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The factors constraining innovation performance of SMEs in Croatia

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ABSTRACT

The aim of this article is to identify innovation barriers that limit innovation performance of small and medium enterprises (SME) in Croatia. Data are obtained using an online survey. The sample consists of 94 SMEs that have experience in innovation activities. The impact of constraints to innovation is measured on five-point scale. Employing the factor analysis, we reduced number of variables to four factors. Cluster analysis is used to group SMEs according to factors that constrain their innovation activities. SMEs are grouped into three clusters. Results reveal that firms are mostly constrained by external factors. In two out of three clusters, firms report high intensity of financial constraints to their innovation activity. The findings reveal that the least pronounced constraints to innovation in SMEs in Croatia are organisational constraints.

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1. Introduction

Firms in Croatia report a rather low level of innovativeness. The Innovation Union Scoreboard (IUS) reveals that Croatia lags behind EU-27 in innovation activities (European Commission, 2014). In 2006 Croatia was listed among trailing countries (Eurostat Statistical Books, 2008). The latest data reveal that the situation is somewhat improved. Croatia joined the EU as one of the moderate innovator countries. For comparison, other EU countries in this group are Czech Republic, Greece, Hungary, Italy, Lithuania, Malta, Poland, Portugal, Slovakia and Spain. The Community Innovation Survey 2010 (CIS 2010) reveals that 42.4% of firms in Croatia are involved in innovation activity. In comparison to previous years this is an improvement, but it is still below the percentage of innovative firms in EU 27 (i.e., 52.9%) and most certainly below the percentage of innovators in Germany (79%) and Luxemburg (68%), for instance (Eurostat News Release No. 5/2013).

Innovation performance in Croatia is improving but it is still well below the EU average. According to IUS 2014 the growth rate of innovation performance in Croatia was only 0.8%, the lowest among moderate innovators. These trends are not satisfactory. More needs to be

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done in order to catch up with the EU average, especially knowing that the gap in innovation performance is increasing (European Commission, 2014). As the absence of innovation and low innovation performance generally are damaging for firms and consequently for the entire economy, it is important to explore factors that constrain innovation activities. Identifying and understanding what limits potential to innovate, or even make it impossible to innovate, help to explain low innovation performance.

Considering the large proportion of small and medium sized enterprises (SMEs) in the Croatian economy [1], the innovation performance of these firms is highly important. Currently, Croatia lags behind the EU-27 in terms of SMEs introducing product and process innovations, as well as SMEs introducing marketing and organisational innovation. In this article we seek to identify innovation barriers that limit innovation performance focusing particularly on SMEs.

We hypothesise that not all SMEs are equally exposed to all innovation constraints. Thus, we aim to group them according to factors that constrain innovation activities. This research enables us to identify the most pronounced constraints to innovation in SMEs in general and by groups. However, the nature of this research is fully exploratory.

The structure of the article is as follows: after the introduction we continue with the theoretical background in Section 2. Section 3 explains the research methodology, in Section 4 we present and discuss results. Finally, Section 5 gives conclusions.

2. Theoretical background

Firms' innovativeness can be explained by studying factors that enhance innovation performance but also by studying factors that impede it. First approach emphasises that innovation is driven by hard to copy internal resources (Cohen & Levinthal, 1990; Conner & Prahalad, 1996; Eisenhardt & Martin, 2000), self-motivation and internal technological capability (Bala Subrahmanya, 2005), corporate culture and investment in skilled labour (Tellis, Prabhu, & Chandy, 2009) and appropriate organisation structure (O'Connor & Ayers, 2005). In the above-cited work, the emphasis is on internal capabilities. External drivers are recognised by Porter (1990) who finds firms' capabilities to innovate affected by strong competition, demanding customers and aggressive suppliers. Unfavourable internal and external factors create unsupportive environment that can impede and constrain innovation activities and, in other words, means the presence of obstacles to innovation.

