CREATIVITY, INNOVATION EFFECTIVENESS AND PRODUCTIVE EFFICIENCY IN THE UNITED KINGDOM: A FIRM LEVEL ANALYSIS

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# *ABSTRACT*

*This paper explores the impact of creativity on innovation effectiveness and productive efficiency of firms. A multi stage CDM – type model is applied to the data from the UK Innovation Survey (2010-2012) to examine the role of managerial decisions to hire employees with creative skills in the different stages of innovation process. The results suggest that better effectiveness of innovation process has a positive impact on productive efficiency. The employees with creative skills are important factors for generation of novel ideas and the R&D process but the ability to meet customer requirements (innovation effectiveness) depends more on other organisational skills. Interesting findings are also obtained with respect to the forces driving innovation process across the sectors.*

**Keywords:** *Creativity, Innovation, Productivity, CDM model, Community Innovation Survey, UK Innovation Survey*

1. **Introduction**

Starting with endogenous growth and evolutionary literature it has been argued that through development of new products and processes firms can differentiate from their rivals and thus achieve above average returns (Schumpeter, 1942; Aghion and Howitt, 1992). Such propositions have led to a vast amount of empirical work on the relationship between innovativeness and efficiency (Hall et al., 2010). The results of this work suggest that investment in research and development (R&D) generates high positive private and even higher positive social returns. While the impact of innovations on various aspects of firm performance has been exhaustively investigated, the research on factors moulding the innovation process attracted much less academic interest. However, outside the field of economics, a range of disciplines including psychology and sociology have established that the innovation activities take place in an environment capable of harvesting creative efforts of individuals (Amabile, 2000; Miron, Erez and Naveh, 2004). To this end, there is the need to shed further light on the relationship between innovations and creativity.

While empirical research on the relationship between creativity and innovations is relatively scarce, its importance for innovations has been recognised by economists several decades ago. In his description of understanding of the functioning of capitalist economies Schumpeter (1942) states that the creative efforts of individuals are the principal driving wheel of the birth of new economic structures through the destruction of existing ones. It can be argued that creativity is the seed of the creation of new products, exploration of new production processes, search for new market niches, organisational and marketing innovations as well as any other form of innovation. Subsequent theoretical contributions such as endogenous growth (Aghion and Howitt, 1992) or the resource–based view (Kogut and Zander, 1994) have further contributed to the understanding of creativity as an key pillar in an entire innovation process.

With the above discussion in mind the objective of this paper is to explore the role of creativity in the innovation process at firm level in the United Kingdom. The data is extracted from the 2010-2012 UK Innovation Survey, a dataset with limited availability to researchers. This dataset contains information on innovation activities, creative skills and performance of firms. The methodological approach of paper is adherent to the line of research known as multi-stage innovation literature (Crepon et al., 1998; Hashi and Stojcic, 2013) which analyses different stages of the innovation process from the decision of firms to innovate, to their decision on innovation expenditure, the relationship between innovation input and innovation output and finally the impact of innovation output on firm productivity. The advantage of such approach is the ability to assess contributions of different factors to each stage of the innovation process while taking into account the potential interrelatedness between these stages and the potential endogeneity of individual variables. As such it can provide valuable recommendations to managers of innovative firms. To the best of our knowledge, there has been no such attempt to assess the role of creativity in different stages of the innovation process.

The paper is structured as follows. Next section provides an overview of existing research on the relationship between creativity, innovation effectiveness and productive efficiency. The characteristics of methodology and dataset are discussed in section three. The model of investigation is presented in section four and it is followed with discussion of results in section five. Finally, section six concludes.

1. **Creativity, innovation effectiveness and productive efficiency**

Recent research has highlighted the importance of employees’ creativity and its contribution to innovation which is crucial for profitable growth, increased market share and survival (Amabile, 2000; Miron, Erez and Naveh, 2004; Andari et al. 2007; Huggins and Clifton 2011; Cooke and De Propris 2011). Throughout the creativity literature and particularly the strand focused on organizational creativity, the term is interchangeably used with the term “innovation” with no clear distinction. Sternberg and Lubart (1999) define creativity as *“the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints”.* On the other hand *“innovation refers to the process of bringing any new problem solving idea into use, it is the generation, acceptance, and implementation of new ideas, processes, products, or services”* (Van deVen and Angle, 1989). This two interrelated concepts suggest that innovation is a process starting from a creative idea whose concept has market potential, has received funding and has overcome some of the obstacles such as technology challenges and competitive pressures. Hence, no innovation is possible without the creative processes as the latter is often an initial invention or deep insight in the first of several stages of innovation (Yusuf, 2009). The role of creativity in innovation is also emphasized by Shane (2003), who notes that many founding teams engage in various forms of brainstorming activities to enhance creativity and consequently lead to an innovation. However, it must be noted that although creativity is a necessary condition for innovation it is not a sufficient one as many ideas are not commercially viable or cannot be developed by employees who generate them (McMullen and Shepherd, 2006).

