Innovation in Croatian Enterprises: Preliminary Findings from Community Innovation Survey

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Abstract

This paper reports preliminary results of the first Community Innovation Survey conducted in Croatia. The survey collects internationally comparable enterprise-level data on inputs and outputs of innovation processes in Croatian companies, covering the period from 2001 to 2003. Key survey findings are summarized and compared to selected countries of Central and Eastern Europe. These include the data on product and process innovation, expenditure on innovation activities, intramural research, information sources for innovation and factors that constrain innovation. Moreover, the relationships between some firm characteristics (firm size and ownership) and innovation are examined. Although the data provide some encouragement in terms of innovation outputs, unfavorable structure of innovation expenditures, widespread occurrence of intra-organizational constraints to innovation and failures in commercialization of innovations and/or their integration into business strategies concerns corroborate the assumptions that the movements towards a knowledge-driven economy in Croatia are still quite weak – emphasizing the need for policy improvements.

Keywords: innovation, innovation management, innovation policy, Community Innovation Survey
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1 Introduction

Innovation tends to be considered as a pivotal driver of both economic growth and competitiveness of companies and sectors. However, measurement and analysis of innovative activities and their impacts at micro-, meso-, and macro-levels have often been burdened with conceptual and applicative difficulties. Following the Oslo Manual (OECD, 1996), a methodology for collecting and interpreting enterprise-level data on technological and organisational innovation has been developed and applied to the countries of European Union, as well as accession countries. In addition to economic imperatives, transition economies of Central and Eastern Europe, have tended to embrace the innovation-related issues within their accession into the European Union, which states the development of a knowledge-based economy as a crucial policy goal.

In addition to underlining the importance of innovation for economic growth in the context of restructuring of the Croatian economy, the paper reports key preliminary results of the first Community Innovation Survey conducted in 2004 on a stratified representative sample of manufacturing and service enterprises in relevant sectors. The survey collected internationally comparable data on inputs, outputs and obstacles to innovation processes in Croatian companies, covering the period from 2001 to 2003. After basic insights into the methodology, the paper focuses on inputs (e.g. expenses, financing, R&D, sources of information), outputs (e.g. types of innovation) and obstacles of innovative activities. We then analyse the characteristics of innovative firms such as size and ownership, and finally offer some concluding remarks.

2 Innovation and Economic Growth

Recent years have seen the emphasis of the relationship between innovation and economic growth (Aralica and Bačić, 2004). For instance, there is a general consensus among economists that technological innovation plays a central role in the process of long-run economic growth (Radosevic, 2003, p. 4). Neoclassical growth theory (Solow, 1956) has not elucidated how the technological progress is achieved, although it perceived such progress as a source of growth. Within endogenous growth models (i.e. models based on externalities, Neoschumpeterian models and AK models) technological progress continues to be perceived as the main source of growth, but such models view it as a result of activity of firms and/or individuals (Romer, 1986, 1990). In the models based on externalities, learning from other firms within an industry leads to new ideas

that may result in technological progress. Knowledge, with which technological progress is identified, is considered free and thus can be easily spilled over. Neoschumpeterian models stipulate that research and development can spur economic growth (Grossman and Helpman, 1990, 1991; Aghion and Howitt, 1992). Namely, in the context of imperfect competition, firms will have an incentive to innovate since they can protect the innovation via patenting, thereby achieving strategic advantage and gaining extra profits. Within the AK models (e.g. Jones and Manuelli, 1990) economic growth stems from capital accumulation whereby capital is viewed as an agglomeration of different forms, including human and physical capital. However, these models fail to differentiate technology from physical capital, which makes them comparatively less sophisticated even in relation to the neoclassical Solow's (1956) model (Romer, 1999).

At the micro-level, the role of innovative SMEs in modern economies has been emphasised; such enterprises, which develop specific capabilities and are often included into corporate production networks, are characterized by higher rates of employment and output growth than other SMEs and large enterprises (Iliev and Račić, 2003). At the macroeconomic level, innovation tends to contribute to the accumulation of capital, and growth of employment and multifactor productivity (OECD, 2001). However, the relationship between research and development (R&D) expenditures and growth is not straightforward. Although significant, aggregate R&D explains limited part of variation of growth. This suggests that the factors such as allocation of R&D resources, and the mechanisms of creation, dissemination and commercial exploitation of knowledge matter fundamentally. These factors are significantly influenced by the national innovative capacity (Stern, Porter and Furman, 2000), which covers the ability of a country to produce and commercialise a long-term flow of innovative technology. R&D or ability to generate new knowledge is only one component of broader concept of national innovative capacity. Among other issues, national innovative capacity depends on the strength of a strong common innovation infrastructure, i.e. cross-cutting factors that contribute to innovation throughout the economy. Hereby the crucial factors include the science and technology policy, mechanisms for the support of basic research, and the accumulated stock of technological knowledge including diffusion and utilisation of the existing knowledge. Consequently, government policies can play an influential role in the facilitation of innovation - notably through support for R&D, education and labour market policies, entrepreneurship support, and the promotion of interaction among different organisations within the national innovation system (including the research institutions, business firms and government).

