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**Investigation of Relations between  
Investment to Technologies and  
Economical Development of a  
Country**

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## **Investigation of Relations between Investment to Technologies and Economical Development of a Country**

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### **Abstract**

Investment to technologies is one of the most important drivers in today's economy. It plays very important role while taking into account enterprises' performance; it has also a big influence to nations' macroeconomic indicators. On the other hand, promotion of investment to technologies is closely related with political strategies as well as with economical development of a country. This investigation was performed in order to define relations between investment to technologies and macroeconomic indicators of a country. Investment to technologies indicators of 24 European countries were taken into account. All countries were classified to technological leaders, followers and modest countries using hierarchical cluster analysis. Classification was performed using Ward's amalgamation rule and Manhattan distance. Differences of summarized investment to technologies' indicators were defined to be smaller between countries of the same class than comparing countries of different classes. Correlations between investment to technologies and macroeconomic indicators were calculated for countries assigned to each group. This investigation has shown that relations between investment to technologies and economical indicators of a country were different for countries classified into different groups according to their investment to technologies level. It was approved that investment to technologies is highly influenced by economical development of a country. This investigation enabled to compare countries according to their investment to technologies and macroeconomic indicators relations and might be useful finding the decision how to improve development of a country while changing political strategies of investment to technologies.

**Keywords:** Investment to technologies, Relations of economic indicators, Countries classification

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## 1. Introduction

Investment to technologies is very important while taking into account enterprises performance; however it has also a big influence to nations' macroeconomic indicators. Investment to technologies is considered to be one of the most important drivers in today's economy. Many authors (Godin, 2004; Comin & Bart, 2010; Vaananen & Belt , 2012) agree that high-technology firms are innovative and gain market share, create new products or markets, use resources more productively; industrial R&D performed by high-technology industries benefits other commercial sectors by generating new products and processes that increase productivity, expand business and create high-wage jobs; high technology firms develop high-value-added products and are successful in foreign markets, which results in increased competition.

However, the strategies' of investment to technologies in the country level depends on the development of this country. The main aim of this investigation was to compare relations between investment to technologies and other economical indicators of different countries. This investigation could help modest countries to follow the strategy of leading ones in order to improve their investment to technologies as well as related economic indicators.

In methodological part, economical indicators corresponding to investment to technologies were investigated. Methods for classification of countries as well as correlation analysis were discussed. Results and discussion part was dealing with classification results. Relations between investment to technologies and other economical indicators of a country were investigated and analyzed for countries assigned to different groups (technological leaders, followers, modest countries).

Investigation was performed using following research methods: analysis of scientific publications, cluster and correlation analysis.

## 2. Methodology

Classification of countries could be performed in order to group them according to their investment to technologies indicators. According to Porter & Newman (2008), technology input values can be grouped as: 1) national orientation- reflects directed action to achieve technological competitiveness, 2) socioeconomic infrastructure – institutions that support and maintain the resources essential to the functioning of a modern, technology-based economy, 3) technological infrastructure – institutions and resources that contribute to a nation's capacity to develop, produce, and market new technology, 4) productive capacity – the physical and human resources devoted to manufacturing products and the efficiency with which those resources are used.

While taking into account investment to technologies indicators financial investment should be in major attitude. Technology spillovers enhance domestic firms' future productive capacity (Liu, 2008). Foreign direct

investment is, along with international trade, an integral element in achieving increased living standards and economic prosperity – not just for economies as a whole, but also for individuals, consumers and companies (Saeed, 2011). A big attitude should be also paid to education (Bouis, R. Duval, 2011) and expenditures for research and development (R&D). Expenditure on research and development can be considered as an investment in knowledge that translates into new technologies as well as more efficient ways of using existing resources of physical and human capital.

Summarizing all indicators a set of variables indicating investment to technologies of a country was selected in the respect of three components: financial investments (R&D expenditure in public sector, R&D expenditure in business sector), skills (higher education, doctorate students, and scientific publications) and technological level (high tech sector enterprises, patents applications, high tech export) of a country. Indexes for all these variables were calculated for 24 European countries in the period of 2005-2009.