The creativity has been studied in the context of organizational learning and behaviour and the role of creative industries and occupations on innovation. The literature on organizational behaviour and management see creativity as a phenomenon that is initiated and exhibited at the individual and organizational level. Variables such as personality (Feist, 1999), motivation (Collins and Amabile, 1999), expertise (Weisberg, 1999) and intellectual capabilities (Sternberg, 1995) are related to creativity at the individual level. Recent research has emphasized that human and intellectual capital needs to be complemented with relational (Kale, Singh & Perlmutter, 2000) and social capital (Nahapiet & Ghoshal, 1998), underlining the importance of collaborative network inside organizations (Björk & Magnusson, 2009). The importance of R&D activities as a direct input to the innovation process as well as their potential to increase learning capability and absorptive capacity of firms has been particularly emphasized by Cohen and Levintahl (1990). It is argued that the speed, frequency and magnitude of innovation are increasingly dependent on creativity of individuals in and outside of organizations with no formal roles in the development of innovation (Baldwin and von Hippel, 2011; Mascia et al, 2015). Conaldi et al. (2012) and Tonellato (2014) found that individuals providing new ideas or suggestions on new products contributed to innovation.

Commercial success of innovations is a function of organizational capability and culture as different organizations have different capacities to absorb innovation in their management processes (Tushman and O’Reilly, 1997). Organizational environment has gained considerable attention among scholars when examining determinants of creativity (Amabile et al., 1996; Shalley, Gilson & Blum, 2000). It is argued that creativity is enhanced in environments characterised by unconventional ways of doing things, challenging authority, creating conflict and competition and taking risks (Baucus et al., 2008). The importance of environment is also emphasized by Isaksen et al. (1993) who argue that employees can produce creative accomplishments only after going through a creative process in an environment that enhances creativity. At the same time, the effectiveness of the innovation process and efficient functioning of organizations requires conformity and attention to detail (Miron, Erez and Naveh, 2004). As the latter two requirements are incongruent with creative climate it follows that today’s organizations face the challenges of how to create a creative environment in which employees are motivated to engage in creative activities but at the same time to meet organizational rules and standards (Mumford et al., 2002).

Martins and Terblanche (2003) developed a framework in which creativity is encouraged, supported and implemented. They argue that in more turbulent environments the greater is the incentive to learn and make continuous changes in products and technology used. Baron and Tang (2011) argue that the motivation to implement ideas is stronger in dynamic environments as they require rapid and effective innovations in products and services. Apart from the environment, the innovation strategy based on improvements in quality and service motivates people to seek information from outside (competitors, suppliers, customers) and will encourage them to make experiments and take risks (Lawson and Samson, 2001). A culture that is tolerant to risk is also more tolerant to entrepreneurial activity making individuals more ambitious to search for innovations (Yusuf, 2009). The existing evidence suggests that entrepreneurs exert a strong impact on the organization culture as founders’ values and motives define the nature of work environments and consequently affect creativity and innovation (Baum and Locke, 2004).

Flexible and decentralised organizational culture is considered to be supportive of creative action and innovativeness as it enables better flow of information that in turn facilitates teamwork and dissemination of ideas (Meyer, 1982; Nonaka, 1994; Garvin, 1993). Moreover, flexibility and a flat structure of organizations enable more autonomy and employee influence on work organization creating opportunities to innovate (Hill, 1996). Values like flexibility, freedom and teamwork will promote creativity and innovation while rigidity, control, predictability are more likely to hinder creativity and innovation (Arad et al., 1997). Finally, support mechanisms which facilitate a learning culture such as IT systems, training schemes or evaluation procedures based on creativity and innovation coupled with increased autonomy, communication and access to information may promote a learning culture, learning facilitation, expertise and professional development (Martins and Terblanche (2003). Emphasis on productivity and downsizing has detrimental effects on creativity and innovation (Filipczak, 1997). Amabile and Gryskiewicz (1987) found that lack of operational autonomy or lack of freedom over one’s work or ideas inhibited creativity.

Several scholars have argued that intrinsic motivation is likely to result in high creativity and therefore should provide opportunities by assigning employees to jobs that are challenging and complex in nature (Hackman and Oldham, 1980). Although the literature suggests that intrinsic motivation enhances creativity, some organizations rely on extrinsic rewards such as monetary incentives or recognition (Frese et al. 1999; Van Dijk and Van den Ende, 2002). However, Deci and Ryan (1985) argue that offering extrinsic rewards to individuals who work on complex jobs that produce high intrinsic motivation may have detrimental effects on their subsequent intrinsic motivation and creativity.

Another strand of the literature emphasizes the role of human capital and its creative component in influencing innovation, productivity and regional growth. In his creative capital theory Florida (2002) argues that formal educational attainment is less important than creativity since workers who are able to identify problems and figure out new organizational solutions combine ideas and knowledge in new innovative ways. He asserts that geography matters as the creative class is especially attracted to places that are characterized by a tolerant urban climate that is open to new ideas and to newcomers. This diversity then serves as an inspiration to the innovation process (Andersen and Lorenzen, 2005). However, recent critique by Glazer (2005) found an insignificant effect of the creative class of employees on economic performance once traditional measure of human capital such as schooling is controlled for. Furthermore the definition and measurement of the creative class defined by Florida is criticized by Markusen (2006) as certain professions entry to the creative class tends to be biased in favour of the higher educated people, thus excluding creativity of employees in occupations that require low levels of education (Markusen, 2006).