Why firms do not innovate, or why they do not innovate on a larger scale, or why they do not innovate with a particular type of innovation can be understood by explaining the effects of constraints to innovation. A good deal of research on constraints to innovation relies on the CIS data set. Examples are Mohnen, Palm, van der Loeff, and Tiwary (2008), Galia, Mancini, and Morandi (2012), Iammarino, Sanna-Randaccio, and Savona (2007), D'Este, Iammarino, Savona, and von Tunzelmann (2008), to name just a few. Earlier contributions to the literature that are not based on CIS data include work of Piatier (1984) and later Hadjimanolis (1999, 2003).

Although constraints to innovation approach aim to explain why firms don't innovate, this question is surprisingly complex to explore. Piatier (1984) emphasised that the most interesting cases in terms of barriers to innovation are mostly not included in surveys, simply because truly constrained firms eventually stop operating due to their inability to innovate. They are hard to identify and not included in survey samples. Non-innovators are

not in a position to fully perceive and experience constraints to innovation. Extant studies confirm that innovators perceive constraint at higher level than non-innovators (Mohnen, Palm, Shim van der Loeff, & Tiwary, 2008). D'Este et al. (2008) point out the importance of distinguishing between non-innovators that aspire to innovate and non-innovators that show no effort to innovate at all. According to their analysis, this approach enables more realistic conclusions on differences between perceptions of obstacles between innovators and non-innovators.

Furthermore, D'Este, Iammarino, Savona, and von Tunzelmann (2012) argue it should be distinguished between barriers that affect degrees of innovation activities experienced mostly by innovative firms (or revealed barriers) and barriers that hinder firms from innovation activities (deterring barriers). Innovators face many problems and risks but they are motivated to overcome them due to their superior market position (e.g., Carpenter & Nakamoto, 1989) and increase of profitability (Cho & Pucik, 2005) that can be achieved through innovation.

Just as innovations are driven and fostered by internal and external factors, problems and constraints to innovation can be of both internal and external origin. This is how they are classified by Piatier (1984). According to Hadjimanolis (2003) there are general and relative barriers, as well as objective and perceptual barriers. General barriers are those that affect all firms regardless of sectors, while relative barriers are rather sector specific. Certain factors can be subjectively perceived as obstacles to innovation unlike the objective barriers that are indeed present and constrain innovation performance. CIS measures the importance of cost, knowledge and market factors that generally covers internal and external problems. Given the abundance of literature based on CIS data set, these are the most often studied constraints to innovation. Incorporating constraints that originate from within firm and those caused by external conditions gives a comprehensive view.

The absence of support within the firm seriously inhibits innovation activities. While it can be argued that this can be improved and eventually changed with the efforts inside the firms, it is important to bear in mind that a firm cannot isolate itself and its innovation activities from the outside environment. These are not controlled by firms and thus they can be more difficult to overcome. Literature on innovation systems can help us understand how external factors create barriers to innovation of particular type. Firms operating within different innovation systems manage innovation differently, putting the emphasis on different factors (Lam & Lundvall, 2007). Lundvall, Johnson, Andersen, and Dalum (2002) explain how other firms, agents, institutions and networks drive innovation in firms. Furthermore, Galia et al. (2012) studied the effects of national innovation system on obstacles to innovation and found that firms operating within different innovation systems experience different obstacles to innovation. These authors point out the importance of country specific policies for minimising obstacles to innovation.

Insufficient amounts in firms for financing research and development (R&D) but also problems to access finances outside of firm can seriously impact innovation performance. Access to finance is very pronounced issue for firms engaged in innovation projects (D´Este, Rentocchini, & Vega-Jurado, 2014). They are highly pronounced in young, small and medium firms engaged in R&D activities (Segarra, García-Quevedo, & Teruel, 2013). Presence of financial constraints strongly decreases probability of innovation activity (Savignac, 2008) and affects investment in R&D (Tiwari, Mohnen, Palm, & van der Loeff, 2007). R&D investment in SMEs is more sensitive to financial constraints and SMEs abandon more R&D

projects due to the inability to finance (Czarnitzki & Hottenrott, 2011). Financial constraints are a widely present obstacle to innovation activity despite all the steps taken to improve access to finance and alleviate this problem (Mohnen et al., 2008). Hyytinen and Toivanen (2005) provide evidence that public funding helps firms dependent on external finances to overcome financial obstacles and innovate.