The realisation of the importance of innovative activities and innovation policy has recently been facilitated by two key factors. Firstly, there has been an exhaustion of growth and productivity improvements based on defensive restructuring and non-investment reallocation of resources (Mickiewicz and Radosevic, 2001). Since competition on the basis of low wages is an unfavourable and unsustainable strategic option for most of these economies, their long-term competitiveness requires technological advancement and the development of innovative capacities. Moreover, most of these countries are being integrated into the European Union. The EU is already the main foreign trade partner and the source of FDI for transition economies during the pre-accession period, which reinforces the need for maintaining and improving internal and external competitiveness. Furthermore, the EU not only states the development of a knowledge-based economy as a crucial policy goal for its current members, but also requires from the candidate countries to demonstrate the same orientation. Namely, innovation and increased technological change in new member states are viewed as fundamental to their economic convergence with current members and the cohesion of the enlarged EU. Consequently, maintenance of productivity and GDP growth require new mechanisms for supporting innovation and industrial upgrading (EC, 2001, p. 11). If transition economies are to catch up with the EU in terms if economic growth, that is likely to require increased competitiveness of firms and sectors in those economies i.e. their ability to withstand competitive pressures within the Union (Radosevic, 2003).

3 The Environment for Innovation in Croatia

In terms of relative wages, Croatia fares badly in comparison to the rest of CEE, which undermined the competitiveness of several traditional export-oriented sectors (e.g. textiles and apparel industries). On the other hand, retarded levels of technological capacity and product and process innovation have not provided an alternative route to competitiveness. The examples of internationally competitive innovations have been sporadic and they have rarely induced strong spillover effects. Moreover, inadequate factor markets (i.e. inflexible labour market and underdeveloped capital market) and insufficiently supportive policy mechanisms have even encouraged dislocation of certain activities to other CEE countries. Deteriorating competitiveness of Croatian exports has been observed both in the EU-15 and former CEFTA markets (National Competitiveness Council, 2003).

Therefore, the necessity for the development of innovative activities supported by adequate innovation policy is paramount for the catching up in terms of technological advancement, product and process developments and the resulting competitiveness of the Croatian economy. However, the realisation of this need by researchers and policy makers and the development of adequate policy mechanisms have been relatively slow and occasionally inconsistent. The economic policies mostly focused on macroeconomic stabilisation, reforms of the financial system, taxation and the pension system, and liberalisation of trade and exchange regimes. When it came to microeconomic issues, the policies have often been related to privatisation and restructuring of existing enterprises; even in these areas the success has been mixed due to political influences and weak institutional frameworks (Račić and Cvijanović, 2004). Consequently, not enough emphasis was given to the issues of new enterprise development, promotion of innovative activities, creation and effective functioning of interfaces between research community and industry, or the facilitation of integration of innovative enterprises into local, national and global industrial networks (Račić et. al., 2004). Moreover, due to inadequate investment promotion policy, the FDI inflows have predominantly occurred through privatisation of existing firms for market seeking reasons, mainly in the services sectors (transportation and telecommunication; financial intermediation; retail), and they have not resulted in significant technology transfers or spillovers (Bačić, Račić and Ahec-Šonje, 2004). More recently, there have been improvements within the area of enterprise development: new credit lines have been secured, and better technical assistance to entrepreneurs provided, which had noticeable effects on the performance of the SME sector and led to wider acknowledgement of its role in the economic growth and job creation.

The existing research into innovation (Radas, 2003a; Radas, 2003b), innovation policy (Švarc, 2004; Andrijević-Matovac, 2003; Aralica and Bačić, 2004) and competitiveness (National Competitiveness Council, 2003) indicates inadequate innovation performance of the Croatian economy and deficiencies in the processes supporting the development and commercialisation of new knowledge. However, these findings have not been supported by comprehensive firm-level innovation surveys that could also give insights into specific firm- and sector- level issues and support the formulation of a more effective innovation policy. First such survey has been conducted in 2004, and the remainder of the paper presents some of its preliminary findings.