Ideas and creativity are crucial in so-called chain link model of innovation developed by Kline and Rosenberg (1986). Lundvall (1992) argues that interactive learning is crucial for the national system of innovation. The role of creativity in technology, culture and entrepreneurship is further explored by Cooke and Schwartz (2007). This work has prompted interest in creative industries and their effects on employment, regional development and innovation (Andari et al., 2007). The effect on the latter may be direct through improvements in product and process innovation or indirect through providing indirect inputs to upstream and downstream industries. The contribution of creative industries is closely related to the concept of open innovation which emphasize combination of a firm’s own innovative resources with external inputs. Innovation through creative industries may also be enhanced through mobility of workforce as people finding new jobs also bring their ideas, knowledge and creative potential with them (Leiponen, 2005).

Empirical work has mostly confirmed that creative industries are relatively innovative. Muller et al. (2009) explored the innovation performance of creative enterprises and their links to other sectors using a survey of more than 2,000 enterprises in creative industries in Austria. They found that creative enterprises are more innovative measured by share of enterprises introducing market novelties. Furthermore, they contribute to innovation activities in other industries especially for in-house R&D and for introducing novel product innovations. Champain et al. (2010) assess the level of innovation in the creative industries and their effects on product innovation, process innovation and soft innovation outputs relevant for creative industries. The results confirm that creative industries use more internal R&D and launch new product to a much larger extent than other industries. Overall, creative firms in almost all regions were twice as likely to have introduced new products to the market as businesses in other sectors.

Besides creative industries, recent research has emphasized the role of creative occupations as key drivers of innovation (Vinodrai, 2006; Cunningham and Higgs, 2009; Lee and Drever, 2012). Marrocu and Paci (2012), using spatial error models and controlling for local environment characteristics, find that across regions of the European Union highly educated individuals in creative occupations have a significant effect in overall production efficiency. On the other hand, Lee and Drever (2012) find no link between creative occupations and process innovation in London’s firms, but significant positive relationships with both new product innovation and modifications to existing products. A recent study by Lee and Rodriguez-Pose (2013) examined the interrelationship between creative industries, creative occupations and urban environment on innovation using data obtained from Annual Small Business Survey (ASBS). Results indicate that firms in creative industries are more likely to introduce entirely new products than firms in other sectors, but that there is no overall link with innovation more generally. However, creative occupations appear a more important factor in development of entirely new and learned innovations in both urban and rural locations.

Other empirical studies taking organizational behavior approach found mixed results. Baron and Tang (2011) using survey data on 99 entrepreneurs in five South-eastern states of the United States and employing hierarchical regression analysis tested interrelationship between entrepreneur’s positive affect and creativity and firm innovation moderated by environmental dynamism. The results indicate that both the relationship between positive affect and creativity, and the relationship between creativity and innovation, are moderated by environmental dynamism and are stronger in highly dynamic environment. Similarly, Sohn and Jung (2010) investigated the determinants of creativity by genetic abilities of employees or by the external environment and the effects of creativity on firm performance in South Korea. They used Structural Equations Modelling to investigate direct, indirect and total effects of factors influencing innovation process and creativity in a company and determine the degree of influence of innovative performance and creativity on each factor. They found that Korean companies are in general interested in creativity, however its impact on innovation is insignificant. Zdunczyk and Blenkinsopp (2007) adopted Martins and Terblanche’s (2003) theoretical framework to explore which organizational factors influence creativity and innovation among Polish managers. The findings suggest that strategy, organizational structure and employee’s behaviour are less supportive of creativity and innovation in domestic firms compared to foreign owned firms.

1. **Methodology and dataset**

To assess the contribution of creativity to the innovation process, a model is applied that portrays innovation process through four stages. The data used for the analysis is the 2010-12 UK Innovation Survey. This dataset is not publicly available and was accessed through special secure access arrangement with UK Data Service. The surveyed firms are distributed across all major sectors of economic activity. In total, the survey covers 13683 firms of which about one third (4482) have invested in some form of innovations over analysed period and about 17% (2258) have successfully commercialized their innovation efforts. First two stages of the model observe the determinants of the decision of firm to innovate and its decision on the amount of research and development expenditure. The unobserved decisions of firm to innovate *gi\** and to allocate certain amount of investment in innovation *ki\** are portrayed with their observable counterparts *g*i and ki from where the first two stages of the model can be defined as follows:

$g\_{i}=β\_{0}x\_{i}^{0}+u\_{i}^{0}$ (1)

*gi* = 1, if *gi\**>0, otherwise *gi=*0

and

*ki|gi>0=β1xi1+ui1*  (2)

*ki=ki* if *ki\**>0, otherwise *ki=*0

The impact of different determinants on the decision of firms to innovate and on their actual level of expenditure on innovation is assessed through the set of independent variables *xi0, xi1* and their corresponding parameters *β0, β1*.

The third stage of model is concerned with the effectiveness of innovation process defined as the success in commercialization of innovations. It is expressed through:

*ti=akki+β2xi2+ui2* (3)

In equation (3) the observed innovation effectiveness $t\_{i}$ is specified as function of research and development efforts $k\_{i}$ estimated in equation (2) and set of explanatory variables $x\_{i}^{2}$ among which the inverse Mills’ ratio is included as a control for selection bias. The productive efficiency of firms enters (3) also to control for potential feedback effect. The final stage of innovation process deals with the impact of innovation effectiveness on productive efficiency of firm. This relationship is modelled as:

*qi=αtti+β3xi3+ui3* (4)

with $q\_{i}$ indicating the firm’s productive efficiency, *ti* representing estimates of innovation effectiveness from Equation 3, $x\_{i}^{3}$ being vectors of independent variables.