In this article we rely on respondents' perception of factor presence and impact rather than measure their objective intensity. Relying on perception instead of objective measures of constraints has some disadvantages. Perception does not necessarily capture the state of the problem. This can provide an explanation, to a certain extent, why some studies (such as Hadjimanolis, 1999) found no correlation between constraints and innovativeness. However, it is difficult to define an appropriate measure of many constraints and measure their presence with great precision. Therefore, studies often rely on perception (D'Este et al., 2014; D'Este et al., 2012; Galia & Legros, 2004; Mohnen & Röller, 2005; Tourigny & Le, 2004).

Relying on extant findings of constraint literature and acknowledging the above-mentioned arguments, in our study we include firms that have experience with innovation activities, i.e., firms that: (1) have developed innovation; and/or (2) perform R&D either continuously or occasionally; and/or (3) employ R&D personnel. The focus of this study is not on firms hindered by obstacles to the level that cause them to stop operating. Although that approach would enable valuable insights, rather we aim to understand how to increase the innovation output of innovative SMEs, and also how to create an environment in which more SMEs will be able to initiate innovation projects. For this purpose, innovating firms provide the answers that reflect the situation more realistically.

3. Research methodology

The data for this study were collected employing an online survey. This choice most certainly affects quality of answers. The absence of the interviewer who could provide additional explanations might result in misleading answers. In order to avoid this problem, for the concepts that could be easily misinterpreted by respondents, we used description rather than the term widely used in the literature. For instance, in the questionnaire (in Croatian) we use 'capability to adopt new knowledge inside the firm' instead of 'absorptive capacity'.

The link to the questionnaire was sent to the directors of 750 enterprises. In designing the sample we focused on manufacturing and service sector (excluding financial sector). In order to increase a response rate, follow-ups, i.e., e-mail and telephone prompts were used. In the literature, the follow-ups are considered as the most effective technique for obtaining a high response rate (Kanuk & Berenson, 1975). E-mail and telephone prompts resulted in a 12.5% response rate; that is 94 received filled questionnaires. Given this is an exploratory study; the sample size is assessed to be sufficient.

The sample is dominated by innovators (Table 1) that is expected considering the survey design. Eighty per cent of respondents report successful innovation development in the period from 2007 to 2011. Furthermore, the majority of them (that is 42.6%) conduct intramural R&D continuously. Inbound R&D is performed occasionally by 26.6%, while 30.9% report no R&D. On average, R&D performing firms invested 792,747 HRK in R&D in 2011.

Firms in the sample employ on average 32.3 employees. As for the education of the employees, 11.6 of employees hold university degrees, while 2.9 employees work in R&D.

Table 1. Characteristics of the sample.

Firms that report innovation development (%)	79.8
Continuous R&D (%)	42.6
Occasional R&D (%)	26.6
No R&D (%)	30.9
R&D expenditure (mean, in HRK)	792,747
Number of R&D staff (mean)	2.9
Number of employees (mean)	32.3
Number of employees with university degree (mean)	11.6

Source: authors' calculations.

The impact of constraints to innovation was measured on 5-point scale (1 = no impact at all and 5 = strong constraints innovation activity). As the aim was to explain constraints to innovation activities in detail and measure and describe problems accurately, we started with a rather broad set of variables. Initially, 29 constraining factors were included in the questionnaire relying on extant literature on both constraints and enablers of innovation. As some of the constraints are closely related to others, representing only an aspect of more general issues, it was important to group them into factors that describe what constraints innovation potential of SMEs and thereby reduce the number of variables. This was accomplished by employing factor analysis. Polychoric correlations were analysed with the minimum rank factor analysis method and the oblique rotation method was applied. Items loaded heavily on more than one factor, and items that did not load heavily on either factor were deleted and removed from further analysis. The procedure resulted in the removal of 13 items[2]. The remaining constraints are grouped in four factors that are linear combinations of sets of variables. According to Kaiser-Guttman criterion, four factors were extracted for final solution with 15 items. The four-factor solution explained 80.8% of the variance. Both the Kaiser-Meyer-Olkin measure of sampling adequacy (0.725) and Bartlett's test of sphericity (630.5, df=105, p=0.000) indicate acceptable levels of appropriateness of factor analysis. The factors are discussed in more detail in Section 4.

