

Evaluation of the Impact of the Global Financial Crisis on the Innovative Performance of Lithuanian Industrial and Service Companies in the European Union Context

Rytis Krusinskas, Ausrine Lakstutiene, and Rasa Norvaisiene

Abstract—The article analyses the intensity of scientific research and experimental development in Lithuanian business sector, as well as the changes in innovation activities of Lithuanian industrial and service companies amidst the global financial crisis and the post-crisis period in the European Union context. The research showed that R&D intensity of Lithuanian business companies is significantly lower than the European Union average and the gap grew even more during the crisis. It was found that the global financial crisis had no significant effect on R&D funding structure in Lithuanian business sector, nor the distribution of R&D expenses by cost areas. During the crisis there was a slight increase in the innovation of Lithuanian business companies; however, both Lithuanian industrial and service companies are lagging behind the EU innovation level both with respect to the pre-crisis and the post-crisis periods. As a result of the global financial crisis, Lithuanian business companies have considerably reduced technological process innovations, especially the industrial companies.

Index Terms—Expenditure on research and development (R&D), innovation, manufacturing industries, service industries, financial crisis.

I. INTRODUCTION

Economic growth, competitiveness, impact of global economy processes on local economies research in the general context of academic literature over the last years gained a new dimension related with economical / financial crisis impact valuation for different industries, markets, institutions, businesses and countries. However in this context, the effect of newly created or adopted in the business innovation for economic stability and in separate cases – even growth and added value creation over the crisis period, has to be examined in more consistent manner. The findings of such research may become as core elements for strategic instruments development aiming to prevent country's economy or separate industries from economic downturn losses or at the same time concentrating public financial support programs to the business areas, targeting to equilibrate economic development during the economic cycles. The literature confirms [1]-[7] that the biggest effect of active R&D expansion on growth occurs in those countries in which the new methods and techniques form an integral

part of the innovation process and allows installing innovative systems and improving the provision of existing services or increasing production volumes. When put against other EU countries, Lithuania spends very little on scientific research and economic development, i.e. in 2006-2011 the expenditure on R&D accounted for 0.79-0.92 % of national GDP, whereas in Finland, Sweden and Denmark the R&D/national GDP ratio in 2011 was at 3.78 %, 3.37 % and 3.09 % (European Union average in 2011 was 2.03 %) [8]. As in many other EU countries, in 2008 R&D volumes in Lithuania decreased, yet only in the business sector, as the public sector and the higher education institutions continued carrying out scientific research and experimental development, resulting in R&D expenses growing by LTL 87 million or 10.8%. With the economy on its way to recovery, already in 2011 Lithuanian business sector stepped up its R&D expenditure. When compared with the previous year, R&D volumes increased in all sectors amounting to LTL 974.3 million which was 28.5 % more than in 2010 and exceeded the pre-crisis level as well. The evidence suggests that during a global economic downturn businesses have a hard time deciding whether to invest or to wait for improved economic conditions, whether R&D is to be considered luxury expenses or whether it is actually better to invest during a recession in order to improve one's position in the market? However, scientists argue that R&D expenses should be encouraged during a recession, especially in hi-tech companies [9]. We should note that the majority of R&D expenditure in leading innovation countries occur in the business sector; meanwhile, in Lithuania most R&D expenditure occur in the public sector, i.e. in Finland in 2006-2011 the business sector accounted to 70.4 % of all R&D expenditure, in Sweden – 69.3 %, in Denmark – 67.6 %, while in Lithuania the figure was only 23.8-29.4 % (European Union average in 2011 was 62.3 %.) [8]. This trend can also be seen in other countries which lag behind in terms of innovation, such as Latvia, Poland, Greece, and Cyprus [10].

In order to foster innovation culture in the country's economy, innovation dynamics according global economy changes has to be observed. At the same time innovation policy measures have to be coordinated and purposefully promoted. Undoubtedly, there can be always found separate cases, situations in business, strategic decisions' consequences predetermined by some historical situations, specific for separate business or industry, but some observed general paths can be noticed and learned. The interaction of such historical datasets and theoretical models can generate valuable insights for policy makers and business entities to

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use it for strategic line and behavior selection. When discussing the opportunities for promotion of innovation and their effect on the economic development, it is important to analyze the intensity of scientific research and experimental development in Lithuanian business sector, as well as the changes in innovation activities of Lithuanian industrial and service companies amidst the global financial crisis and the post-crisis period in the European Union context.

