DETERMINANTS OF INNOVATION IN CHEMICAL SUBSTANCES MANUFACTURING COMPANIES: THE CASE OF LATVIA

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Abstract

Innovation is crucial for countries and companies for their survival and growth, and this is especially significant in the light of recent economic turmoil. In this research, one particular industry was analysed – the chemical substances manufacturing industry. The aim of the paper is to evaluate the impact of firm-specific determinants on the innovation level of the company and, based on the empirical results, to make conclusions and recommendations.

Based on the analysis of a sample of 97 companies over the period from 1996 to 2011, it can be concluded that more innovative companies are smaller and their debt level is negatively correlated with profitability. During financial crisis (2008-2011), a divergent feature can be found – more innovative companies use more short-term debt and total debt. This might indicate that, during the economic boom, the companies finance their innovations by using other financing sources than debt, while during economic recession when internal resources are not sufficient to cover innovative projects debt financing is required. To companies it is recommended to analyse and evaluate the possible innovative projects diligently, and if their future incoming cash flow exceeds the required investment, then it is lucrative to finance their investments using external debt.

Key words: capital structure, innovation, intangible assets, profitability

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Introduction

Innovation is the basis for competitiveness. Innovation is crucial for countries and companies for their survival and growth. The importance of innovation and innovative companies is especially significant in the light of recent economic turmoil. There are differences and specific features across industries, therefore, the authors of the paper chose one particular industry – the chemical substances manufacturing industry. The chemical industry of Latvia

has stable traditions as it has manufactured for a long time both the production for the customer, as well as business consumption. It is important to analyse determinants of innovative companies of chemical substances manufacturing industry.

The aim of the paper is to evaluate the impact of firm-specific determinants on innovation level of the company and, based on the empirical results, to make conclusions and recommendations.

The analysis is conducted on a sample of 97 chemical substances manufacturing companies over the period from 1996 to 2011. In the research paper, the following qualitative and quantitative methods of research are applied: the monographic method, graphical method and correlation analysis.

Innovation studies started to emerge as a separate field of research in the 1960s (Fagerberg, 2003). Since then a sizeable amount of literature on innovation has been developed (Fagerberg, Fosaas, & Sapprasert, 2012). Some studies explore the characteristics of innovative companies. More innovative companies are large exporting companies characterized by private ownership, highly educated managers with mid-level managerial experience, and access to external finance (Ayyagari, Demirguc-Kunt, & Maksimovic, 2011). The current crisis has substantially reduced the number of firms willing to increase their innovation investment, from 38% to 8% (Archibugi, Filippetti, & Frenz, 2012). In addition, the share of R&D spending over total investment is countercyclical without credit constraints, but this cyclical behaviour could be reversed as firms face tighter financial constraints (Lopez – Garcia, Montero, & Moral-Benito, 2012). Many papers are published on innovation and profitability. Results by Bartoloni (2013) indicate that a firm's leverage is caused by both innovation and profitability, while no causal effect is registered from a firm's leverage to either profitability or to a measure of innovation output. Cozza, Malerba, Mancusi, Perani and Vezzulli (2012) estimate a positive and significant „innovation premium" in terms of profitability and growth for companies who introduced new innovative products. Brien (2003) provided empirical evidence that intended strategy (attempting to compete on the basis of innovation) impacts financial slack, and that the interaction between intended strategy and slack, in turn, influences performance.

1 Intangible assets as a proxy for innovation

The concept of innovation is interpreted differently among statisticians, economists and entrepreneurs, and this often causes inaccuracy in innovation accounting. The reasons for

the difficulty in producing accurate innovation statistics are to do not only with the failure in the interpretation of the concept of innovation, but also with the complexity and dynamism of the innovation process (Jesilevska, 2012).

