Innovation activity of Hungarian SMEs: an empirical examination

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Abstract: While there has been great attention surrounding researches on innovation on the macro level (eg. propagation rate of innovations, spatial pattern, tender systems, contribution to economic performance, etc.), research on the firm-level (micro level) have been pushed to the background due to the high costs associated with data collection. In my view, making statements about the micro level of innovation without having the necessary firm-level data can only be done under restricted conditions. For this article I used University of Pécs' Small Business Competitiveness Research Group's (led by Prof. Dr. László Szerb) small business database, regarding innovation of new or improved products and services, and innovation of production/service processes. This is the database which I intend to analyse in this article, using descriptive statistics, relationship exploratory statistics and cluster analysis.

1 The relationship of SMEs and innovation

In the European Union and Hungary, the significance of SMEs is well known. The sector cannot be neglected for many reasons: it's share in overall economic performance, role in job creation, retaining economic-social plurality, balancing territorial inequality, the increasing life quality owing to the diversified value proposition and self-realization of the individual are all significant. Therefore, the number of studies examining small businesses and their business environment has increased extremely fast in previous years.

The Small Business Act of Europe (SBA) has warned for years that there are many weak spots in Hungary's SBA profile (most recent is COM 207). Out of the SBA fact sheets' 9 pillars Hungary performs below the EU average in 6, and two out of this (including skills & innovation) shows a deteriorating trend in the 2007-2018 time frame. The variables within skill & innovation – except for one – are all unfavourable.

As a result of the EU's policies the Hungary's Office for National Economic Planning made an action plan in 2013, called „SME strategy for 2014-2020" (NTH 2013). The document contains the situation analysis, which results in low

growth potential of the SME sector as a root problem. One of the reasons for low growth potential was the weakness of innovation activity.

Innovation activity at the firm-level (micro level) and generally the success and / or failure of enterprises may be influenced by a number of factors. Without the need for completeness: the legal environment (legal protection or other regulations), the institutional factors, (higher) education system, state R & D & I systems, accounting and taxation systems (eg. accounting for innovation costs), the company's external relationships (eg. cooperation), the country's average level of development (primarily technical-technological), the financing of innovation, the infrastructural conditions of innovation, the general economic environment, general supply and demand conditions and certain elements of the socio-cultural environment (eg. social acceptance / reception of innovation) can have a significant impact on innovation activity individually and as an interconnected system as well.

The innovation activity, the operation and success (or survival) of SMEs are shaped by many firm-size-specific advantages and difficulties at a micro level. These characteristics are well known from the literature of the small business management (eg. Man et al. 2002, Dholakia – Kshetri 2004, Aragón-Sánchez – Sánchez-Marín 2005, Singh et al. 2007, Vecsenyi 2011, Longenecker et al. 2016).

Small businesses – unlike large firms – handle much less resources, run less processes and activities, and produce smaller quantities of products and services on a narrower palette. All this makes it possible to keep the organizational structure flat, making communication and decision making faster and more efficient. Small and informal working relationships are typical for small businesses, the operation is less formalized, the employee's work satisfaction is higher, and the familiar atmosphere is more typical.

These features provide flexibility so that small businesses can respond in an adaptive way to the effects of the economic environment and to changes in the segment of the buyer's markets and to concentrate on precious corners with specific, unique needs. Flexibility supports firm-level innovation processes, because of which new ideas are often incubated in small businesses (valuable for large companies as well). Meeting the focus and meeting individual needs also increases social well-being and quality of life. This is especially the case in most of the national economies in the dominant service sectors where demand for investment and entry barriers are typically lower.

Many sector related difficulties can be found in small businesses' lives. Managing tasks are most often carried out by the owner, and rarely have professional management. The use of management methods is less typical, decision making is rather intuitive and ad hoc.

Much of small businesses operate on a linear, functional basis or on a blended organizational structure organized on their own. It is known that in the linear

organization there is an overload of managerial staff, and in the functional organization over time, performance reserves are necessarily generated. In addition, there is a limited range of internal division of labour, no specialized positions, employees need to understand multiple tasks, there is no place for "hijackers".

In such organizations the top executives carry out all the “unowned” tasks, and operate all activities and functions with no agent, which will be the other source of the burden. When the top manager is overwhelmed with operational tasks, he cannot pay enough attention to matters of strategic importance or to the organization's development and future success. He tends to anchor and stay in the magic of the first idea – the founding idea – and renewal becomes cumbersome. They are limited in information about funding opportunities, co-operation or internationalization, as well as potential EU / national tenders. The development of dependence of the operating processes on top managers is also rapid, which makes it difficult to pass on managerial tasks to specialized professionals, succession and a possible sale.