This paper aims to investigate the main tendencies and impact of crisis on Lithuania high-tech industries, with the cross-view of the country's economy fast development before and slow recovery after the economic downturn.

II. RESEARCH BACKGROUND

However, relatively low academic interest on economic crisis and innovation activities interaction can be explained probably due to a general belief that innovation has little to do with economic crises [11]. Authors derived two hypotheses: innovation is cyclical and therefore firms tend to reduce their innovation efforts during the economic downturn or in the period recession there is a productive environment for companies' innovative activities. At the same time authors [12] stated that "while on the whole firms' investment in innovation declined during the economic downturn, a small but significant minority of firms are "swimming against the stream" and have increased their expenditures on innovation". The questions of this research were related with the dynamic nature of the companies' and newcomers in innovation markets, seizing the business opportunities in the crisis period. The questions of impact of the global crisis on firms' innovation profiles and which firms were most affected were also analysed by author [13] analysing dataset on the innovation performance of 1223 firms across 8 Latin American economies during the 2008–2009 economic downturn. In reference [13] research alignment was based on firms with access to public financing for innovation projects, firms maturity and size influencing decisions to continue or stop projects and firms relying on foreign markets/companies as business partners.

Author's [13] research findings indicated that in research area (8 Latin American economies) one in four firms stopped innovation investment projects in response to the global financial crisis, but firms with access to public financing were less likely to discontinue their projects, also firms which lost-out on export market sales during the crisis were also more likely to stop innovation investment projects. But in the context of crisis these firms planned to innovate more in future. And at the same time, according [14], Latin American and the Caribbean countries recovered relatively quickly and reached 5.73% GDP per capita growth in 2010.

In this context authors [11] analysing the phenomenon across the European countries found that "substantial amount of firms have managed to maintain their investment for innovation, but the number of firms able to expand it has dramatically dropped, and the firms that have decreased them have also substantially raised. This trend is not distributed uniformly across the European economic space. The most affected have been the European catching-up countries, namely the New Member Countries of Central and Eastern

Europe. "However, authors [11] used latest data of 2009, when crisis was not yet ended. In this context Lithuania, as New Member Country of Central and Eastern Europe is an interesting research area.

Data sample. The research sample is 8000 Lithuanian companies of all forms of ownership, which consist of 45.9 % manufacturing companies, 7.1 % construction, mining and quarrying companies, 6.3 % water supply, sewerage, electricity, gas companies, 10.9 % wholesale companies, 4.9 % transportation and storage e-companies and companies, 2.1 % financial and insurance companies, and 11.9 % information and communication companies. The research period is 2006-2011. The research uses Science, technology and innovation in Europe 2009 - 2013 data [8], [15]-[18] and the company data provided by Statistics Lithuania, Official Statistics Portal, Technology and Science [19]. The research classifies the industries into the following 4 sectors by technology intensity based on the EBPO classification: *High-technology industries*, *Medium-high-technology industries*, *Medium-low-technology industries* and *Low-technology industries* [20]. However, we will only focus on manufacturers of basic pharmaceutical products and pharmaceutical preparations and manufacturers of computer, electronic and optical products, which belong to the *High-technology industries*, as well as manufacturers of chemicals and chemical products, manufacturers of electrical equipment, manufacturers of machinery and equipment n.e.c., manufacturers of motor vehicles, trailers and semi-trailers, and manufacturers of other transport equipment, which belong to the *Medium-high-technology industries*.

Research methodology. When evaluating the intensity of scientific research and experimental development in the business sector and its changes, there are three indicators used: intensity ($R\&D\ expenses / GDP$), innovation level ($innovative\ companies / total\ number\ of\ companies$), innovation level in manufacturing and service sectors ($innovative\ service\ companies / total\ number\ of\ service\ companies$ and $innovative\ manufacturing\ companies / total\ number\ of\ manufacturing\ companies$), innovative activity of companies in the high-technology sector ($innovators / total\ number\ of\ high-technology\ companies$ and $technological\ innovators / number\ of\ innovative\ companies$), the structure of innovation expenses in service and manufacturing companies.