4 Empirical Foundations and Methodology

Empirical basis for this paper is being obtained through the first Community Innovation Survey (CIS) in Croatia. In this survey enterprise-level data are collected in accordance with the Oslo Manual (OECD, 1996) guidelines and the available literature on the implementation of CIS III (e.g. Kurik et al., 2002; Boia et al., 2003a). The survey covers the period from 2001 to 2003. In addition to general information about the enterprise, the survey includes the data on the following aspects of innovation activities: product and process innovation, expenditures on innovation activities, intramural research and experimental development, innovation cooperation, information sources for innovation, factors hampering innovation activities, innovation protection, and important strategic and organisational changes in the enterprise. The survey is based on a stratified representative sample of all Croatian enterprises in relevant manufacturing and service sectors. Consequently, the survey is to provide comprehensive overview of innovative activities in Croatian enterprises, which should form a basis for the formulation of more effective innovation policy. Although the survey provides a fairly comprehensive data set, it also has a number of important shortcomings that can affect the validity and usefulness of the data, which have been tackled, among others, by Archibugi and Pianta (1996), Radosevic (1999) and Criscuolo and Haskel (2003)[1]. However, the shortcomings can be controlled to some extent by careful survey implementation and subsequent application of analytical techniques (for an example, see Boia et al., 2003b). The questionnaire was initially sent to companies by mail. Those who failed to respond to the initial mailing were contacted by phone. Those who still did not reply have received an additional mailing and a phone reminder. The survey was administered from May 2004 onwards. Preliminary findings have been reported on the basis of the first 617 valid responses from companies in relevant manufacturing and service sectors.

5 Innovative Activities: Inputs, Outputs and Obstacles

In this section we tackle some of the basic results from our survey, which deal with main inputs into innovation activities (structure of innovation expenditures, R&D activities undertaken and the persons employed in innovation-related activities), outputs of such

[1] *The shortcomings stem from various factors ranging from the sampling procedure to definitional issues, composition of the questionnaire, and the implementation process. Moreover, since CIS is a voluntary postal survey, the results are necessarily subjective.*

activities (i.e. the types of innovations observed[2]) and the main obstacles to innovation activities and processes.

5.1 Structure of Innovation Expenditures

The majority of innovation expenditures are related to acquisition of machinery or equipment (83.1%). This indicates that innovative processes in Croatian companies are mainly oriented at purchase and use of "embodied" technologies (innovative machinery and plants). Although this type of innovation costs is also high in EU (50%) (Radosevic, 1999), its overwhelming position in the structure of innovation expenditures observed in Croatian companies is quite problematic. These investments do not seem to be accompanied by adequate technology transfer processes, i.e. they do not regularly lead to new innovations based on the acquired technology. Consequently, the investments in patents, licenses and know-how (4.0%) and education (1.3%) do not feature prominently. Furthermore, only 10.1% of innovation expenditures are related to intramural R&D. Extramural R&D is represented by only 1% of total innovation expenditures, which indicates very weak co-operation between companies and research institutions, as it has already been reported in similar studies (Radas et al., 2003). Total R&D expenditures (11.1%) considerably lag behind the EU average, which amounted to 41% in 1998 (Radosevic, 1999). Finally, expenditures for marketing of innovations are represented only by 0.4% of the total, which indicates a major drawback to the possibilities of market success of innovated products and processes.

[2] *Within the questionnaire, innovation is defined as the creation of a new or significantly improved product (good or service) introduced to the market as well as a new or significantly improved process introduced within a company. By innovation we consider those activities that are based on the results of new technological developments, new combinations of existing technology or utilization of other knowledge by the company. Product innovations cover goods and services that are either new or significantly improved with respect to fundamental characteristics, technical specifications, incorporated software, or other immaterial components, intended uses, or user friendliness. Product innovations should be new to the company, even if they are not necessarily new to the market. It does not matter whether the innovation was developed by the company or by another entity. Changes of a solely aesthetical nature, and pure selling of innovations produced and developed by other companies, are not included.*

Table 1. **Structure of innovation expenditures**	
Type of expenditure	**Percentage**
Intramural R&D	10.1
Extramural R&D	1.0
Acquisition of machinery/equipment	83.1
Patents, licenses, know-how	4.0
Education and training	1.3
Design	0.2
Marketing	0.4

5.2 R&D Activities

Although intramural R&D makes only 10.1% of total innovation expenditures, 19.4% of the surveyed companies continuously engage in intramural R&D, whereas 16.9% of companies undertake intramural R&D occasionally. The combined figure of 36.3% companies engaged in intramural R&D at least at some level of intensity puts Croatia above Poland (10.7%) and Slovenia (22.7%) (Radosevic, 1999). Although such a high percentage signifies a large proportion of firms engaged in R&D, low share of R&D in total innovation expenditures (11.1%) implies that R&D is predominantly a non-core concern within corporate strategies. Since innovation activity is mainly related to equipment, R&D activities are currently insufficiently related to reaping of economic benefits through marketable products and/or more efficient processes.

Correspondingly, the majority of companies engaged in intramural R&D have small R&D teams with 1-3 researchers, whereas R&D departments of more than 10 persons exist in 2.2 percent of companies - as it can be seen in Table 2. Although the overall proportion of companies with R&D personnel has been fairly stable in the observed period, a negligible increase of the proportion of larger R&D teams can be discerned.

