	0.995	Tucker-Lewis index
Size of residuals		
SRMR	0.005	Standardized root mean squared residual
CD	0.934	Coefficient of determination

The highly significant results prove the validity of theory of planned behavior with empirical data.

5. Discussion and Conclusions

Innovation is closely linked to the company’s performance and represents one of the main driving forces for a country’s economic and sustainable growth. The ability of a company to innovate has direct consequences on its ability to compete with other companies in the same sector, in a global market. If we consider a company as a complex set of resources, skills and competences, the effect of innovation can be portrayed as an improvement of these skills, making it more competitive and cutting edge.

In this context, analyzing the behavior of entrepreneurs could help understand their attitude towards innovations and therefore their contribution to the development of a country.

This study sought to understand which psychological constructs influence decision-making on innovation in the Hungarian food sector, using empirical data from a 2017 survey conducted in 151

food processing companies. Planned behavior theory (TPB) was applied in order to explore the nature of individual drivers in innovation decision-making, using SEM for analysis. It has been found that TPB effectively explains the development of the decision-making processes and that, in accordance with previous studies [34,71] once more in Hungary, the positive attitude of business leaders towards innovation, the positive evaluation of the innovative products and processes together with the intention to market new products, has a positive relationship with the performance of the innovation.

The current effort to improve quality, the design of the company and the technological conditions is very low [72], confirming our study as 57.5% of the food processing companies indicated that they had no made innovations in the three years preceding the interview. Our analysis confirmed that managers' positive attitude towards innovation directly increases the intention to put into practice more innovation; however, we have seen that this does not happen here.

We see that the direct effect on the intention of innovation is negative, although the direct influence on innovation is positive. This means that the companies studied would like to innovate but believe that their innovative skills are not enough to carry out adequate innovation projects.

The study has important implications in the Hungarian economic field, as it launches a precise message for managers: their ability to adapt to innovation should be radically improved in order to meet the needs and desires of consumers. Furthermore, these results could be a good starting point for policymakers in accompanying and facilitating, through appropriate economic policy measures, Hungarian companies in the adoption of innovations, so as to increase their competitiveness in international agri-food markets. However, despite the importance of our results, the following study shows some limitations. It refers only to the Hungarian market, and the results do not extend to other countries of Central and Eastern Europe, where the agri-food sector plays a crucial role in economic growth.

Even though the study uses the most recent data available (2017), it would be interesting to repeat the analysis with further figures from future studies, to extend our research to other sectors.

We are confident that this would help to understand whether future results collected from other countries will follow the highlighted patterns of this study and/or how the difficulties encountered in innovation have been addressed.

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