III. RESEARCH FINDINGS

A. R&D Development Changes in Lithuanian Business Sector

The global financial crisis had a rather small effect on R&D intensity in the business sector in the European Union: during the pre-crisis period, i.e. in 2006-2007 business sector R&D expenses accounted to 1.17-1.18 % of the GDP [15], however, during the crisis the ration grew and in 2009 was already at 1.25 % of the GDP [16], [17] (see Fig. 1). A slight decrease in R&D intensity in the European Union can only be seen in 2010, yet in the succeeding years European Union business sector continued to increase the intensity of their R&D activities and in 2011 the ration between R&D and

GDP was already at 1.31 % [8], [18]. Unlike the EU, R&D intensity of Lithuanian business companies is significantly lower than the European Union average: R&D expenditure of Lithuanian business companies in the examined period ranged from 0.19 to 0.24 % of national GDP. The crisis first affected R&D intensity in Lithuania in 2008 when R&D of business companies decreased by 7.7 %, while the ration between R&D expenses and GDP was at a mere 0.19 %. As of 2010 there was a fast growth in R&D expenditure: since 2010 they have grown by 18.4 %, in 2011 – by another 14.8 %; however, unlike in the EU, R&D intensity was slightly above the pre-crisis level and significantly underperformed in comparison with its EU equivalent, as R&D in 2011 only accounted to 0.24 % of the GDP.

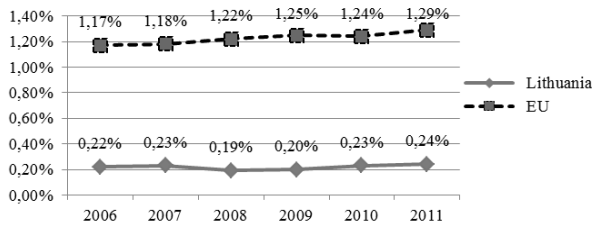


Fig. 1. Business R&D expenditure as % of GDP.

It is unfortunate that government funding contributes very little to the R&D activities of Lithuanian business companies: in 2007-2009 government funding accounted to 2.5-3.5 % of all business sector R&D expenditure and even though the proportion of government funding to business R&D expenditure increased to 4.4 % in 2010, already in 2011 the government cut the funding in half, resulting in just 1.9 % of all business R&D expenditure being funded by the government.

An interesting note is that the global financial crisis did not affect the funding structure of Lithuanian business sector R&D: in 2007-2009 78-78.3 % of all R&D expenditure were funded by business companies, whereas more significant changes occurred only in the post-crisis period with the growth of foreign financing which grew by 38.1% in 2010 and by 27.6 % in 2011; meanwhile, the proportion of foreign funding to R&D expenditure in 2011 accounted to 23.3 % (2006 - 13.5 %). Such growth is linked to the absorption of EU Structural Funds support. Looking at other EU countries, we can see that Italian companies use external funding for implementing innovations rather than their own R&D budgets; however, the overall impact of R&D flows on promoting product innovations and facilitating the innovativeness of new technologies is very small when compared against other EU countries [21]. The authors note that Italian companies face structural, institutional and political hindrances which lead to low R&D activity and have found that R&D expenditure in Italian companies are used for introducing new products, yet not for implementing new processes [21]. Meanwhile, in Lithuania up until 2010 the majority of R&D expenditure in business companies went towards technology development; however, the situation has changed significantly, as business companies started increasing funding for applied research, as well as fundamental research which meant that the share of technology development in the overall R&D expenditure structure decreased and accounted for just 68.6 % in 2011

(2006 - 74.9 %).

B. Lithuanian Industry and Services in an Innovative Performance Assessment

Scientific research and experimental development are closely related to innovation development. Lithuanian business sector underperformed significantly when compared against many other EU countries both before the crisis and during it. In 2006-2008 only 28.8 % of Lithuanian companies implemented innovations, while the EU average was 51.6 % (see Fig. 2). During the crisis, however, Lithuanian companies realized the importance of innovations and the ratio between innovative companies and the total number of companies increased to 32.5 %, yet the gap to the EU remained very large, as 52.9 % of all companies in the EU on average implemented innovations in 2008-2010. At the same time, in Germany innovation activities were carried out by 79.3 % of all German companies, in Iceland the ratio was 63.8 %, whereas in Belgium – 60.9% [8].