Afterwards, a k-means cluster analysis is performed in order to generate groups regarding the perceived intensity of constraint to innovation. This method enables us to group firms into minimum within-group and maximum between-group variation clusters. We hypothesise that SMEs can be classified into three clusters regarding the intensity of constraining factors. In particular, we expect to find:

- Group of SMEs that, above all, face serious financial problems that impede their innovation performance,
- Group of SMEs that face pronounced internal constraints to innovation, and
- Group of SMEs constrained predominantly by external constraints.

4. Results and discussion of results

In this section we start with exploring constrains and their intensity. Then we turn to cluster analysis, that is, we classify SMEs into clusters and explore characteristic of each cluster.

As explained in the previous section, the number of constraints was reduced to four factors. Factor 1 includes organisational constraints. They are internal support to innovation, business strategy, organisational structure and communication inside the firm. Factor

2 refers to financial problems related to the environment outside the firm (availability of bank loans, cost of external sources of finances and undeveloped financial market). Factor 3 consists of variables referring to market constraints. They are the following: the main market is too small, saturated and dominated by incumbents, problems in finding a suitable partner for cooperation and too rigid regulations. Factor 4 refers to uncertainty related to innovation activities and protection of innovation. Variables in this factor have a high level of perceived risk and patenting policy. Table 2 gives the factor loadings for each variable.

Mean values of impact of constraining factors reveal that firms are strongly constrained by financial issues. Measured on a 5-point scale, the mean value of impact of financial issues is 2.96 (Table 3). This, however, is not the most pronounced issue in innovating SMEs. Market constraints are found to be the most constraining factor, with the mean value 3.11. Furthermore, firms in the sample complain about uncertainty related problems. Organisational constraints are found to be less present constraints to innovation.

When we compare each constraint separately, the most pronounced problems are incumbent dominated market, overly rigid regulations, lack of external sources of finance and imperfections of financial market.

Our results indicate that organisational constraints, i.e., those related to support within the firms are not pronounced. Namely, the least salient constraints in SMEs are insufficient support from top management, colleagues and other business functions, as well as existing business strategy (Table 2). Those constraints, along with perceived risk of innovation as a constraining factor, analysed separately have the lowest means. Overall mean for factor referring to organisational constraints is 1.85, slightly higher than mean for constraints that come as a result of uncertainty (2.16).

Table 2. Means and factor loadings.

		Means	Factor loadings
Factor 1	Insufficient support from top management	1.60	0.821
	Insufficient support from colleagues in the firm	1.56	0.949
	Insufficient support from other business functions	1.69	0.844
	Business strategy currently applied	1.73	0.683
	Unsupportive and rigid organisational structure	2.26	0.704
	Lack of communication inside the firm	2.23	0.837
Factor 2	Unavailability of bank loans	2.80	0.750
	Lack of external sources of finance	3.04	0.882
	Imperfections of financial market	3.03	0.850
Factor 3	Main market too small	3.13	0.654
	Main market too saturated	2.60	0.739
	Market dominated by incumbent	3.41	0.791
	Impossible to find a suitable partner for cooperation	2.70	0.307
	Regulations too rigid	3.32	0.516
Factor 4	Perceived risk	1.70	0.493
	Patent policy	2.62	0.974

Source: authors' calculations.

Table 3. Mean values of constraining factors, N=94.

		Mean	Standard deviation
Factor 1	Organisational constraints	1.85	0.82
Factor 2	Financial constraints	2.96	1.22
Factor 3	Market constraints	3.11	0.96
Factor 4	Uncertainty related constraints	2.16	0.94

Source: authors' calculations.

Employing the cluster analysis, we generated three clusters. Cluster 1 consists of 21 firms that perceive constraints at quite high level. The perceived intensity of each of the four factors is higher than average (Table 4). The most pronounced constraints are those regarding to finances (mean 3.52) followed by market constraint (mean 3.31). Organisational constraints appear to be the least pronounced of the four constraints in this group of firms.

For 34 cases grouped in Cluster 2 the biggest problem refers to market constraints. Intensity of factors strength in this cluster is below the sample mean. Their impact is lower than in the firms belonging to Cluster 1 and Cluster 3. Uncertainty problems (Factor 4) are reported to be the second most pronounced constraining factor. Perceived impact is still lower than in other two Clusters. Firms in Cluster 2 don't struggle heavily with organisational problems.