In all four equations it is assumed that disturbances *ui* are randomly distributed and not correlated with explanatory variables. However, it is assumed that these error terms are semi-correlated with each other through the unobserved heterogeneity stemming from managerial characteristics, financial factors or market conditions. To allow for such correlation, the first two equations are estimated in a framework of generalised tobit model. Our model may also be prone to potential endogeneity of some of the explanatory variables. The R&D expenditure enters equation (2) as dependent variable but appears on the right hand side of the equation (3). Similarly, innovation effectiveness, the dependent variable of equation (3) is among regressors of equation (4). This problem is taken into account through the estimation in a simultaneous equations framework of three-stage least squares where potentially endogenous variables are being controlled for with proper instrumentation.

1. **Model**

Our modelling strategy aims to meet several objectives. First it aims to assess determinants of innovation effectiveness and productive efficiency. Second, it aims to investigate factors moulding different stages of the innovation process. Third, it aims to explore the role of creativity in different stages of this process, and fourth it aims to assess the differences in innovation process and related importance of creativity within individual economic sectors. The multi-stage model has been developed to meet these objectives. The dependent variable of (1) defines firm as innovative if it reported a positive amount of innovation expenditure of any kind. In the equation (2), the left-hand side variable (R&D expenditure) is the natural logarithm of total innovation investment, regardless of its source over 2010-2012. period. The effectiveness of innovation process is modelled in the third stage. Schmidt and Finnigan (1992) defined effectiveness as the ability of organization to meet requirements of customers. Following this definition, a dependent variable of third stage is defined as the natural logarithm of the proportion of sales attributable to new products. An increase of this measure would signal better ability of firm to recognize needs of its customers.[[1]](#footnote-1) Finally, following Kling (2006), the productive efficiency of firm in the equation (4) is measured with labour productivity, the ratio of turnover to total employment of firms in 2012.

The creativity is modelled with three categorical variables derived from responses of surveyed firms on their practices of hiring individuals with different creative skills in three years prior to survey. The first variable takes value of one if firm hires individuals with creative skills in areas of graphic arts and design. The second variable controls for firms that hire employees with creative skills in the area of information technology such as multimedia and software development. Finally, the third variable controls for the contribution of creative skills in applied and technical sciences (such as engineering and mathematics) to the innovation process. It is likely, however, that all sorts of creative skills will not exercise same weight in all sectors of economic activity. To control for such sectoral effects, the model also includes two sets of variables controlling for sector specific creativity effects in manufacturing and service sectors (interaction terms indicating creative skills in the two sectors). All creativity-related variables enter equations (1) – (3). It is thus assumed that the impact of creativity on productive efficiency takes place through innovation effectiveness channel.

The determinants of decision of firms to innovate (equation 1) include the size of firm (the natural logarithm of employment), a dummy variable for exporting firms, three categorical variables for cost, knowledge and market factors hampering innovation, a categorical variable for firms that employ more than 50% of employees with tertiary education (a measure of human capital), dummy variables for firms that introduced organisational and marketing innovations, a dummy variable for ongoing and abandoned innovations and two categorical variables for manufacturing and service sectors. With exception of market factors hampering innovations, the above variables enter equation (2) as well. Equation (2) also includes two categorical variables controlling for firms that received national and EU subsidies for the development of innovations.

The innovation effectiveness is specified as function of firm size, R&D expenditure from the second stage, the inverse Mills ratio from the first stage; controls for EU and national subsidies, categorical variables for exporting firms and for firms with majority of staff with tertiary education. The model also includes in this stage controls for firms that had ongoing or abandoned innovation activities (reflecting potential experience) and for firms that cooperated with actors from their environment (firms, universities, professional institutions, etc) on the development of innovations. Finally, there are four variables for sources of information on innovation including internal sources, market sources, institutional sources and other sources. Finally, the productive efficiency is specified as a function of firm size, innovation effectiveness from the third stage; organisational and marketing innovations, control variables for exporting firms, firms employing over 50% staff with tertiary education and previously abandoned or ongoing innovations.

1. **Discussion of results**

The results of investigation are presented in Table 1 where Equations 1 to 4 refer to the four stages of the innovation process discussed in the previous section. Starting with creativity variables it appears that creative skills are relevant in the early stages of innovation process (decision to innovate and invest in R&D) while the implementation of innovations (the effectiveness of innovation process) requires stronger conformity and meeting of rules and standards which may be incompatible with creativity. From there it follows that organisations that do not hire individuals with creative skills are more effective in developing products that meet requirements of their customers. However, it is possible that our results reflect the inability of managers to exploit the full potential of individuals with creative skills in this advanced stage of the innovation process (transformation of innovation inputs into innovation output). Regarding sectoral differences in management of creativity, we observe positive impact of creative skills in information technology in both services and manufacturing sectors as well as positive impact of creative skills in applied and technical sciences on the decision to innovate in the manufacturing sector and on the decision on innovation expenditure in the service sector. However, the impact on the innovation output stage is largely negative or insignificant which is consistent with our previous findings.