In order to compare different countries according to their investment to technologies cluster analysis can be performed. Manhattan distance and *Ward's* amalgamation rule were selected for classification purposes (Boguslauskas & Adlyte, 2010)

Once countries are classified, relations between investment to technologies and other economic indicators should be determined in order to compare differences between classes. Correlation analysis is suitable for this purpose. The significance level should be selected and hypothesis  $H_0$ : "Correlation is equal to zero" tested. According to Ubius & Alas (2009), if p-value in the model is equal or higher than the significance level, then the hypothesis must be accepted, otherwise it must be rejected. The correlation is considered to be significant, if calculated p – value is less than significance level (Lakstutiene, 2008).

### **3. Results and discussion**

Hierarchical cluster analysis was performed in order to classify 24 European countries to technological leaders, followers and modest countries. A set of variables indicating investment to technologies of a country in three different perspectives: financial investment, skills and technological level of a country were taken into account for classification purposes. The period of 2005-2009 was analysed. Classification results are presented in table 1.

The summarized investment to technologies index of all technological indicators was calculated for each country. As it is shown in figure 1, technological leaders had highest values of summarized index and the values decreased while taking into account technological followers and modest countries.

As it was already discussed, investment to technologies is one of the most important drivers in today's economy. On the other hand, economical development of a country could be one of the most important factors while

speaking about investment to technologies level. In order to compare summarized investment to technologies index and GDP growth rate for countries assigned to different classes, both indicators' (technologies index and GDP growth rate) values were normalized. Figure 2 presents relations between these 2 indicators. It is evident that counties classified as technological leaders had the highest GDP growth rates while comparing with followers and modest countries. All leading countries there found in the quadrant with the highest GDP growth rate as well as summarized investment to technologies index values. Technological followers were assigned to quadrants with lower technological index and both (lower and higher) GDP growth rate values. All modest counties (except Greece and Cyprus) were grouped as having lowest technological and GDP growth rate values.

The total correlation (for all 24 counties) between summarized investment to technologies index and GDP growth rate index was 0.8 and it was statistical significant with the significance level of 0.05. The correlation ratios between these 2 variables were calculated separately for leading and modest countries because of investigation purposes. It was found that correlation ratio for leading countries was -0.3 and it was not significant. The correlation ratio for modest countries (excluding Greece and Cyprus as they were determined to be outliers in this case) was 0.7. The investigation has shown that investment to technologies is strongly related to GDP growth rate of a country for modest countries and there is no relation of these variables for leading countries. This is because leading countries pay a big attitude for investment to technologies in all stages of economical cycle, not only in the economical growth period.

Normalized average values for other economic indicators were calculated. The correlation ratios between these indicators and summarized investment to technologies index are presented in table 2. While comparing these economical indicators it is to notice that correlations between these indicators and summarized investment to technologies index are different for leading and modest countries. Leading countries have no strong relations between these variables at all. However there is negative correlation of -0.73 between *labour cost* index and investment to technologies index as well as positive correlation of 0.80 between mean income and investment to technologies index for modest countries. Relations of these indicators are presented in Fig. 3.

Despite these correlations for modest countries, most of average values had no relations to investment to technologies index. It is evident that economic cycles and lagging effects should be taken into account while determining relations between these variables.

It is to conclude that correlations between investment to technologies index and other economic indicators are related to economic development of a country. Leading countries pay a big attention to investment to technologies in all stages of economical cycle. Modest countries could follow this strategy as an example in order to improve their performance. However, lagging effects plays a big role and should be in major respect while investigating relations between investment to technologies and other economic indicators.