Innovation is hard to measure. It is possible to measure inputs (for example, widely used R&D expenses), however, it is not possible to measure output precisely. Surveys can capture the numeric value of innovation only vaguely; because it is filled in by a human and biases are due to appear. Innovation is broader than R&D or patents. Therefore, taking into consideration the vast majority of different innovation indicators and diverse innovation methodologies, as well as their strengths and weaknesses, it is possible to conclude that a particular indicator or methodology at the moment does not exist, which would be recognized as the best way to measure and analyse innovation. All indicators are based only on approximate calculation and assumption.

Considering the afore mentioned and the available data, the authors of this study use intangible assets as a proxy for innovation (in particular, the ratio of intangible assets deflated by the total assets of the company). This decision is based by the fact that although research and development (R&D) costs are not equivalent to intangible assets, however, R&D are included in the composition of intangible assets (development costs) and, in addition, R&D activities frequently result in the development of something that is patented or copyrighted, which in turn is included in the balance sheet as an intangible asset. Intangible assets consist of development costs; concessions, patents, licenses, trademarks and similar rights; other intangible investments; goodwill; payments on account for intangible investments (Law on Annual reports, 2006). In general, it is possible to conclude that intangible assets can for the most part be considered as innovation indicators as well, since they are composed of balance sheet items which might indicate the level of innovation in the company and intangible assets incorporate a wider range on innovation inputs/outputs than if only R&D costs were used.

Several authors have already explored the use of intangible assets. Andrews and De Serres (2012) explored the growing importance of intangible assets as a potential source of innovation and productivity gains. The importance of intangible capital has been rising steeply in OECD and emerging economies with implications for innovation and economic growth. Another view is that there are two types of intangible assets: those that are purchased, and those that are internally generated. R&D costs fall into the category of internally generated intangible assets; therefore it is possible to establish that expenditure on R&D can fall into the category of intangible assets (ACCA, 2007).

Table 1 summarizes the strengths and weaknesses of ratio of intangible assets as a proxy for innovation.

Tab. 1: Strengths and weaknesses of ratio of intangible assets as a proxy for innovation

Strengths	Weaknesses
✓ Data available (balance-sheet) ✓ The use of ratio makes the indicator more comparable ✓ Information is classified in much detail ✓ Covers a large variety of innovation – inputs/outputs	- Rough approximation and assumption of (possible) innovation ouput - Based in accounting data, which may be incorrect or prepared in accordance to divergent accounting standards - Does not cover all innovation output

Source: prepared by the authors of the paper.

Therefore the authors of this study use the ratio of intangible assets deflated by total assets of the company as a proxy for innovation.

2 Sample and research methodology

The study is based on the financial data collected from the financial statements of 97 Latvian chemical substances manufacturing companies over the period from 1996 to 2011.

The analysis is conducted using the correlation method. The Pearson correlation ratio measures the degree and direction of linear relationship between two variables. Correlation coefficient of +1 corresponds to a perfect positive linear relationship, coefficient of -1 corresponds to a perfect negative linear relationship, and 0 indicates no linear relationship between variables. The study uses book values of calculated variables.

The study used the following variables:

- As a proxy for innovation (IA), the ratio of intangible assets was used (calculated by dividing intangible assets by total assets);
- Short-term debt (STD) is calculated by dividing short-term debt by total assets;
- Long-term debt (LTD) is calculated by dividing long-term debt by total assets;
- Total debt (TD) is calculated by dividing total debt by total assets;
- As a proxy for profitability (PROF), return on equity was used (calculated by dividing net profits by stockholders' equity);
- As a proxy for size (SIZE), the logarithm of total assets was used;
- As a proxy for liquidity (LIQ), current ratio is used (calculated by dividing current assets by current liabilities).

3   Empirical analysis and discussion of results

Figure 1 provides information on the ratios of intangible assets, long-term debt, short-term debt and total debt. The ratio of intangible assets decreased significantly from 1996 to 2002, however, in recent years, an upward trend can be observed. At the same time, one can observe a significant increase in the ratio of total debt, although from 2009 the ratio of total debt has started to decrease.