Small businesses will be characterized by under-capitalization. Generally lacking financial management, these small businesses usually cannot get the adequate financial resources they need. Innovation typically is a cost in the present, and only in the future does it contribute to financial performance. In business however a large part of the decisions are made on the basis of ex-post financial data, which leads to innovation having low priority. If these difficulties cannot be effectively addressed, they will be the source of uncompetitiveness, founder and growth “traps” and the loss of orientation in customer segments.

After the description of firm-size-specific advantages and difficulties of SMEs determining / influencing firm-level innovation activity, it is necessary to define business innovation as well, to create a clear basic conceptual base. (In this paper I ignore the discussion of debate about the definitions of innovation, the description of evolution of concepts, and the introduction of the trans- and multidisciplinary aspects of innovation.) Among the many existing innovation definitions, it is my view that the following application is the most promising when we look at innovation at firm-level and we give this notion a meaning based on that: innovation is a multifaceted process by which companies transform their ideas into new or improved products / services, production / service processes, methods used in company and / or business models in order to succeed, develop, compete and differentiate themselves in their market segments (using Baregheh et al., 2009). I also considered the application of the general business innovation concept to be appropriate for SMEs as well.

The scope of methods used in company is the only one that needs to be clarified in the definition: sales, marketing, investment, finance, management, organizational structure, HRM, work organization ... etc. methods are also covered, which is why

the definition is broad, and the practice that complies with it can be realized in many ways.

2 Empirical examinations

The Small Business Competitiveness Research Group of University of Pécs, led by Prof. Dr. László Szerb, was kind to provide an SME dataset for my disposal, which was compiled for years, starting in 2013 (date stamp of version used: 01/01/2017). The data set included a questionnaire on the self-assessment of innovation activity, whose empirical analysis results have not been implemented yet, have not been published.

2.1 Introduction of sample and observed variables

The dataset contained data of 987 Hungarian small businesses, from which I have filtered duplications, organizations that are not considered SMEs under COM 2003, 361/EC, responses with missing critically deficient answers, registered but non-operating companies and companies involved in liquidation, winding-up and / or bankruptcy. The filtered sample number is n=768.

The sample is not representative in terms of firm-size categories, geographic location (according to NUTS1 / NUTS2) and / or sectoral affiliation (according to TEÁOR'08), and the deviation from the composition of the population cannot be corrected by a weighting system with statistically acceptable weights. Because of the lack of representativeness, the conclusions of analysis cannot be generalized to the basic population. Nevertheless the sample is suitable for conducting interesting investigations. Now I show the composition of the sample along the firm-size categories from the various options of the listed nominal (observed) cross-variables (Table 1).

1. Smaller sized micro enterprise	employs 1.001-4.999 people	250 pcs	32.55%
2. Bigger sized micro enterprise	employs 5.000-9.999 people	186 pcs	24.22%
3. Smaller sized small enterprise	employs 10.000-19.999 people	134 pcs	17.45%
4. Bigger sized small enterprise	employs 20.000-49.999 people	121 pcs	15.76%
5. Medium sized enterprise	employs 50.000-249.999 people	77 pcs	10.03%
	Sum:	768 pcs	100.00%

Table 1
Firms size composition of the sample (n=768)

The implementation of the described business innovation conceptualization is possible in 8 ways, among which the dataset can be examined in boldface in Table 2. Respondents were asked about the intensity of innovation activity and the

answers were requested on a scale of 0 to 3 (0: none; 1: low intensity; 2: medium intensity; 3: high intensity).

Improvement of existing products/services	***Development and introduction of new products/services***
Improvement of existing production/service processes	***Development and introduction of new production/service processes***
Improvement of already used methods within the company	*Development and introduction of new methods*
Improvement of existing business model	*Development and introduction of new business model*

Table 2
Examined areas of implementation of business innovation

In addition, respondents were asked about the success of innovation, intellectual property under industrial property rights, related costs and benefits, and innovation co-operation. In this paper, I only analyse variables suitable for communicating consistent results.

2.2 Results and discussion

In 174 SMEs (in case of 22.66% of the total sample) “some” innovation activity was associated with "some" efforts intensity. The proportion of different sized enterprises that belonged to innovators are as follows: 14% of smaller sized micro enterprises, 24.2% of bigger sized micro enterprises, 25.4% of smaller sized small enterprises, 32.2% of bigger sized small enterprises and 27.3% of medium sized enterprises. 24.7% of innovative companies innovate in 1, 23.0% in 2, 16.7% in 3, 33.9% in 4 areas of innovation (1.7% did not elaborate innovation activity). Table 3 shows the frequency and relative frequency of responses by area and the intensity of related innovation efforts.