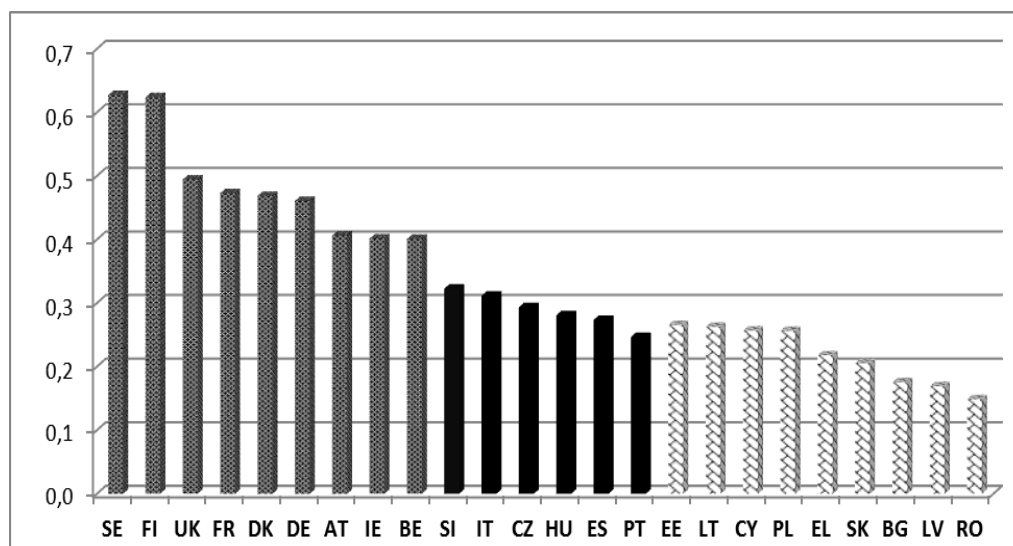
## References

- V. Boguslauskas, V. and R. Adlyte, Evaluation of criteria for the classification of enterprises. *Inzinerine Ekonomika-Engineering Economics*, vol.1, pp. 119-127, 2010.
- R. Bouis, R. Duval and F. Murtin, *The Policy and Institutional Drivers of Economic Growth Across OECD and Non-OECD Economies: New Evidence from Growth Regressions*, OECD Economics Department Working Papers, No. 843, OECD Publishing, 2011.
- D. Comin and H. Bart, An Exploration of Technology Diffusion, *American Economic Review*, vol. 100, No. 5, pp. 2031-59, 2010.
- B. Godin, The observation of competitiveness and its impact on statistics: the construction of high technology indicators, Project on the History and Sociology, of S&T Statistics, Working Paper No.25, Canadian Science and Innovation Indicators Consortium (CSIIC), 25 p., 2004.
- Lakstutiene, A. (2008). Correlation of the indicators of the financial system and gross domestic product in European Union countries. *Inzinerine Ekonomika-Engineering Economics* (3), 7-18.
- A. L. Porter, N. C. Newman, Xiao-Yin Jin, D. M. Johnson, J. D. Roessner *High Tech Indicators Technology-based Competitiveness of 33 Nations, 2007 Report*, Technology Policy and Assessment Center, Georgia Institute of Technology, Atlanta GA, USA, 30332-0345, 38p., 2008.
- J. Sae, Foreign Direct Investment as a Catalyst for Economical Development, Selected papers of the 6th International Scientific Conference "Business and Management 2010", Vilnius, ISSN 2029-4441, pp.1080-1085, 2011.
- Ubius, U., & Alas, R. (2009). Organizational Culture Types as Predictors of Corporate Social Responsibility. *Inzinerine Ekonomika-Engineering Economics* (1), 90-99.
- M. Vaananen, P., J. Belt, J. Harkonen, M. Mottonen, Improving High-Tech Product Development through Communication Audits, *Technology and Investment*, vol. 3, pp.18-25, 2012.
- Zhiqiang Liu, Foreign direct investment and technology spillovers: Theory and evidence *Journal of Development Economics*, vol. 85, Issues 1-2, pp. 176-193, 2008.