Cluster 3 is the largest and consists of 39 cases. Firms in this group report the highest intensity of financial and market constraint, even higher than firms in Cluster 1. The importance of these two factors is above the sample mean. The biggest problem these firms face again refers to factor 2 – financial constraint closely followed by factor 3 – market constraints. As for factors 1 and 4, Cluster 3 follows the same pattern as the Cluster 2. Mean value of factors 1 and 4 are close to means of Cluster 2, only slightly higher. This Cluster gathers SMEs constrained primarily by financial problems. While the results of cluster analysis don't fully support our assumption of set of SMEs that struggle with internal problems, there is clearly a group of SMEs with very pronounced problems of financing their innovation activities. In fact, in two out of three clusters, firms report high intensity of financial constraints to their innovation activity. Firms in Cluster 2 are dominantly constrained by external factors. Thus, our assumption on external factors as main constraint to innovation for some SMEs is supported. However, we did not identify a group of firms whose innovation activities are limited primarily by internal constraints. In fact, SMEs in general reported these as the least pronounced constraints to innovation.

In the remainder of this section we depict a profile of each cluster. In comparison to other two clusters, the SMEs in Cluster 2 are the least exposed to the constraints. This is evident in their innovation performance. Although Cluster 2 firms report somewhat less radical innovation than the firms in Cluster 3, they still perform better in radical innovation development (61.76%) than firms in cluster 1 (42.86%). Continuous engagement in R&D is reported by 50% of firms in the cluster, this is more than in the other two clusters. Furthermore, firms in this cluster invest high amount in R&D (in average 1,099,057 HRK). On average, 40.71 employees employed in SMEs in Cluster 2 hold university degree, more than it is the case in Cluster 1 and 3 (Table 5). The majority of firms in Cluster 3 are from the service sector. Almost 60% of them operate in computer programming, consultancy and related activities, architectural and engineering activities; technical testing and analysis,

Table 4. Cluster means.

	Cluster 1 (21 cases)		Cluster 2 (34 cases)		Cluster 3 (39 cases)	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Factor 1	3.03	0.79	1.46	0.41	1.54	0.44
Factor 2	3.52	0.89	1.69	0.59	3.76	0.79
Factor 3	3.31	0.96	2.47	0.78	3.57	0.80
Factor 4	3.26	0.86	1.81	0.77	1.87	0.63

Source: authors' calculations.

Table 5. Characteristics of SMEs in three clusters.

	Cluster 1	Cluster 2	Cluster 3
Firms that report innovation development (%)	66.7	79.41	87.18
Radical innovation development (%)	42.86	61.76	64.10
Continuous R&D (%)	33.33	50.00	43.59
Occasional R&D (%)	14.29	23.53	33.33
No R&D (%)	52.38	26.47	23.08
R&D expenditure (mean, in HRK)	280,000.1	1,099,057	720,093.2
Manufacturing firms (%)	57.89	41.94	48.65
Number of R&D staff (mean)	2.71	2.16	2.69
Number of employees (mean)	39.4	40.71	21.35
Number of employees with university degree (mean)	9.05	13.58	11.37

Source: authors' calculations.

Scientific research and development, advertising and market research and other professional, scientific and technical activities.

Unlike Cluster 2, Cluster 1 is mostly manufacturing firms (57.89%) operating in the following industries: Manufacture of chemicals and chemical products, Manufacture of basic pharmaceutical products and pharmaceutical preparations, Manufacture of basic metals, Manufacture of other non-metallic mineral products, Manufacture of computer, electronic and optical products, Manufacture of electrical equipment, Manufacture of machinery and equipment, Manufacture of motor vehicles, trailers and semi-trailers, Manufacture of other transport equipment, Repair and installation of machinery and equipment. On average, 39.40% of employees hold university degrees. The intensity of all four factors in Cluster 1 is high. Impact of the problems can be observed in innovation performance of SMEs belonging to this cluster. Dominant are firms with no R&D (52.38%). The proportion of radical innovators is the lowest compared to the other two clusters. Average R&D expenditure is less than half the amount invested in firms belonging to Cluster 3, and almost 820,000 HRK less than the mean investment reported by firms in Cluster 2.