Table 2. **Number of employees engaged in intramural R&D**		
Number of employees	**2001 (%)**	**2003 (%)**
1-3	20.9	19.6
4-10	5.8	8.3
11-20	0.9	1.1
21 and more	0.9	1.1
No intramural R&D	63.7	63.7
No answer	7.8	6.2

5.3 Sources of Information for Innovation

The most important sources of information for innovations are fairs and exhibitions (11.6), suppliers of equipment, materials, components or software (11.2), and professional conferences, meetings, journals (11.1). Universities and companies for research and development are given low importance (6.9 and 3.9), which further indicates weakness of co-operation and technology transfer between research and business sectors.

Table 3. **Sources of information for innovations**

Sources of information	**Importance of the source**
Within the enterprise	9.5
Other enterprises within your concern	6.0
Suppliers of equipment, materials, components or software	11.2
Clients or customers	9.6
Competitors and other firms from the same industry	10.6
Consultants	7.1
Universities and higher schools, their units and institutes	6.9
Companies for research and development	3.9
Professional conferences, meetings, journals	11.1
Expert associations	10.1
Fairs and exhibitions	11.6
Technical standards	9.6
Standards and regulations connected with health and protection	10.1
Standards and regulations connected with environmental protection	9.5

Importance of sources of information is calculated by giving weights to each level of importance (high 0.6, medium 0.3, low 0.1), and by summing up weighted frequencies.

5.4 Type of Innovations

The percentage of companies that have introduced new or significantly improved products during the period between 2001 and 2003 amounts to 36.6 per cent. On the other hand, the percentage of companies that have introduced new or significantly improved production process in the aforementioned period is 31.1 per cent. Both figures seem fairly high and may be partially due to bias towards innovative firms (which are more likely to respond to a voluntary survey), as well as to possible over-reporting. For example, comparable data for Estonia and the UK are 27 and 18 per cent for product

innovations, and 23 and 15 per cent for process innovations respectively (Stockdale, 2002 and Kurik et al., 2002)[3].

5.5 Obstacles to Innovation

Factors that hamper innovation activities should carry strong features of the economic environment in which companies operate, but they may also reflect particular characteristics of organizational strategy and culture, which may be more or less supportive of innovation activities. The following table shows the main obstacles for innovation activities and their perceived degree of importance.

Table 4. **Obstacles to innovation activities**

Factors	**Importance of the factor**
Excessive perceived economic risk	10.9
Innovation costs too high	10.0
Lack of appropriate source of finance	10.9
Market decrease	9.8
Organizational rigidity	9.5
Lack of qualified staff	10.6
Lack of information concerning technology	11.8
Lack of information concerning market	13.0
Insufficient support from the state for innovation activities	9.3
Insufficient flexibility of regulations or standards	9.9
Lack of customer responsiveness to new goods or services	11.8

Importance of hampering factors is calculated by giving weights to each level of importance (high 0.6, medium 0.3, low 0.1), and by summing up weighted frequencies.

The most important hampering factors are lack of information concerning market (13.0), lack of information concerning technology (11.8), lack of customer responsiveness to new goods or services (11.8). It can be observed that these are predominantly marketing-related, which can be linked to the rather low share of overall innovation expenditures allocated to marketing activities.

Furthermore, insufficient support from the state seems to be the least important hampering factor. This reinforces the claim that the main obstacles to innovation are within companies, rather than in insufficiencies in state support or the lack of funds for

[3] *The Estonian data have been obtained through CIS 3, whereas the UK data stem from CIS 2.*

innovative activities. However, this is also likely to be related to the unfavorable structure of innovation expenditures, since the role of the state becomes more pronounced as innovative activities in enterprises (and in innovative SMEs in particular) begin to revolve around R&D and networking, rather than around purchase of equipment, as it is currently the case in Croatia.

6 Firm Characteristics

In this section we examine the relationship between some firm characteristics and innovation. In particular, we consider firm size and firm ownership and examine whether they have any impact on innovation output.

6.1 Firm Size

There is a large body of literature devoted to examining the relationship between the firm size and innovative activities. Some authors posit that several things cause the positive effect of firm size on innovation. For example, large firms can take advantage of scale and scope economies in productions of innovations. They have the ability to better spread the risk of R&D by conducting many projects at the same time, and to recover the investment through sufficiently large sales. They also often have better access to external finance. For manufacturing industry some studies justify the existence of a positive effect of firm size on innovation activity (Cohen (1995), Freeman and Soete (2001)). For services, a study by Arias-Aranda et al. (2001) found that firm size is positively related to innovation. Opposite arguments have also been suggested in Scherer and Ross (1990), Acs and Audretsch (1990, 1991) and Pavitt et al. (1987). These studies show that the relationship between firm size and innovation depends on industry sectors, definition of innovation output and other variables. However, Symeonides (1996) points out that most authors would probably agree that innovative output tends to rise with firm size, but less than proportionally, although other patterns were also suggested for particular industries, periods or countries.