Turning to other variables, there is evidence of a positive relationship between different stages of innovation process stretching over all four equations. The impact of decision on innovation expenditure on innovation output is positive as well as the impact of innovation output on the firm’s productive efficiency. These findings suggest that better effectiveness of innovation process contributes positively to the productive efficiency.

In all four stages we observe the positive and statistically significant impact of firm size. This signals that economies of scale and other drivers of efficiency associated with larger firms motivate them to engage in innovation, spend more in this process and be more successful in the commercialization of their innovation efforts. The evidence suggests that exporting firms are more likely to engage in innovation than their non-exporting counterparts; they spend more on innovation and are more productive but they are less successful in transforming innovation inputs into innovation output. On the basis of these findings it can be concluded that these firms base their competitiveness on non-innovative products despite investing strong efforts in innovation activities. Finally, we obtain positive coefficient on the variable controlling for the quality of human capital in firm, a categorical variable taking value of one if firm employs more than 50% of employees with tertiary education in first two stages but negative coefficient in the third stage. Such finding may be signal that managers within these firms fail to exploit the full potential of their human capital, consistent with our already reported findings on the management of individuals with creative skills.

Table 1: Results of estimation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables/ Equations | 1 | 2 | 3 | 4 |
| Graphics & Design creative skills | 0.32\*\*\* | 0.13\*\* | -0.58\*\*\* | - |
| IT creative skills | 0.34\*\*\* | 0.20\*\* | -0.99\*\*\* | - |
| Applied and technical sciences creative skills | 0.31\*\*\* | 0.46\*\*\* | -2.19\*\*\* | - |
| Graphics and design creative skills in manufacturing | 0.03 | -0.18 | 0.66\*\*\* | - |
| IT creative skills in manufacturing | 0.21\* | -0.004 | 0.15 | - |
| Applied and technical sciences creative skills in manufacturing | 0.18\* | 0.13 | -0.57\*\*\* | - |
| Graphics and design creative skills in services | -0.20\* | 0.23 | -1.04\*\*\* | - |
| IT creative skills in services | 0.23\*\* | 0.02 | -0.15 | - |
| Applied and technical sciences creative skills in services | -0.07 | 0.45\*\*\* | -2.14\*\*\* | - |
| Firm size | -0.02\* | -0.43\*\*\* | 2.04\*\*\* | 0.06\*\*\* |
| Exporting | 0.45\*\*\* | 0.80\*\*\* | -3.93\*\*\* | 0.48\*\*\* |
| Academic degree | 0.13\* | 0.57\*\*\* | -2.74\*\*\* | -0.10 |
| Innovation input | - | - | 4.98\*\*\* | - |
| Innovation output | - | - | - | 0.26\*\* |
| Inverse Mills ratio | - | - | 0.03 | - |
| Cost factors hampering innovation | 0.39\*\*\* | 0.02 | - | - |
| Knowledge factors hampering innovation | 0.19\*\*\* | -0.06 | - | - |
| Market factors hampering innovation | 0.10\*\*\* | - | - | - |
| Organisational innovations | 1.54\*\*\* | 0.06 | - | -0.12\* |
| Marketing innovations | 1.40\*\*\* | 0.04 | - | -0.06 |
| EU subsidies | - | 0.81\*\*\* | -3.81\*\*\* | - |
| National subsidies | - | 0.52\*\*\* | -2.58\*\*\* | - |
| Ongoing and abandoned innovations | 1.35\*\*\* | - | 0.09\* | -0.04 |
| Cooperation in the development of innovations | - | - | 0.14\*\* | - |
| Sources of information on innovation – internal | - | 0.32\*\*\* | -1.41\*\*\* | - |
| Sources of information on innovation – market | - | 0.22\* | -1.13\*\*\* | - |
| Sources of information on innovation - institutions | - | 0.40\*\*\* | -1.91\*\*\* | - |
| Sources of information on innovation - others | - | 0.11\* | -0.45\*\*\* | - |
| Manufacturing | 0.05 | 0.60\*\*\* | -2.92\*\*\* | -0.06 |
| Services | -0.11\*\* | -0.03 | 0.28\*\*\* | -0.40\*\*\* |
| Constant term | -1.77\*\* | 0.07 | 2.14\*\*\* | 3.51\*\*\* |
| Number of observations | 13683 | 4482 | 2258 | 2258 |
| LR test | 0.35\*\*\* | - | - | - |

Source: Own calculation

\*\*\*,\*\* and \* note statistical significance at 1%, 5% and 10% level of significance respectively.

Among factors constraining innovation we obtain positive sign in first equation on all three variables. Such finding is consistent with earlier literature (e.g. Hashi and Stojcic, 2013) and can be taken as a sign that constraining factors motivate firms to search for new ways of survival including innovations in order to differentiate themselves from their rivals. There is also evidence that organisational and marketing innovations such as changes in supply chain management, business re-engineering, improvements in the knowledge and quality of management, introduction of new systems of employee responsibilities, team work, decentralization, training of employees as well as new methods of organising external relations and the implementation of changes to marketing concepts or strategies are beneficial for the firm’s innovation activities. The model also includes, in second and third stage, two variables controlling for access of firms to national and EU subsidies for innovation. Reported findings suggest that firms receiving subsidies spend more on innovation but are less effective in their innovation process which may have important implications for existing subsidy schemes.