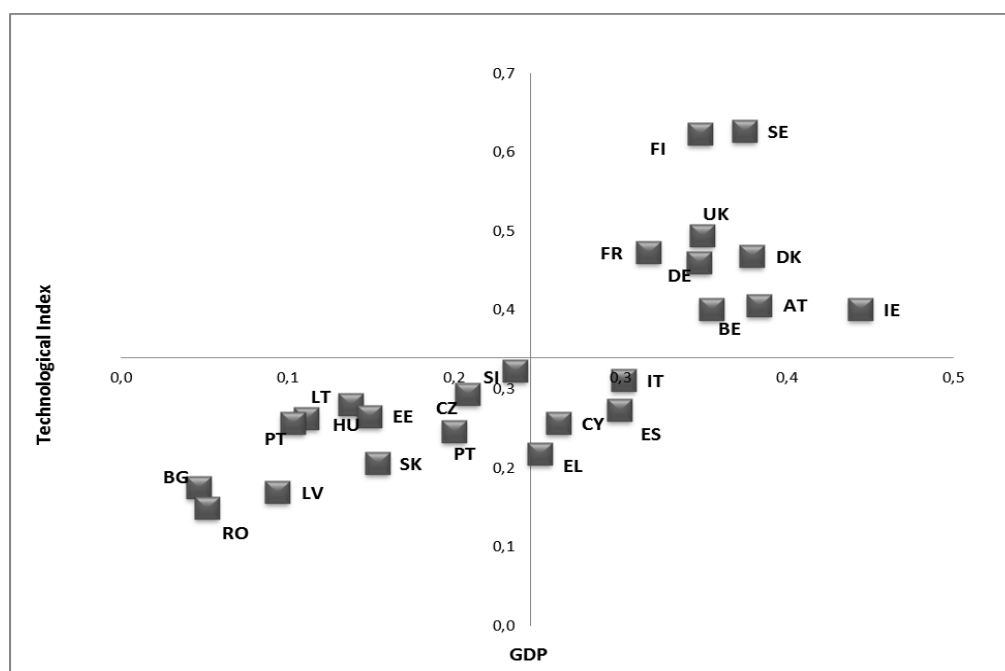
**Table 1. Classification of countries**

Leaders		Followers		Modest countries	
Country	Mark	Country	Mark	Country	Mark
Sweden	SE	Italy	IT	Slovenia	SI
Finland	FI	Czech Republic	CZ	Estonia	EE
United Kingdom	UK	Hungary	HU	Lithuania	LT
France	FR	Spain	ES	Cyprus	CY
Denmark	DK	Portugal	PT	Poland	PL
Germany	DE			Greece	EL
Austria	AT			Slovakia	SK
Ireland	IE			Bulgaria	BG
Belgium	BE			Latvia	LV
				Romania	RO

**Figure 1. Summarized investment to technologies index**



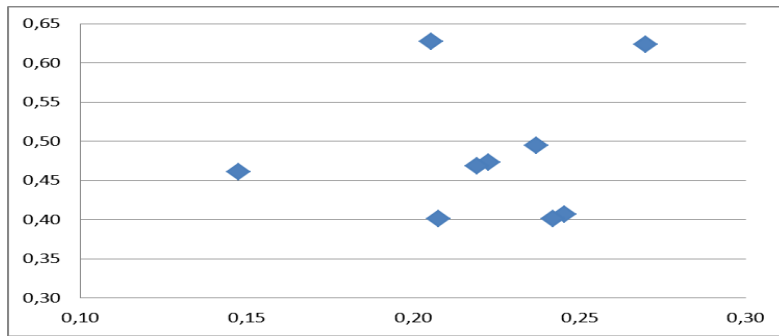
**Figure 2. Investment to technologies and GDP growth rate indexes**