Areas of innovation	sum			Intensity of the related innovation efforts [pcs]		
	freq. [pcs]	rel. freq. [%] in proportion to innovators	rel. freq. [%] in proportion to total sample	low	medium	high
Existing prod./service	116	66.7%	15.1%	26	59	31
New prod./service	130	74.7%	16.9%	28	64	38
Existing process	113	64.9%	14.7%	31	56	26
New process	87	50.0%	11.3%	19	48	20

Table 3
Intensity of innovation examined by areas (n=174)

This means that 26.2% of all (intensity-weighted) innovation efforts target the improvement of existing products / services; 29.9% targets new products / services

development and introduction, 24.5% targets existing process improvement, and 19.4% targets new process development and introduction.

I also examined whether there was any dependency between the different areas. During the cross-variable independence test between ordinal variables, I formulated the following conditions: a) a strong condition is that the asymptotic significance of Pearson's $\chi 2$ test shall be below the 0.050 threshold; (b) a weak condition is that the proportion of cells have expected count less than 5 cases shall be below the 20% threshold; and the minimum expected count shall be above a threshold of 1. Of the usable indicators of crosstab statistics for ordinary variables and non-symmetric tables, I chose Kendall's τc and Goodman-Kruskal's γ to assess the strength of the relationship. It is known that γ sometimes overestimates the strength of the relationship, so I examined the difference between τc and γ. If the difference is greater than 0.05, then τc is considered, γ if smaller. The results are shown in Table 4.

		New prod./service		Existing process		New process	
		Results	Evaluation	Results	Evaluation	Results	Evaluation
Existing prod./service	Pearson $\chi 2$ test value	39.079	OK	75.597	OK	54.113	OK
	Pearson $\chi 2$ test asymp. sign.	0.000		0.000		0.000	
	Ratio of cells having expected count less than 5 [%]	12.5%	OK	18.8%	OK	25.0%	NO[1]
	Minimum expected count [pcs]	4.18	OK	3.89	OK	2.84	OK
	Kendall's τc	**0.220**	moderately strong connection	**0.337**	strong connection	**0.226**	moderately strong connection
	Goodman-Kruskal's γ	0.305		0.460		0.348	
New prod./service	Pearson $\chi 2$ test value	–	–	31.107	OK	44.436	OK
	Pearson $\chi 2$ test asymp. sign.	–	–	0.000		0.000	
	Ratio of cells having expected count less than 5 [%]	–	–	12.5%	OK	31.2%	NO[1]
	Minimum expected count [pcs]	–	–	4.18	OK	3.06	OK
	Kendall's τc	–	–	0.053	no or very weak connection	**0.153**	weak connection
	Goodman-Kruskal's γ	–	–	**0.074**		0.237	
Existing process	Pearson $\chi 2$ test value	–	–	–	–	150.091	OK
	Pearson $\chi 2$ test asymp. sign.	–	–	–	–	0.000	
	Ratio of cells having expected count less than 5 [%]	–	–	–	–	25.0%	NO[1]
	Minimum expected count [pcs]	–	–	–	–	2.84	OK
	Kendall's τc	–	–	–	–	**0.494**	extremely strong connection
	Goodman-Kruskal's γ	–	–	–	–	0.708	

Comment: [1] = one weak condition is not met.

Table 4

Crosstab statistics of areas of innovation (n=174)

The table shows that the innovations of existing and new processes are strongly related, and these are often go hand in hand. Similarly, there is a significant, but substantially inferior relationship between existing products / services and existing processes. This is probably due to the fact that existing features are often (though not always) enough to cover existing competencies, so such innovations are likely to be less costly.

In the following, I implemented a cluster analysis based on the similarity of properties, involving the normalized values of the intensity of the innovation activity associated with each area. As a first step, I examined the desirable number of clusters to be created by hierarchical cluster analysis using the Ward method based on the squared Euclidean distance. Based on the agglomeration schedule and the dendogram, it is recommended to create 5 clusters. After that the cluster formation was done with K-means cluster analysis. The relevance of the 5 groups was confirmed by the ANOVA table. Table 5 shows the number of cases, the relative frequency of the generated subsamples (relative to the innovators and to the total sample), the average of normalized intensity values by areas of innovation and the name of the cluster.