In this study we measured firm size by number of employees. Firms were divided into four groups: firms with 9 employees or less (so called micro firms), firms from 10 to 49 employees, firms from 50 to 250 employees, and finally firms with more than 250 employees.

To examine if there is any relationship between firm size and innovation in Croatia, we first observe how many firms innovate in every size segment. For the EU and several CEE countries, CIS data shows that there is a positive relationship between firm size and the fact that the firm innovated; namely there is a higher share of innovating firms among large firms than among other groups (Radosevic, 1999). This same pattern is found in Croatian study, namely there is a much higher share of innovating firms among those firms with more than 250 employees. There is smaller percentage of micro and small firms that report innovation, both in products and processes, but there is a relatively high percentage of innovating firms among medium firms (between 50 and 250 employees). Please see table 5 for details.

Table 5. **Percentage of innovating firms related to size**

Firm size	Both product and process	Only product	Only process
	Innovative	Innovative	Innovative
0-9	36.33%	30.04%	24.12%
10-49	49.74%	40.84%	36.32%
50-250	57.61%	49.45%	41.30%
>251	76.32%	63.16%	63.89%
	Pearson Chi Square 29.05, df=3, p=0.000002	Pearson Chi Square 21.95, df=3, p=0.000067	Pearson Chi Square 26.92, df=3, p=0.000006

It is obvious from the table 5 that the share of innovative enterprises increases with firm size. This is not unexpected finding, because it is shown in extant CIS studies that propensity to innovate generally increases with firm size. This finding, which is true for all the EU countries and those candidate countries that performed CIS surveys, confirms Schumpeter's argument that large firms stimulate innovations.

When we compare share of innovative firms in Croatia with the share of innovative firms in the EU, we find that these numbers are very close (table 6). This is a very unexpected finding, and it certainly does not mean that Croatia is as innovative as the EU (unfortunately abundant anecdotal evidence points to the contrary). We have to take in account the fact that a very large number of companies did not respond to the survey. It is only natural to assume that most of them are non-innovative companies, since it is logical that such companies would not take the time to fill out an innovation survey.[4] This would mean that the percentage of innovating firms is in reality much lower.

[4] *It is known that CIS samples can be biased towards innovating firms (Radosevic, 1999).*

Table 6. **Proportions of enterprises with innovation activity in EU and Croatia**		
Firm size	**EU***	**Croatia**
10-49	39%	50%
50-250	60%	58%
>251	77%	76%

** The data for the EU is from the most recent third CIS survey.*

Apart from exploring if firm size is related to the fact that companies innovated, we examine a related issue of whether the structure of innovation output depends on firm size. We would actually expect that this relationship does exist in Croatia. For example, in Croatia larger firms have more resources that can be devoted to innovations development, which can result in their ability to develop and commercialise larger number of new products than smaller firms. This should hold true in particular for incremental new products, where economies of scale, power in distribution channel and better management and marketing skills are more important. Regarding radically new products, one could again make the case for large companies. Croatian industry is for the most part capital intensive, and small firms do not posses adequate resources for investment that radical innovation requires. In addition, radical innovation usually requires research proficiency. Many small firms simply do not have enough research "man-power", because majority of active research scientists who are employed in industry work for large companies. To prove that point, we regressed the number of highly educated employees against the total number of employees. Resulting regression shows that the number of highly educated employees increases with firm size.[5]

As measures of innovation output, we consider number of new products and their share in firm's sales. We first divide new products in three categories according to how new they are to the firm and to the consumers (here we followed established CIS methodology). The first category consists of products that are not very new for the firm, but are new for the market. An example of such product is when company lengthens its product line with new offerings. For instance, a chocolate producer introduces a chocolate with a novel filling or some new properties (chocolates with 70% or more cocoa were an example of such product when they first appeared on the market). Here the firm has necessary technology and experience, so it does not consider the product to be very new from their perspective, although it is new for the consumers. This is a very good situation for the company, because it can enjoy first mover advantage with minimal

[5] *$F=581.56$, $p=0.0000$, adjusted $R^2=56.33\%$.*

investment. Second category consists of products that are new for the firm and not new for the market. For example, if a company that regularly produces chocolate starts producing chocolate ice cream, this will be quite new for the company (it needs new equipment, technology and expertise), but consumers would consider it as just another chocolate ice cream. Since this involves certain investment in new product development for the firm, such new product must be able to return the investment unless its role is to be the loss leader and to fulfil certain strategic mission in the company portfolio. The last category of products that we consider is those products that are new both for the company and for the firm. Such radical innovations require substantial investments in terms of heavy R&D, special organizational arrangements and developmental activities, but they present huge profit opportunities.