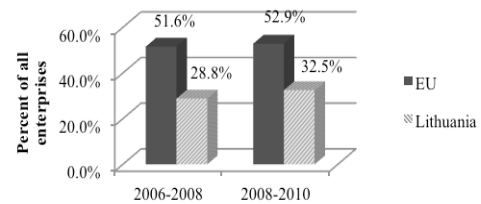


Fig. 2. Innovative enterprises.

Not only Lithuanian industrial companies but also the service sector is also lagging behind the EU in terms of innovation level. In 2006-2008 innovations were implemented by a mere 30.2 % of Lithuanian industrial companies, whereas in the EU innovation activities were performed by 54.5 % of all industrial companies. The percentage of Lithuanian companies implementing innovations grew slightly in 2008-2010 and was at 32 %; however, in EU countries the innovative activity of industrial companies fell, as innovations were implemented by just 52.9 % of all EU industrial companies (see Fig. 3). The literature suggests that in many European Union countries industrial companies are more innovative than their counterparts in the service sector [8]. The same can be said about Lithuanian companies during the pre-crisis period, as innovations were implemented by only 28.7 % of all Lithuanian service companies (whereas in the industrial sector 30.2 % of all companies were innovative). Nevertheless, in 2008-2010 innovations were implemented by 35.8 % of all service companies meaning that the service sector surpassed the industrial sector with respect to innovation, yet still lagged behind the EU service sector levels (in 2008-2010 50.5 % of all EU service companies on average were innovative).

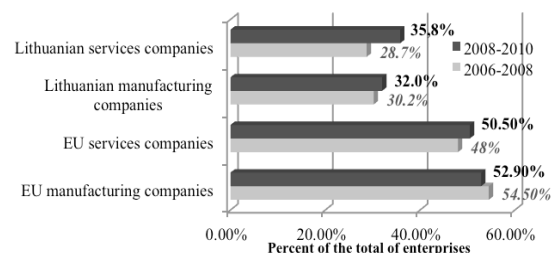


Fig. 3. The percentage of innovative companies in the industrial and the service sectors.

Tendencies are observed in the scientific researches that limits, separating manufacturing enterprises from the ones in service sector, become increasingly uncertain. Traditional industry classification that distinguishes products and service sectors is not applied so often in the modern knowledge-based economy, while service sector becomes an increasingly important business driver, stimulating innovations, leading to the strengthening of international competitiveness [22]. The comparative study performed in the industrial and service sectors showed that there are more problems and uncertainties in service sector than in the industrial sector. Communication with customers and other companies are very important in service sector; besides, during the implementation of innovation, there is a lack of protection of intellectual property and information is rarely exchanged due to competitive reasons. On the other hand,

service sector requires fewer investments than industrial sector, for example, there is no need to allocate so many expenses for R&D [23]. Scientists, who examined the impact of innovations on U.S. companies in service sectors, believe that the emergence of innovative services and development has a positive impact on the growth of companies; however, it does not affect productivity [24].

Significantly higher innovative activity in Lithuania can be seen amongst the *high-tech* companies, as evidenced by the fact that innovative companies made up 51.5 % of all companies in 2006-2008, whereas in 2008-2010 the percentage of innovative companies in this sector grew to 66.2 % (see Fig. 4). The ratio of innovative companies to total number of companies also increased in Lithuanian *medium-high* technology sector although was considerably lower at only 40.1 % in 2006-2008 and 49.0 % in 2008-2010.



Fig. 4. Innovators and technological innovators in Lithuanian *high-tech* and *medium-high tech* industrial sectors.