Fig. 1: Ratio of IA, LTD, STD and TD for the companies in the study (1996-2011)
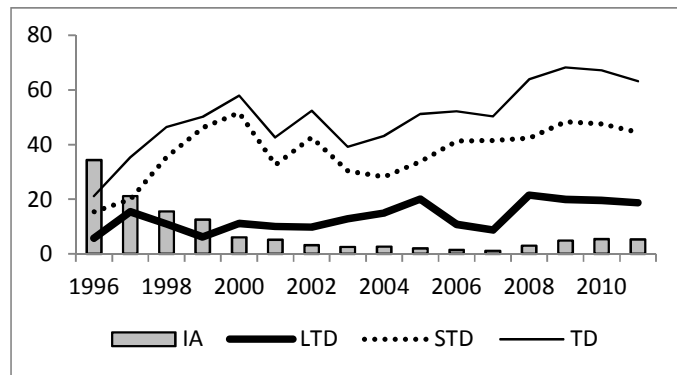
Source: authors' construction based on the annual reports (Lursoft, 2013)

The recent economic downturn has significantly impacted the profitability ratios of chemical substances manufacturing companies (Table 2). Return on equity (ROE) measures how much profit a company generates over the money shareholders have invested, and return on assets (ROA) is an indicator of how profitable a company is relative to its total assets. Before 2008, both ROE and ROA were positive and high, especially ROE. Yet, starting with 2008, all profitability ratios are mostly negative.

Tab. 2: Average return on equity (ROE) and return on assets (ROA) of the companies in the study (2006-2011), %

	ROE	ROA
2006	35.2	8.8
2007	39.1	4.1
2008	-0.3	0
2009	-4.2	-0.9
2010	-5.3	-0.4
2011	-2.6	-0.1

Source: Lursoft, 2013

To sum up, based on the graphical analysis, innovative chemical substances manufacturing companies use less debt, therefore their main source of financing is equity. The

companies of this industry use more short-term debt than long-term debt. At the same time, the current financial crisis has impacted the profitability as well. Before crisis (2006 and 2007) ROE was significantly higher than ROA, which means that financing was costing less than company earns. Company was making enough profit on borrowed funds to cover the cost of interest on these funds.

Table 3 presents the Pearson correlation matrix of the variables included in the study of chemical substances manufacturing companies.

Tab. 3: Pearson correlation matrix of the companies in the study, 1996-2011

	IA	LTD	STD	TD	PROF	SIZE	LIQ
IA	1						
LTD	-0.190** (0.003)	1					
STD	0.136* (0.036)	-0.225** (0.001)	1				
TD	0.032 (0.629)	0.310** (0.000)	0.841** (0.000)	1			
PROF	-0.010 (0.879)	-0.154* (0.018)	-0.242** (0.000)	-0.320** (0.000)	1		
SIZE	-0.316** (0.000)	0.311** (0.000)	-0.147* (0.023)	0.043 (0.511)	-0.097 (0.136)	1	
LIQ	-0.020 (0.754)	0.218** (0.001)	-0.089 (0.172)	0.029 (0.651)	0.003 (0.968)	-0.103 (0.115)	1

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed)
Source: prepared by the authors of the paper.

Ratio of intangible assets is positively correlated with short-term debt and negatively correlated with long-term debt and size, whereas no significant relationship was found with total debt, profitability and liquidity. It means that innovative companies are smaller in size and use more short-term debt than long-term debt. In addition, there is a negative relationship between profitability and all three debt ratios. Conclusion can be made that an increase in total debt is associated with a decrease in profitability.

If one compares both subsamples (1996-2007 and 2008-2011, results are presented in Table 4 and Table 5), some differences can be found.

Tab. 4: Pearson correlation matrix of the companies in the study, 1996-2007

	IA	LTD	STD	TD	PROF	SIZE	LIQ
IA	1						
LTD	-0.183* (0.023)	1					
STD	-0.073 (0.367)	-0.179* (0.026)	1				
TD	-0.166*	0.318**	0.837**	1			

	(0.038)	(0.000)	(0.000)				
PROF	-0.048 (0.555)	-0.081 (0.314)	-0.219** (0.006)	-0.255** (0.001)	1		
SIZE	-0.286** (0.000)	0.247** (0.002)	-0.326** (0.000)	-0.163* (0.041)	-0.072 (0.372)	1	
LIQ	0.103 (0.201)	-0.061 (0.452)	-0.256** (0.001)	-0.278** (0.000)	0.009 (0.909)	0.000 (1.00)	1

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed)
Source: prepared by the authors of the paper.