We conducted regression analysis to examine whether the number of new products in each category is related to the firm size. We expected to find that the larger the size, the more new products are introduced. We conducted three separate regressions (one for each new product type) with the number of new products of specific type as dependent variable and number of employees as independent variable. All three regressions turned out to be non-significant[6], suggesting that in our sample there is no relationship between size and the number of new products of any type.

Next we conducted three separate regressions (one for each new product category) to examine whether the share of sales from new products depends on the firm size. We found that regressions for the first new product category (i.e. products not new for the firm, but new for the market) is significant, but does not have a good fit[7]. The other two regressions are not significant[8]. These findings show that the share of new products in sales does not depend on firm size except for the products that are line extensions (not new for the firm but new for the market), where we detect a decreasing trend. This last result is contrary to findings in Radosevic (1999), who points out that for the EU the shares of new products in firm sales follow a U type relationship (share is larger for small and large firms than for medium ones). However, because of the low fit in our data

[6] *Regression statistics for "not new for the firm, new for the market" are p=0.57, F=0.56, regression statistics for "new for the firm, not new for the market" are p= 0.33, F=1.11, regression statistics for "new for the firm and for the market" are p= 0.79, F=0.29.*

[7] *Function is decreasing, p= 0.017, F=4.23, adjusted R^2=6.5%.*

[8] *Regression statistics for "new for the firm, not new for the market" are p= 0.058, F=2.93, regression statistics for "new for the firm and for the market" are p= 0.099, F=2.37.*

it would be dangerous to draw general conclusions about capability of large Croatian enterprises to commercialise innovations[9].

Another interesting issue is where innovations are developed. Here we adopt four categories from extant CIS surveys. Namely, innovations can be developed by the enterprise, or by the enterprise in collaboration with other companies and institutions. Innovations could be developed by other companies and institutions, or they could be developed by the enterprise group that a company belongs to. Not surprisingly, overwhelming majority of firms that answered that question reported that they developed their innovations within their enterprise and without any collaboration. Table 7 compares Croatian results with the EU results from the most recent CIS survey (European Communities, 2004).

Table 7. **Percentage of innovators developing innovations with selected partners***

	Croatia		EU	
	Product	**Process**	**Product**	**Process**
Developed by the enterprise or the enterprise group	26%	18%	66%	57%
Developed in collaboration with other companies and institutions	6%	9%	18%	25%
Developed by other companies and institutions	3%	3%	9%	9%

** Percentages in columns do not add up to 100 because of the non-response.*

To investigate that issue further, we explored whether firms of different sizes differ in where they develop innovations. For example, large firms often have larger networks and could develop more products in collaborations than small firms. To test whether firm size is related to where the innovation is developed, we used the Chi-square statistics. We found that this relationship is statistically significant[10]. For all firms size groups, majority of products are developed mostly in-house, but this is most pronounced for micro and small firms. On the contrary, among the companies that develop their products in-house but in collaboration with other firms and institutions, there are more medium and large firms than micro and small firms. This reflects weak network structure of small firms. This result is not surprising; as all CIS surveys show that large firms are more networked than the small ones. Interestingly, the interaction between firm size and the

[9] *It should be noted that such discrepancy could be also caused by industry structure.*

[10] *Pearson Chi Square 22.78, df=9, p=0.007. Less than half of product innovating firms supplied the information about the place where the products were developed.*

place where new processes are developed is not statistically significant[11]. Again as for the new products, we observe that most new processes are developed in-house. Certain percentage of processes is developed in-house, but in collaboration with other companies or institutions. This percentage is larger for processes than for products, which reflects the nature of technological process where certain procedures can be adopted from outside and then improved on. Please see table 8 for details.

Table 8. **Where new products/processes were developed**

	Developed by the enterprise		**Developed in the enterprise group that the company belongs to**		**Developed in collaboration with other companies or institutions**		**Developed by other companies or institutions**	
Size	Product	Process	Product	Process	Product	Process	Product	Process
0-9	7.80%	59.26%	0%	0%	18.06%	29.63%	11.11%	11.11%
10-49	82.67%	63.77%	1.33%	1.45%	6.67%	21.74%	9.33%	13.04%
50-249	58.14%	58.33%	11.63%	5.56%	20.93%	30.56%	9.30%	5.56%
>250	59.09%	47.83%	0%	0%	31.82%	43.48%	9.09%	8.70%

Extant literature shows that new products and processes are connected, namely the firms that develop new processes also develop new products (Koschatzky et al., 2001; Radas, 2003a, Radosevic, 1999). This relationship is confirmed again in this study, where we find a strong and significant correlation between the number of new products and the number of new processes introduced from 2001 to 2003[12]. This reflects the fact that to realize new products, especially those of higher novelty, firms have to improve outdated technologies and processes.