Previous experience in innovation activities is beneficial for both decision to innovate and transformation of innovation inputs into outputs. Similarly, cooperation with subjects from external environment such as rivals, suppliers and distributors, consultants, professional and scientific institutions as well as universities and research institutes has beneficial effect on innovation output stage. Our model also includes four variables controlling for sources of information on innovation activities, internal sources, market, institutional and other sources. The positive impact of these sources on innovation expenditure and the negative impact on innovation output stage is further signal of suboptimal use of available resources in innovation process. Finally, significant coefficients are obtained on nearly all variables controlling for manufacturing and service industry suggesting the presence of industrial heterogeneity in innovation process.

1. **Conclusions**

Over past years, significant efforts have been invested in understanding innovation activities and the process of innovation. The interest in this matter stems from the beneficial impact of innovative efforts on firm performance and competitiveness. The existing research in this area has pointed to a number of factors that facilitate the innovation process. However, within the vast amount of literature produced on this topic, the relationship between creativity and innovation has been relatively unexplored. This is particularly surprising as the importance of creativity for innovation has been recognised in the academic literature for several decades. With this in mind the objective of this research was to explore the impact of creativity on different stages of the innovation process among firms in advanced European economy. The paper uses a dataset not publicly available to researchers, containing information on innovation activities, performance and creative efforts of firms for its empirical investigation.

The findings from our research provide support to the long line of investigation suggesting that there is a positive relationship between the decision of firms to innovate, their innovation expenditure, innovation output and productivity. These findings suggest that the effectiveness of the innovation process, i.e. the ability of firms to meet requirements of their customers has positive effect on productive efficiency. Similarly, positive efficiency effects can be associated with firm size and R&D process. Moreover, there is evidence of the impact of creativity on all stages of innovation process. Our findings in this respect have important managerial implications. It seems that hiring of individuals with creative potential in different disciplines has beneficial impact on the decision of firms to innovate and their innovation expenditure. Yet, when it comes to the commercialization of innovation efforts (innovation effectiveness), these skills have the opposite effect which may signal the inability of managers to optimally exploit the creative potential of their staff in all stages of the innovation process. Similar findings hold when one looks at a number of other reported findings such as the utilization of sources of information in the innovation process, the use of subsidies, exporting and the use of staff with tertiary education. These findings have important implications for policy makers. Our findings also point to industrial heterogeneity in the importance of individuals with creative potential between manufacturing, services and other sectors.

While contributing to a relatively unexplored area of the relationship between creativity and innovation, the present research has several limitations. First, it is undertaken on the sample of firms from only one country. Second, it focuses on only one period in time due to the nature of data (three-yearly Community Innovation Surveys). Third, it does not take into account many other factors related to the innovation process such as financial factors. However, perhaps the most important drawback of the research is its inability to address all aspects of creativity. Hiring employees with creative skills presents only the first step in developing the innovation potential of firms. The ability of talented individuals to generate novel ideas depends also on the ability of their managers to create favourable climate and to employ proper methods to stimulate creativity. Unfortunately, dataset for the UK does not provide information on such managerial activities and this issue remains to be addressed by subsequent research. Together, these limitations of our work can be considered as guidance for future research.

**Bibliography**

Aghion, P. and Howitt, P., (1992): **A Model of growth through creative destruction, *Econometrica,*** 60 (2): 323-351

Amabile, T.M. (2000). **A model of creativity and innovation in organizations.** In B. M. Staw & L. L. Cummings (Eds.) Research in organizational behaviour (Vol. 10, pp. 123 – 167). Greenwich, CT: JAI Press.

Amabile, T.M., Conti R., Coon H., Lazenby J. and Herron M. (1996): **Assessing The Work Environment For Creativity, *Academy Of Management Journal***, 39 (5): 1154-1184.

Amabile, T. M. and Gryskiewicz, S. S. (1987): **Creativity in the R&D laboratory**. Technical Report Number 30. Greensboro, NC: Center for Creative Leadership.

Andari, R. Bakshi, H, Hutton, W., O’Keefe, A. and Schneider, P. (2007): **Staying ahead? The economic contribution of the creative industries**. London: Department for Culture, Media and Sport.

Andersen, K. and Lorenzen, M. (2005): **The Geography of the Danish Creative Class: A Mapping and Analysis**. Copenhagen: Imagine.

Arad, S., Hanson, M. A. and Schneider, R. J. (1997): **A framework for the study of relationships between organizational characteristics and organizational innovation**. ***The Journal of Creative Behavior***, 31 (1): 42-58.

Baldwin, C. Y. and von Hippel, E., (2011): **Modeling a paradigm shift: From producer innovation to user and open collaborative innovation. *Organization Science*** 22 (6): 1399-1417

Baron, R.A., and Tang, J., (2011); **The role of entrepreneurs in firm-level innovation: Joint effects of positive affect, creativity, and environmental dynamism**. ***Journal of Business Venturing***, 26: 49-60.