Tab. 5: Pearson correlation matrix of the companies in the study, 2008-2011

	IA	LTD	STD	TD	PROF	SIZE	LIQ
IA	1						
LTD	-0.217 (0.052)	1					
STD	0.448** (0.000)	-0.299** (0.007)	1				
TD	0.334** (0.002)	0.252* (0.023)	0.848** (0.000)	1			
PROF	0.015 (0.892)	-0.175 (0.119)	-0.252* (0.023)	-0.352** (0.001)	1		
SIZE	-0.384** (0.000)	0.344** (0.002)	-0.020 (0.859)	0.170 (0.128)	-0.118 (0.295)	1	
LIQ	-0.041 (0.719)	0.259* (0.020)	-0.116 (0.301)	0.026 (0.820)	0.009 (0.939)	-0.239* (0.032)	1

*Correlation is significant at the 0.05 level (2-tailed), **Correlation is significant at the 0.01 level (2-tailed)
Source: prepared by the authors of the paper.

In the first period (economic boom), there is no significant relationship between the level of innovation and profitability and liquidity. Overall, these results are similar to the whole period of the study. However, if the second period is analysed, one can find a significant and positive relationship between the level of innovation and short-term debt and total debt. These results indicate that during the economic boom the innovative companies of chemical substances manufacturing industry use less debt and they finance their innovations by using other financing sources (retained earnings, etc). During the economic recession, when internal resources are not sufficient to cover innovative projects, debt financing is required.

To sum up, innovative chemical substances manufacturing companies change their financing strategies within the business cycle. In addition, more innovative companies are usually smaller than less innovative companies. The study also found that more profitable companies use less debt.

Conclusion

The research covered companies of Latvian chemical substances manufacturing industry for the period of 1996-2011, and analysed the impact of firm-specific determinants on innovation level of the company.

Although innovation studies started to emerge as a separate field of research in the 1960s and a sizeable amount of literature has been developed since then, research is still on-going and many papers are being published on innovation-related subjects. One challenge is that the concept of innovation is interpreted differently among various stakeholders.

Innovation is hard to measure, since it is possible to measure inputs on some level, however, it is not possible to measure output precisely. A particular indicator or methodology does not exist at the moment, which would be recognised as the best way to measure and analyse innovation. This paper uses intangible assets as a proxy for innovation.

Interesting results arise, when the ratio of intangible assets, capital structure and profitability are analysed. The ratio of intangible assets decreased significantly at the end of the 1990s as the ratio of total debt increased, and this might mean that the main source of innovation financing is equity. Before the crisis, ROE was significantly higher than ROA, which may indicate that companies are making enough profit on borrowed funds to cover the cost of interest on these funds.

Based on the graphical method, one can conclude that more innovative companies use less debt. This conclusion is logical, since intangible assets are not good collateral, because they are the least liquid assets. At the same time, more innovative companies are usually smaller than less innovative companies. The increase in company debt is associated with a decrease in profitability.

A distinct characteristic is found if the data of financial crisis (2008-2011) are analysed separately. Namely, innovative companies use more short-term debt and total debt. This might indicate that, during the economic boom, companies finance their innovations by using other financing sources than debt, while during the economic recession, when internal resources are not sufficient to cover innovative projects, debt financing is required.

It is recommended to analyse and evaluate the possible innovative projects diligently, and if their future incoming cash flow exceeds the required investment, then finance the investments using external debt, since the cost of debt is usually cheaper than the cost of equity. At the same time, it is recommended to be cautious and not increase the level of debt above the industry average.

Acknowledgment

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