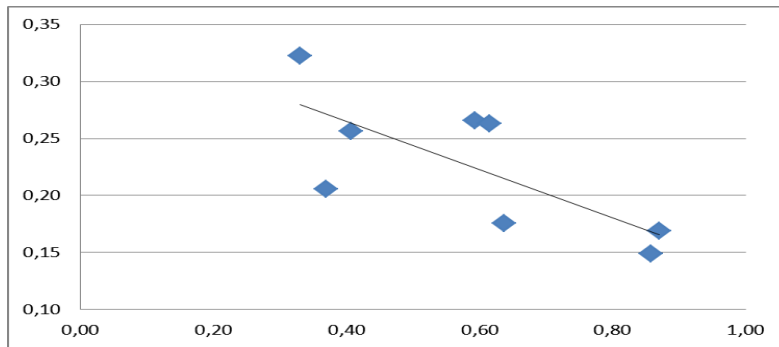
**Table 2. Correlations between investment to technologies index and other indicators**

Indicators	Leaders		Modest	
	Correlation	p-value	Correlation	p-value
Average number of usual weekly hours of work in main job	-0,06	0,896	-0,41	0,310
Industry new orders index	-0,26	0,541	-0,59	0,120
Building permits - percentage change	0,05	0,903	-0,39	0,339
All-items HICP	-0,52	0,183	-0,67	0,067
Unemployment, annual average	0,18	0,665	-0,70	0,051
MFI interest rates - Loans to households	-0,29	0,486	-0,67	0,070
HICP - overall index excluding goods	0,07	0,864	-0,56	0,147
Labour cost index	0,27	0,525	<b>-0,73</b>	<b>0,039</b>
Employment growth and activity branches	0,38	0,353	-0,37	0,364
Mean income	0,07	0,869	<b>0,80</b>	<b>0,016</b>
Industry production index	-0,10	0,805	-0,06	0,882
Unemployment rate, annual average	0,13	0,752	-0,28	0,508

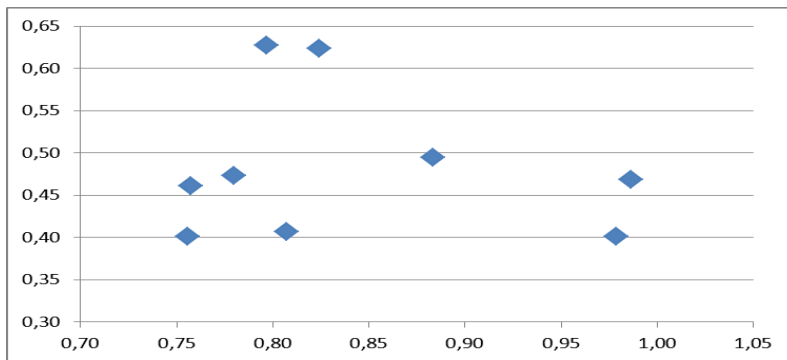
**Figure 3. Relations between investment to technologies index and other indicators**



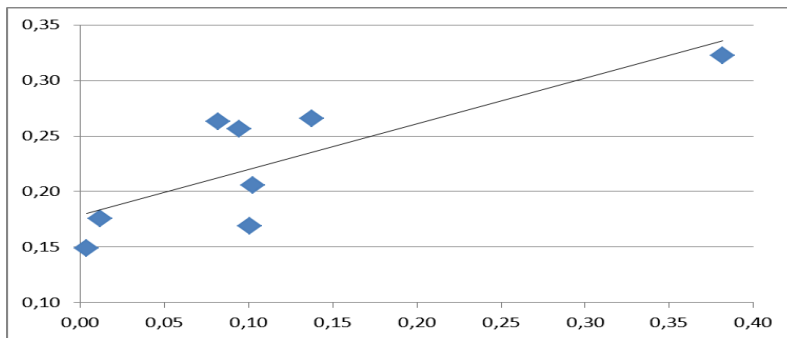
a) Labour cost for leading countries



b) Labour cost for modest countries



c) Mean income for leading countries



d) Mean income for modest countries