It might be beneficial for the company to enter into collaboration with another company or institution when developing certain types of new products. For example, when developing a product new for the firm but not new for the market, it might be better to collaborate with a company that already has required expertise and technology. On the other hand, products that are not new for the firm would be better produced in-house. Development of radical innovations might benefit from collaboration with a research institute. If these hypotheses are true, we might be able, for example, to find that on average larger number of products that are new for the firm but not new for the market

[11] *Pearson Chi Square 10.59, df=9, p=0.3. Less than half of process innovating firms supplied the information about the place where the processes were developed.*

[12] *R=0.55, p=0.0000.*

are developed in collaborations. To investigate that issue further, we used the location where product was developed[13] as a categorical factor in ANOVA analysis, and then we examined whether there are any differences among the mean numbers of new products for each location. We performed such analysis for every category of new product separately, and did not find any significant effects. To check if this effect is dependent on the firm size, ANOVA was performed for all firm size groups separately. Again, no significant relationship was discovered. This indicates that for every new product category, the number of new products is not related to where the product is developed. This same result holds for all four groups of enterprises (micro, small, medium and large). This means that all our hypotheses stated in the beginning of this paragraph should be rejected.

Regarding innovation expenses, in EU total innovation expenditures per employee increase with firm size (Radosevic 1999), indicating that there is a positive relationship between firm size and innovation intensity. Interestingly, we do not find that effect in Croatia. On the contrary, we find that the total innovation expenditures per employee are decreasing with firm size. Although we observe that innovation expenses per employee are lowest in large firms, the variability of the data is so large that this effect is not statistically significant (ANOVA analysis was performed, p=0.26). Please see table 9 for details.

Table 9. **Innovation expenditures per employee[14]**

Firm size	Mean innovation expenditures for innovative firms
0-9	1109.414
10-49	9069.315
50-249	132.551
>250	15.552

This finding might suggest that large firms do not make sufficient investments in innovation, which could seriously hamper their innovation capability in the future.

[13] *These items are: developed by the enterprise, developed in the enterprise group that the company belongs to, developed in collaboration with other companies or institutions, developed by other companies or institutions.*

[14] *Expenditures are expressed in HRK 1000.*

6.2 Ownership and Innovativeness

Extant studies indicate that innovation capability for firms in CEECs could depend on their ownership structure (Bonin and Abel 1998, Bojnec 2000, Shipley et al. 1998). The rationale is that owners, being vitally interested in their business performance, will be strongly motivated to foster innovation. For example, Shipley et al. (1998) find that there is a higher incidence of new product development among privatised firms in Poland.

To examine whether the same is true in Croatia, the firms in the sample were divided in two groups: those that are in predominantly private ownership, and those in predominantly state ownership.

We first examine whether the share of innovative firms is larger among privately owned companies. Although we would expect to find many more innovative firms among private companies due to entrepreneurship, the data shows that the share of innovative firms is almost the same for both privately and state owned companies. The same fact is found in Radas (2003a) in a study of hundred leading Croatian firms. Similarly, Koschatsky et al. (1998) find that there is no relation between ownership structure and innovative performance in Slovenia, which they explain as the consequence of private owners being not yet developed enough to "…exert their ownership rights and supervise management ". It is possible that the same explanation would work for our findings, although to be precise we would need to control for a variety of factors.

However, when we look into the structure of innovation, we do find some indications that private companies might be more innovation active. In order to control for the type of the private company, we distinguished those that are newly formed (i.e. after 2001) from those firms that were established before 2001. When we explored if private and state owned companies differ in the number of new products, we found that the number of new introductions is on average indeed larger for private companies, as we would expect. However, ANOVA analysis showed that the effect is statistically insignificant for all three-product types, due to large data variability exhibited by state owned enterprises. Similar results are found when share of sales based on new products is examined in relation to ownership. Again we observe that privately owned firms indeed earn more of their sales from new products, but again because of large variability among state owned firms ANOVA showed that the relationship is not significant. Please see table 10 for details.