Cluster No.	freq. [pcs]	rel. freq. [%] in proportion to innovators	rel. freq. [%] in proportion to total sample	Average of normalized innovation intensity values (per area per cluster)					Description
				Existing prod./service	New prod./service	Existing process	New process	Sum	
1	53	30.5%	6.9%	0.09	0.32	0.15	0.16	0.71	low intensity innovators
2	47	27.0%	6.1%	**0.58**	**0.69**	0.19	0.05	1.51	product developers
3	17	9.8%	2.2%	**0.61**	0.10	**0.78**	0.26	1.75	developing the existing ones
4	13	7.5%	1.7%	0.15	0.31	**0.74**	**0.80**	2.00	process developers
5	44	25.3%	5.7%	**0.79**	**0.80**	**0.77**	**0.75**	3.11	high intensity innovators

Table 5
Characterization of innovation activity clusters (n=174)

An attempt was made to investigate the relationships between the innovation activity clusters and the nominal (observed) cross-variables (firm-size-category, NUTS1, NUTS2 geographical location, size (and status) of settlement where firm operates, sectoral affiliation based on the TEÁOR'08 code of the most important activity and the ownership background). Only one significant linkage emerged in this test: the frequency of occurrence of high intensity innovators is the lowest among smaller size micro-enterprises and it grows as firm-size increases. Among medium sized enterprises the presence of high intensity innovators is lower than in the size category of bigger sized small enterprises but is still high in comparison to other groups. The statistical evidences of connection between firm-size-category and presence of high intensity innovators: Pearson's $\chi 2$ test of association had a value of 9.892 (n=174) and the asymptotic significance was below the 0.050 threshold (0.042). The weak conditions were also met: the proportion of cells have expected count less than 5 cases was below the 20% threshold (0.00%), and the

minimum expected count was above a threshold of 1 (5.31). The strength of relationship between the nominal variables was measured by Cramer's V value (φc), which showed a moderately strong relationship of 0.238. With no other nominal (observed) cross-variables was it possible to detect a consistent relationship. Although interesting, geographical and sectoral difference could be observed, but they did not prove to be significant.

We have conducted some interesting observations on the level of simple variables:

- Direct cost allocation to innovation activity was not present in 43.2% of innovative companies. Expenditure on innovation activity is proportional to the 3% or less of the net sales revenue in 59.5% of companies; 5% or less in 73.0% ; 10% or less in 86.5% of companies (n=174).
- We listed 10 innovation co-operation partners for each of the respondents, in each case we asked for an evaluation of cooperation on the [1-3] scale. In the weighted co-operation rankings co-operations with competitors, technology parks (geographically close-to-field sector actors) and public research centres proved to be the closest. Interestingly, at the end of the ranking we find the buyers and suppliers. It appears that companies are in a "meeting-expecting" relationship with customers and suppliers, with less chance and intensity to innovate with them, although it is known that they are the most often starting points of innovation (theoretically).

Conclusions

In my view, drawing conclusions from the firm-level can only be done by examining firm-level data. It is not different in case of studying the innovation activity of SMEs. The focus of the article was the empirical analysis of a questionnaire for innovation activity in a non-representative dataset containing n=768 (n'=174) Hungarian SMEs. In addition, apart from the presentation of some other interesting results from the level of simple variables, I examined the intensity of the innovation efforts of firms for new or improved products / services and production / service processes.

22.66% of the sample SMEs carried out innovation activity in at least one of the examined areas, while 7.68% of the sampled firms made efforts in all four areas. Generally speaking, the development of products / services is + 27.80% more intensive than the development of production / service processes. Compering the different directions it is also clear that "novelty" has higher priority when firms implement product / service innovation and the key phrase of "improving the existing ones" is more important when they innovate processes.

Innovation activities in different fields are related: simultaneous innovation of existing and new processes is very often, and firms develop existing products / services and existing processes at the same time moderately frequent.

The cluster analysis of innovation activities revealed: (1) 30.5% of innovative SMEs are low intensity innovators in all areas; (2) 27.0% are explicitly product developers; (3) 9.8% are only developing existing products / services and existing processes (4) 7.5% are process developers; (5) 25.3% are high intensity innovators.

In the sample, the frequency of occurrence of high intensity innovators is the lowest among smaller sized micro enterprises and it grows as firm-size increases till the firm-size-category of larger sized small enterprises. Among medium sized enterprises the presence of high intensity innovators is lower than in the size category of bigger sized small enterprises but is still high in comparison to other groups. It can also be considered that there was no statistical relation between the occurrence of high intensity innovators and other cross-variables (eg. no sectoral specificities).

Overall, besides research on systemic innovation it is important to have empirical researches on firm-level innovation activities as well, a topic to which I want to contribute with this article.

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