Baucus, M., Norton, W., Baucus, D. and Human, S., (2008): **Fostering creativity and innovation without encouraging unethical behaviour**. ***Journal of Business Ethics***. 81: 97-115.

Baum, J. and Locke, A. (2004): **The Relationship of Entrepreneurial Traits, Skill and Motivation to Subsequent Venture Growth, *Journal of Applied Psychology***, 89 (4): 587-598.

Bjork, J. and Magnusson, M. (2009): **Where do Good Innovation Ideas Come From? Exploring the Influence of Network Connectivity on Innovation Idea Quality, *Journal of Product Innovation Management,*** 26 (6): 662-670.

Chapain, C., Cooke, P., De Propris, L., MacNeill, L. and Mateos-Garcia, J. (2010): **Creative clusters and innovation: Putting creativity on the map**. London: National Endowment for Science, Technology and the Arts.

Cohen, W. and Levintahl, D. (1990): **Absorptive Capacity: A New Perspective on Learning and Innovation, *Administrative Science Quarterly,*** 35 (1): 128-152.

Collins, M.A. and Amabile, T.M. (1999): **Motivation and creativity**. in R.J. Sternberg (Ed.), ***Handbook of Creativity***. Cambridge: Cambridge University Press.

Conaldi, G., Lomi, A. and Tonellato, M., (2012): **Dynamic models of affiliation and the network structure of problem solving in an open source software project***.* ***Organizational Research Methods***, 15 (3). pp. 385-412.

Cooke, P. and De Propris L., (2011): **A Policy Agenda for EU Smart Growth: The role of the Creative and Cultural Industries**. ***Policy Studies***, 32 (4): 365 – 375.

Cooke, P. and Schwartz, D. (2007): **Creative Regions: Technology, Culture and Knowledge Entrepreneurship**, London: Routledge.

Crepon, B., Duguet, E. and Mairesse, J., (1998): **Research, Innovation, and Productivity: An Econometric Analysis at the Firm Level**. National Bureau of Economic Research, Working Paper, No. 6696.

Cunningham, S. and Higgs, P. (2009): **Measuring creative employment: Implications for innovation policy**. ***Innovation: Management, Policy and Practice***. 11 (2): 190 –200.

Deci, E. L., and Ryan, R. M. (1985): **Intrinsic motivation and self-determination in human behavior**. New York: Plenum.

Feist, J. (1999): **The Function of Personality in Creativity** in Kaufman, C. and Sternberg, J. (eds.) ***The Cambridge Handbook of Creativity***: 113-130. Cambridge: Cambridge University Press.

Filipczak, B. (1997): **It takes all kinds: creativity in the workforce**. ***Training***, 34 (5): 32-40.

Frese, M., Teng, E. and Wijnen, C. J. (1999): **Helping to improve suggestion systems: Predictors of making suggestions in companies. *Journal of Organizational Behavior***, 20: 1139 – 1155.

Garvin, D.A. (1993): **Building a learning organization, *Harvard Business Review***, 71 (4): 78-92.

Glazer, N. (2005): **Separate and Unequal**. ***New York Times Book Review***, Sept 25th 2005: 12-13.

Hackman, J. R., and Oldham, G. R. (1980): **Work redesign**. Reading: AddisonWesley.

Hall, B., Mairesse, J. and Mohnen, P. (2010): **Measuring the returns to R&D,** National Bureau of Economic Research, Working Paper, No. 15622.

Hashi, I. and Stojcic, N. (2013): **The Impact of Innovation Activities on Firm Performance Using a Multi-Stage Model: Evidence from the Community Innovation Survey 4**. ***Research Policy,*** 42 (2): 353-366.

Hill, R. (1996): **A measure of the learning organisation, *Industrial & Commercial Training***, 28 (1): 19-26.

Huggins, R. and Clifton, N. (2011): **Competitiveness, creativity and place-based development**. ***Environment and Planning*** A (43): 1341-1362.

Isaksen, S., Puccio, G. and Treffinger, D., (1993): **An Ecological Approach to Creativity Research: Profiling for Creative Problem Solving, *Journal of Creative Behaviour,*** 27 (3): 149-170.

Kale, P., Singh, H. and Perlmutter, H. (2000): **Learning and protection of proprietary assets in strategic alliances: building relational capital**. ***Strategic Management Journal*** 21 (3): 217-237.

Kasia Z. and Blenkinsopp, J. (2007): **Do organisational factors support creativity and innovation in Polish firms?, *European Journal of Innovation Management*** 10 (1): 25 – 40.

Kline, S.J. and Rosenberg. N. (1986): **An overview of innovation**. In Landau, R. and N.

Rosenberg (Eds.) ***The Positive Sum Strategy: Harnessing Technology for Economic Growth***, Washington, DC: National Academies Press.

Kling, R. (2006). **In search of efficiency – concurrent concept elaboration and improvement**, ***Technovation.*** 26: 753 – 760.

Kogut, B. and Zander, U. (1992): **Knowledge of the Firm, Combinative Capabilities and the Replication of Technology, *Organization Science*** 3 (3): 383-397

Lawson, B. and Samson, D. (2001): **Developing Innovation Capability in Organisations: A Dynamic Capabilities Approach, *International Journal of Innovation Management*** 5 (3): 377-400.