In 2006-2008 as much as 83.6 % of all Lithuanian technology-innovative companies carried out technological innovations. The percentage of technology-innovative companies in the *high-tech* and *medium-high tech* sectors was around 96.4-97.9 % of all innovative companies in that sector. Although the innovative activity of industrial companies increased during the crisis, the nature of innovations had changed completely. In 2008-2010 the percentage of companies implementing technological innovations decreased to 69.2 %. The decrease during this period can be evidenced in industrial sectors on all technological levels, yet the most significant decrease was in the medium-high technology sector, in which technological innovations were implemented by 77.3 % of all innovative companies in that sector. Meanwhile, the share of technological innovators in Lithuanian high-technology industry remained rather stable during the crisis: In 2008-2010 technological innovations were implemented by 55.7 % of all high-tech companies, down 6 percentage points from the 2006-2008 level. This suggests that the decisions of Lithuanian government in strengthening the competitiveness of the national economy and encouraging the growth of innovation have achieved their goal: as of 2010 the high-technology sector is way ahead of other Lithuanian industrial sectors in terms of investment intensity.

industrial companies can be characterized by completely different trends during the crisis: 22.2 % of all industrial companies carried out technological innovations in 2008-2010, down 3 percentage points from 2006-2008, whereas the expenses of technology-innovative industrial companies on innovative activities decreased by 43.2 %.

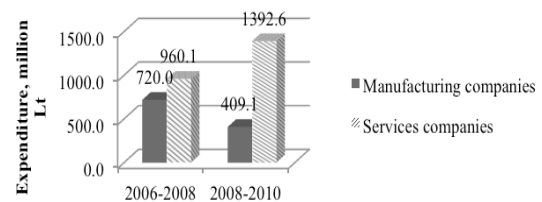


Fig. 5. The expenses of technology-innovative Lithuanian companies on innovative activities.

The increase in Lithuanian service sector innovative activity during the crisis can also be seen when analysing the dynamics of innovation expenses of technology-innovative companies: Lithuanian technology-innovative service companies ramped up their expenditure for innovation activities by LTL 432.5 million (45 %) in 2008-2010 as compared to 2006-2008 (see Fig. 5). Meanwhile, the

The structure of innovation expenses has changed drastically during the crisis (see Fig. 6). The largest share of all innovation expenses in Lithuanian industrial and service sectors go towards purchasing machinery, plants and equipment. In 2006-2008 83.5 % of all innovation expenses of technology-innovative industrial companies went towards purchasing machinery, plants and equipment. In 2008-2010 industrial companies slightly decreased their expenses on internal R&D, yet the expenditure towards purchasing machinery, plants and equipment were almost cut down in half, hence the percentage of expenses towards internal R&D increased by 18.5 %. Completely opposite trends can be seen in the service sector. Before the crisis service companies only spent 64.6 % of their innovation funds on purchasing machinery and plants, whereas internal R&D mad up just 21.4 % of all innovation expenses. During the crisis, unlike

industrial companies, service companies significantly increased their expenditure on purchasing machinery, plants and equipment (by 73.7 % or LTL 457.4 million) and decreased their expenditure on internal R&D, resulting in the

growth of expenses on purchasing machinery, plants and equipment up to 77.4 % and the decrease of expenditure on internal R&D down to 12.4 % of all innovation funds.

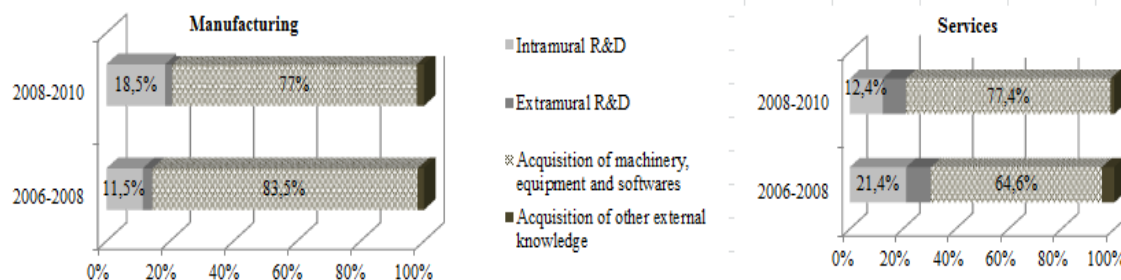


Fig. 6. The structure of expenses of Lithuanian technology-innovative industrial and service companies on innovative performance.

A relatively large part of innovation expenses of Lithuanian technology-innovative service companies is made up of expenses for external R&D: in 2006-2008 this percentage was 9.3 %. During the crisis service companies increased their expenses in the field up to 36.7 % (LTL 32.9 million), yet in the face of quickly rising other innovative expenses, the percentage of external R&D expenditure in total innovation expenditure decreased to 8.8 %.

innovations related to the use of new and improved manufacturing methods by applying new equipment or new methods of production organization, with particularly significant cuts being seen in industrial companies where the improvement of the technological process should be essential. In 2006-2008 technological process innovations were carried out by 86.5 % of all technology-innovative industrial companies, whereas in 2008-2010 the indicator decreased down to 58.9 % (see Fig. 7).