As for the Cluster 3, it is evident they struggle the most with lack of finances for innovation activities. Their average R&D expenditure is 720,093.2 HRK that is less than in Cluster 2. Despite the unavailability of financial resources, SMEs in Cluster 3 report involvement in R&D (43.59% continuously and 33.33% occasionally). They, in fact, perform more R&D then SMEs in Cluster 2. Moreover, there are fewer firms with no R&D at all then in Cluster 1. In terms of having developed an innovation (87.18%) and radical innovation development (64.10%), Cluster 3 performs well regardless of the financial issues they face. In Cluster 3 48.65% of firms are from manufacturing, namely Manufacture of food products, Manufacture of leather, Manufacture of paper and paper products, Manufacture of chemicals and chemical products, Manufacture of basic pharmaceutical products and pharmaceutical preparations, Manufacture of rubber and plastic products, Manufacture of fabricated metal products, except machinery and equipment, Manufacture of electrical equipment, Manufacture of machinery and equipment, Manufacture of other transport equipment, and Manufacture of furniture and Other manufacturing.

5. Conclusion

The results of this exploratory study provide an insight into problems that impact innovation activities and lead to low innovation performance in SMEs in Croatia. There are evidently

SMEs (mostly from the manufacturing sector) whose innovation performance suffers due to financial constraints. Public funding is one possible solution of financial issues. However, currently this is not the case as SMEs report a lack of public funding and government support. Although the variable referring to public funding and the government support programme was omitted due to factor analysis results, descriptive statistics for this variable reveals it is perceived by SMEs as one of the more serious constraints for their innovation activities. From this we can speculate that SMEs assess that the innovation system is not supportive enough. Policymakers interested in improving innovation performance should take this into account. One of the biggest constraints can be lessened by more public support, through both public funding and other measures. This, of course, requires not just introduction of innovation programmes but also their appropriate design.

However, results indicate that SMEs in Croatia struggle with problems related to the market. This is a wide-spread obstacle faced by both the group dominated by services as well as manufacturing firms and groups focused on radical innovation to different extend and groups with different average R&D investments. Market size and its saturation, big and strong companies with well-established market position as well as regulation are found to be serious constraint to innovation in SMEs. Possible solution to these problems is entering new markets. However, SMEs often don't possess all necessary experience and capabilities to compete on the international market.

The most encouraging finding of the survey is that SMEs do not face problems when it comes to learning and creating knowledge. Both adoption and creation of knowledge are crucial for innovation activities and firms that struggle with problems of this kind are less likely to improve innovation performance in the short-run. In comparison to knowledge related issues, problems such as financial issues are a lot easier to overcome.

The findings indicate that some constraints to innovation are more persistent in some sectors. In clusters dominated by services we identified an interesting pattern. The innovation performance of these firms is the least constrained and the most pronounced problems are those related to market characteristics. This indicates that policies should consider sector differences when designing appropriate tools for alleviating constraint to innovation. Also, future research should focus on exploring sectorial differences even further. Special focus can be placed on technology intensive sectors and their comparison to less technology intensive sectors in terms of constraints to innovation.

Considering that some obstacles are likely to prevail in some regions depending on regional innovativeness (Toedtling & Trippl, 2005), the findings of this research provide inputs for policies aiming to improve innovation performance in countries with moderate level of innovativeness.

Notes

1. According to structural business statistics data published by the Croatian Bureau of Statistics (2013) 99.7% of firms operating in non-financial sectors in 2011 in Croatia were SMEs, i.e., firms employing less than 250 people.
2. Those include lack of finances inside the firm, low absorptive capacity, lack of specific knowledge on technology, low level of knowledge on customer needs, low level of knowledge on competitors, lack of willingness to cooperate with external subjects, lack of capacity to establish collaboration with external subjects, lack of willingness to initiate changes, lack of qualified employees, lack of public funding programmes for innovation activities, lack

of experience in innovation activities, business culture does not support creativity and complicated process of testing and approving new products. The full list of variables and the statistics are available from the corresponding author upon request.

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