Lee, N. and Drever, E. (2012): **Creative industries, occupations and innovation in London**. Big Innovation Centre Working Paper, University of Lancaster.

Lee, N. and Rodriguez-Pose, A. (2013). **Creativity, Cities and Innovation,** CEPR Discussion Paper, No. DP9598.

Leiponen, A. (2005): **Core complementarities of the corporation: organization of an innovating firm**. ***Managerial and Decision Economics***, 26: 351–365.

Lundvall, B-Å. (ed.) (1992): **National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning**, London: Pinter Publishers.

Markusen, A. (2006): **Urban development and the politics of a creative class: evidence from a study of artists,** ***Environment and Planning A***, 38(10): 1921 – 1940.

Marrocu, E. and Paci, R. (2012): **Education or Creativity: What Matters Most for Economic Performance?** ***Economic Geography*** 88: 369–401.

Martins, E.C. and Terblanche, F. (2003): **Building organisational culture that stimulates creativity and innovation*, European Journal of Innovation Management*** 6(1): 64 - 74

Mascia, D., Magnusson, M. and Bjork, J. (2015): **The Role of Social Networks in Organizing, Ideation and Creativity and Innovation: An Introduction, *Creativity and Innovation Management*** 24 (1): 102-108.

McMullen, J. and Shepherd, D. (2006): E**ntrepreneurial action and the role of uncertainty in the theory of the entrepreneur. *Academy of Management Review*** 31: 132–152.

Meyer, A.D. (1982): **Adapting to environmental jolts, *Administrative Science Quarterly*** 27 (4): 515-38.

Miron, E., Erez, M. and Naveh, E. (2004). **Do personal characteristics and cultural values that promote innovation, quality and efficiency compete or complement each other?, *Journal of Organizational Behaviour*** 25: 175 – 199.

Müller, K., Rammer, C. and Trüby, J. (2009): **The role of creative industries in industrial innovation**. ***Innovation: Management, Policy & Practice*** 11 (2): 148-168.

Mumford, M.D. Scott, G.M. Gaddis, B. and Strange, J.M. (2002): **Leading creative people: Orchestrating expertise and relationships**. ***The Leadership Quarterly*** 13: 705-750.

Nahapiet, J. and Ghoshal, S. (1998): **Social Capital, Intellectual Capital and the Organizational Advantage, *The Academy of Management Review*** 23 (2): 242-266.

Nonaka, I. (1994): **A dynamic theory of organizational knowledge creation, *Organization Science*** 5 (1): 14-38.

Schmidt, W.H. and Finnigan, J.P. (1992). **Race without a finish line: America’s quest for total quality.** San Francisco, CA.: Jossey – Bass.

Schumpeter, J., (1942): **Capitalism, Socialism and Democracy**, New York: Harper & Row.

Shalley, C., Gilson, L. and Blum, T. (2000): **Matching Creativity Requuırements And The Work Environment: Effects On Satisfaction And Intentions To Leave, *Academy Of Management Journal*** 43 (2): 215-223.

Shane, S. (2003): **A General Theory of Entrepreneurship. The Individual–Opportunity Nexus**. Cheltenham: Edward Elgar.

Sohn, S.Y. and Jung, C.S. (2010). **Effect of Creativity on Innovation: Do Creativity Initiatives Have Significant Impact on Innovative Performance in Korean Firms?, *Creativity Research Journal*** 22 (3): 320 – 328.

Sternberg, R.J. (1995): **In Search of the Human Mind,** Orlando: Harcourt Brace.

Sternberg, R. J. and Lubart, T. I. (1999): **The concept of creativity: Prospects and Paradigms.** In R.J. Sternberg (ed.) ***Handbook of Creativity***: 3-16. London: Cambridge University Press.

Tonellato, M. (2014): **Relational coordination in an Open Source Software Project: The Role of Attention Networks**. Paper presented at the XX Organization Science Winter Conference, 6–9 February, Steamboat Springs, Colorado.

Tushman, M. L. and O’Reilly, C. A. III (1997): **Winning through Innovation: A Practical Guide to Leading Organizational Change and Renewal**. Boston: Harvard Business School Press.

Van De Ven, A. and Angle, H.L., (1989): **Suggestions for Managing the Innovation Journey,** University of Minnesota, Carlson School of Management, Advance Management Practices Paper, No. 9.

Van Dijk, C. and Van den Ende, J. (2002): **Suggestion systems: Transferring employee creativity into practicable ideas. *R & D Management*** 32: 387 – 395.

Vinodrai, T. (2006): **Reproducing Toronto's design ecology: Career paths, intermediaries and local labour markets**. ***Economic Geography*** 82 (3): 237-263.

Weisberg, R.W. (1999): **Creativity and Knowledge: A Challenge to Theories** in R.J. Sternberg (ed.) ***Handbook of Creativity***: 189-212. Cambridge: Cambridge University Press.

Yusuf, J., (2009): **From Creativity to Innovation,** ***Technology in Society*** 31 (1): 1-8.

1. Innovation effectiveness and innovation output are similar but not exactly the same. If innovation output is measured as, for example, number of new products, the two are not the same as the number does not indicate success of the products with customers. However, when the output is measured as the proportion of sales arising from new products (as in this paper), the two concepts are the same. [↑](#footnote-ref-1)