As a result of the global financial crisis, Lithuanian companies cut down considerably on technological process

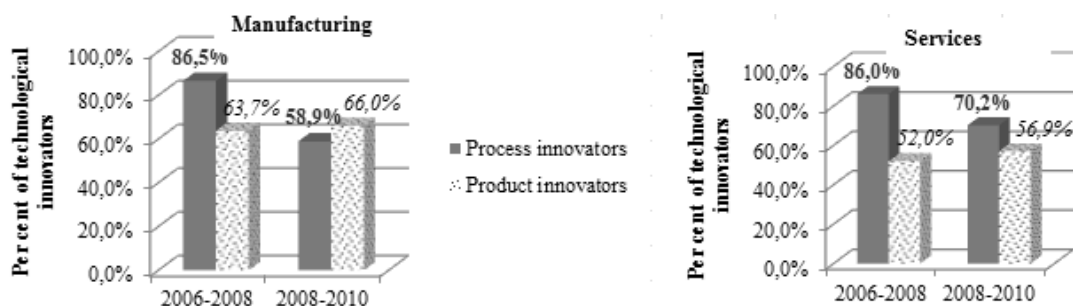


Fig. 7. Product and technological process innovators in Lithuanian industrial and service sectors.

During the crisis the service sector surpassed the industrial sector in terms of technological process innovations, with the former having 70.2 % of all technology-innovative companies improving their technological processes. In 2008-2010 both industrial and service companies focused more on product innovations, i.e. design and development of goods and services which stand out in terms of their characteristics from the rest of goods and services offered in the market (or a specific company). In 2006-2008 63.7 % of all technology-innovative industrial companies implemented product innovations, whereas in 2008-2010 the ration grew to 66 % meaning that during the crisis innovative activities of industrial companies were mainly focused on product development rather than process development. Meanwhile, service companies were more focused on technology process innovations rather than product innovations during the same period.

business companies was significantly lower than the European Union average: R&D expenditure of Lithuanian business companies in the examined period ranged from 0.19 to 0.24 % of national GDP, whereas in the EU the ration grew from 1.17 % to 1.31 %. The global financial crisis had little effect on R&D funding structure of Lithuanian business companies, as the single largest source of R&D funding for the companies was their own funds, with foreign funding seeing more significant role only in the post-crisis period and only due to the absorption of EU Structural Funds support; meanwhile, government's contribution in funding R&D activities of Lithuanian companies is very small.

Lithuanian business sector underperformed significantly when compared against many other EU countries both before the crisis and during it. During the crisis, however, Lithuanian companies realized the importance of innovations and the ratio of innovative companies to total companies grew. Not only Lithuanian industrial companies but also the service sector is also lagging behind the EU in terms of innovation level. The literature suggests that in many European Union countries industrial companies are more

IV. CONCLUSION

The research showed that the R&D intensity of Lithuanian

innovative than their counterparts in the service sector. The same phenomenon can be seen in the pre-crisis period in Lithuania; however in 2008-2010 Lithuanian service sector surpassed the industrial sector in terms of innovation.

Significantly higher level of innovative activity can be seen in Lithuanian high-technology sector where the number of innovators grew even during the crisis. Lithuanian medium-high technology sector also saw an increase in the number of innovators during the crisis. Although the innovative activity of industrial companies increased during the crisis, the nature of innovations had changed completely. In 2008-2010 the percentage of companies implementing technological innovations decreased.

As a result of the global financial crisis, Lithuanian business companies have considerably reduced technological process innovations, especially the industrial companies where the improvement of the technological process should be essential. In 2008-2010 both industrial and service companies focused more on product innovations. During the crisis more innovative activities of industrial companies were directed towards product development rather than process development. Meanwhile, service companies were more focused on technology process innovations rather than product innovations during the same period. In conclusion, we could say that the global financial crisis did not have a significant effect on the innovative activity of Lithuanian industrial and service companies; however, it did trigger considerable changes in the nature of investments.

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