**Investment strategies relating R&D and human capital during the crisis:**

**impact on performance**

Theory and practice provide evidence that intangibles have crucial impact on companies’ performance (Lev, 2001). Due to their nature intangibles allow the companies to create sustainable competitive advantage. Drawing on literature review the authors argue that the major of studies and empirical investigations on intangibles’ employment consider the period of economic prosperity. Only few studies such as Filippetti and Archibugi, 2011; Cincera et al., 2012; Archibugi et al., 2013 explore the impact of economic recession on managers’ decision concerning investment strategies relating intangibles.

This paper explores the relationship between expenditures in intangibles changed due to economic crisis and companies’ performance. The paper provides empirical evidence of how managers' decisions on input in intangibles during the crisis impact on intangibles' output and outcome in future. The research question is: “What is beneficial for company: to reduce or to increase expenditures in intangibles over the crisis?” Each strategy has the risks but can provide future opportunities as well (Archibugi et al., 2013).

The authors of present paper make a proposition as follows: “*Companies that accumulate intangibles during the crisis benefit more than those who decide to decrease investment in intangibles”.*

In the framework of this study among the intangibles the authors consider the key resources: R&D and human capital. The influence of intangibles on firm performance is described through chain: input-output-outcome.

Figure 1. Input-output-outcome chain of intangibles

For econometric modeling the authors consider two-stage process which is described through three equations:

**Output equations:**

Patents2010-2013=f(change in R&D2008-2009; IA/BV2008; control variables);
Productivity of employees2010-2013 = f(change in employee costs2008-2009; board of directors qualification; control variables)

**Outcome equation:**

Performance2010-2013=f(Patents2010-2013, Productivity of employees2010-2013, control variables)

The empirical part of this study is conducted using database of 1650 public European companies. The dataset covers the period from 2008-2013 and includes five countries (UK, France, Germany, Italy and Spain); as well all industries. Table 1 presents the variety of managers’ decision on intangibles’ expenditures over the crisis. The motivation of this study was induced through empirical evidence that companies pursued different strategies.

Table 1. Growth rate of R&D and employee expenses over the crisis 2008-2009

|  |  |  |  |
| --- | --- | --- | --- |
| **Intangibles** | **Descriptive statistic of growth rate**  | **Investment decision** | **t-test** |
| **Mean** | **Median**  | **Max** | **Min** | **Decrease** | **Increase** | **country** | **industry** |
| R&D | 13,3% | -3,9% | 3496,5% | -100,0% | 36.5% | 63.5%  | F=1.96 (0.13) | F=0.81 (0.56) |
| Employee costs | 5,0% | 0,0% | 4712,4% | -97,8% | 23.8%  | 76.2% | F=0.18 (0.96) | F=1.4 (0.23) |

The authors performed t-test and found that country and industry effects are insignificant by managers’ decision on intangibles during the crisis.

For econometric estimation the authors use the software “stata 12” and apply structural equation modeling (SEM). The authors control country, industry and size effects.

Table 2 presents preliminary results of SEM estimations. The values of RMSEA and R2 show that the model of “input-output-outcome chain of intangibles” is valid and reliable. The positive impact on performance of labour productivity was found. Contrary to our expectations the output of intangibles measured by number of patents appeared to be insignificant for companies’ performance. The hypothesis put forward in study was partly confirmed. The companies that accumulate intangibles during the crisis benefit more by increasing the output of intangibles. This empirical evidence can be considered by decision making during the economic recession.

Preliminary estimations with SEM methodology:

Table 2. Preliminary results

| Dependent variable | Independent variable | Standardized estimates |
| --- | --- | --- |
| EVA/Assets |  |
|  | Number of patents | -0,011 |
|  | Productivity of employees | 0,401\*\*\* |
|  | Manufacturing industry | 0,142\*\*\* |
|  | Size (Number of employees) | 0,033 |
|  | Financial leverage (2008) | 0,025 |
|  | Financial leverage (2009) | 0,006 |
|  | Capital intensity | -0,103\*\*\* |
|  | Cons. | -0,067\* |
| R-squared | *0,195* |
|  |  |  |
| Number of patents |  |
|  | Δ R&D\_2008-2009\_bin | 0,034\* |
|  | Intangible assets/BV | 0,008 |
|  | Manufacturing industry | 0,053\*\* |
|  | Size (Number of employees) | 0,47\*\*\* |
|  | Technological readiness of the country | 0,0003 |
|  | Market size of the country | 0,023 |
|  | Innovation position of the country | -0,0012 |
|  | Cons. | -1,063 |
| R-squared | *0,235* |
|  |  |  |
| Productivity of employees |  |
|  | Δ Costs on employees\_2008-2009\_bin | 0,074\*\*\* |
|  | Board qualification | 0,056\*\* |
|  | Manufacturing industry | 0,019 |
|  | Health and primary education of the country | -0,112\*\*\* |
|  | Higher education and training of the country | -0,037 |
|  | Labor market efficiency of the country | 0,088\*\* |
|  | Cons. | 9,15\*\*\* |
| R-squared | *0,097* |
|  |  |  |
| RMSEA | 0,058\*\* |
| Overall R-squared | *0,278* |
| Number of observations | 1550 |

Significance levels: \*\*\* - 1%, \*\* - 5%, \* - 10%.