Table 10. **Innovation and ownership**			
	Mostly owned by state, state agencies and institutions	**Mostly privately owned**	
		Founded in the period 2001-2003	**Founded before 2001**
Innovated	25	5	227
Did not innovate	24	11	252
Average number of new products			
Not new for the firm, new for the market	3	4.3	3.5
New for the firm, not new for the market	0	5.6	5.3
New for the firm and for the market	3	2.4	1.3
Average share of new products in sales			
Not new for the firm, new for the market	1	23.1	23.0
New for the firm, not new for the market	0	13.6	14.9
New for the firm and for the market	1	14.3	14.3

An interesting question is whether the distribution of private and public innovative firms changes with firm size. Table 11 shows the distribution of the share of innovative firms across firm sizes and ownership. We observe that in all size groups, except among medium enterprises, the shares of innovative firms are almost the same. If we compare it to the results of Polish study from Radosevic (1999), we can see that the results are very similar for large enterprises, while for small and medium firms we observe certain differences. For example, more innovative enterprises are reported among small firms in Croatia than in Poland. This is true both for public and private ownership. Also, among privately owned Croatian firms there is a higher share of innovative enterprises than is reported in the Polish study. We need to take these comparisons with a grain of salt, as there might be differences in sampling and response that one would need to account for.

Table 11. **Share of innovative firms in Croatia and Poland**			
	Small	Medium	Large
	CROATIA, 2004		
Mostly owned by state, state agencies and institutions	0.16	0.40	0.44
Mostly privately owned	0.38	0.17	0.70
	POLAND, 1997		
Mostly owned by state, state agencies and institutions	0.16	0.44	0.74
Mostly privately owned	0.16	0.29	0.70

In conclusion, we can say that firm characteristics do have some bearing on innovation, although not all effects are statistically significant. Regarding firm size, we find that

share of innovative firms increases with firm size, i.e. the largest percentage of innovative firms can be found among large companies. Most new products are developed in house regardless of firm size, while medium and large firms engage in some collaboration with other companies and institutions. This collaboration is more pronounced for new processes than for new products. The average number of new products increases with firm size, but this effect is not statistically significant. However, the share of new products in firm's sales decreases with firm size. Both of these facts together suggest that large firms might lack ability to commercialise their innovations. We also observe that innovation expenditure per employee decreases with firm size. Although this effect is not statistically significant, comparison with the EU where innovation expenditure increases with size indicates that large firms do not invest enough in innovation.

Regarding firm ownership, contrary to expectations, we do not find larger share of innovative firms among privately owned companies. Similarly, we do not find statistically significant impact of ownership structure on innovation output, although private firms on average introduce more new products and have larger share of new products in income.

7 Concluding Remarks

Although recent years have seen the emphasis of the relationship between innovation and economic growth, this has not been sufficiently realized neither in the business practice of Croatian enterprises, nor in the development of an effective innovation policy. Consequently, the mechanisms of creation, dissemination and commercial exploitation of knowledge are still being developed, with varying degrees of success. In this context, the preliminary results of the Community Innovation Survey for the period between 2001 and 2003, which have been analyzed in this paper, have presented a mixed picture. Although the overall performance - in terms of product and process innovations - seems relatively strong, this still requires corroboration that could not be undertaken for the purpose of this paper.

The share of innovative firms increases with firm size. The largest percentage of innovative firms can be found among large enterprises. In our sample we have detected no relationship between size and the number of new products of any type. The share of new products in sales does not depend on firm size except for the products that are line

extensions (not new for the firm but new for the market), where we detect a decreasing trend. It is likely that enterprises innovate on the fringe of their businesses and thus fail to integrate innovation into their strategic concerns. Most new products are developed in-house - regardless of firm size. Medium and large firms engage in some collaboration with other companies and institutions – although more often when developing new processes than new products. Innovation expenditure per employee decreases with firm size, although this effect is not statistically significant. The predominance of investments into machinery and/or equipment in the structure of innovation expenditures – at the expense of research and development, patents, licensing, know-how and education – demonstrates a rather restrictive view of innovation and value-creation, which hinders the development of sustainable innovation capabilities.

Correspondingly, main obstacles to innovation seem to be within companies, rather than in insufficiencies in state support or in the lack of funds for innovative activities; the key obstacles are discerned in unsupportive organizational strategies and cultures, which result in inadequate managerial and marketing practices. Even if this is acknowledged, a need for improvements in innovation policy can be discerned – especially in order to stimulate business R&D, reduce the risks and costs of setting up and growth of new innovative SMEs and facilitate the collaboration between various actors in industrial networks. The policy areas that might be addressed in this context include science-industry collaboration, technology transfer, innovation finance and integration of innovative enterprises into wider industrial networks, as well as linkages between innovation policy and other (economic) policy areas – such as science and technology policy, enterprise policy and industrial policy.

Although enterprise-level data obtained through the Community Innovation Survey provide some encouragement in terms of innovation outputs, unfavorable structure of innovation expenditures, widespread occurrence of intra-organizational constraints to innovation and failures in commercialization of innovations corroborate the macro-level findings that economic growth is still largely driven by private consumption and investment in low-tech sectors with limited spillovers (i.e. construction), rather than through dynamic medium- and high-tech manufacturing and services. That leads us to the conclusion that the movements towards a knowledge-driven economy in Croatia are still quite weak – which necessitates urgent development of a more effective innovation policy.

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