

DOES INNOVATION INFLUENCE FIRM PERFORMANCE
AND IS IT WORTH DOING:
CASE OF UKRAINE

by

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Kyiv School of Economics

Abstract

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This study investigates the relationship between innovation activity and firm performance. The main hypothesis is that a new product introduction has somewhat beneficial effect on the results of its maker. Using the sample of 6.9 thousand Ukrainian firms over 2004-2010 we found that the relationship between lagged innovation activity and firm performance is actually negative for RAO and insignificant for EBIT margin and TFP. However, the reverse relationship is found. Performance variables are positive determinants of ability to implement new products. Also we found that larger firms tend to launch more number of new products, however, less diversified firms are more likely to innovate.

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GLOSSARY

New to the firm innovation – implementation of the product, which the firm has never produced before, but other firms might have already introduced it

R&D. Research and Development

ROA. Return on Assets

EBIT. Earnings before interest and taxes

TFP. Total factor productivity

Chapter 1

INTRODUCTION

This paper investigates the effect of innovation activity on firm performance. More specifically, we test the direct effect of a new product introduction on return on assets, return on sales and total factor productivity.

In the modern world of highly competitive business environment, it is very important for a company to stay ahead of its rivals and create competitive advantages. One of the main forces that facilitates this process is the ability of a firm to use its innovative capacity. A high level of flexibility allows the firm to respond to changes in demand and consumer preferences more rapidly and adjust its product range in line with the most recent trends. As technologies evolve with time it allows to produce the improved products, which, in its turn leads to economic growth.

So, innovation is one of the reasons why economic growth takes place – because firms upgrade what they produce. During this process they transform their current products to some improved related products. This is known as innovation implementation. From the global perspective, radical innovations can influence economies by creating new markets through the complete replacement of existing products, services or technologies. Over and above, investment in product innovation probably can be one of the effective ways of market expansion. What is important from the economic point of view – to investigate the influence of a new product introduction on the financial results of its maker.

Therefore, the primary purpose of this work is to test whether product innovation has a beneficial effect on firm performance.

So, it is important to estimate the contribution of innovative output on firm performance because not every innovative product is a commercially successful one. Individuals do not consume more just because they have more variety of products to choose from. Therefore, innovation activity creates additional risks and uncertainty. On the other hand, a firm can achieve risk reduction through diversification effect. Considering this, it is a big challenge to assess the costs and benefits associated with innovation activity.

The firm-level innovation literature usually looks into the impact of innovation outputs (such as product innovation) on firm productivity or growth of employment or sales. Quite often empirical studies fail to find any connection between innovation and sales growth. Instead of this, many articles find a typical positive and significant effect of innovation output on firm productivity. Some researchers (Damijan, 2011) argue that this is due to distinguishing between process and product innovations. The former often has labor displacement effects and tends to result in significant productivity growth. The latter, due to the demand effect, may cause an increase in employment, which may not result in significant productivity growth. We can find many empirical researches on this topic for the EU countries, but there is lack of attempts to evaluate such questions for CIS countries.

According to the theory there are some links between innovation and firm performance, therefore researchers try to assess the importance of innovation in company's business strategy. To investigate this, in 2013 Bain & Company surveyed nearly 450 executives around the world at enterprises that earn more than \$100 million in revenue. Two-thirds of respondents said their companies

made innovation one out of their top three priorities. However, less than one-quarter believed that their companies were effective innovators.¹ So, it is important not only to implement innovations, but also to realize their effect on business and be able to make them commercially successful.

Understanding the relationship between firm performance and innovation activity could provide useful insights for company management for two reasons. Firstly, managers would be able to optimize decision-making processes as concerns a new output line. Secondly, this may help allocate resources more effectively.

The data for this research cover firm-level by-product outputs from 2004 to 2010. To capture firm differences we will try to control for industry and size effect and connect these data with general firm's characteristics, such as balance sheet data, employment, investment, etc. We will use fixed effects regression with robust standard errors in order to capture fixed effects and address possible heteroskedasticity issues to estimate the effect of a new product on ROA, return on sales and productivity.

As expected results, implementation of innovation should lead to better performance comparing to the firms that do not innovate. What concerns return on sales, higher number of new product introduced reflects the higher EBIT margin. Besides, a positive and significant effect of innovation on productivity is expected.

The remainder of the paper is organized as follows. Chapter 2 analyses the literature on the topic. Chapter 3 describes the methodology and Chapter 4 describes the data. Further, Chapter 5 provides the empirical results and Chapter 6 sums up the research and explains the results of the analysis.

¹ <http://www.bain.com/publications/articles/taking-the-measure-of-your-innovation-performance.aspx>

Chapter 2

LITERATURE REVIEW

In this chapter we will first show theoretical frameworks within which innovation effect can be studied and then present the most influential empirical papers that show the impact of innovation on productivity, sales, employment and others.

2.1 Theoretical frameworks

From the perspective of welfare economics, implementation of innovation has an advantageous effect for society. This is due to the fact that usefulness from using the invention made by someone does not decrease when it is used by others (Arrow, 1962).

However, the most important thing to start with is the right conceptualization, because quite often it is difficult to measure innovation due to the ambiguity in defining real inputs and innovative outputs. The vast majority of studies in this field are consistent with the definition provided by Oslo Manual (2005), which designates four different types of innovation: process innovation, marketing innovation, organizational innovation and product innovation.² The last one, in its turn, is divided into three categories depending on the degree of novelty: new to the world, new to the market and new to the firm.

In this research, the last type of innovation is the most appropriate. It is, by definition, implementation of the product, which the firm has never produced

² Due to restrictions concerning data availability, we can only estimate the effect of product innovation

before, but other firms might have already introduced it. Hence, it is not necessary for the company to be the initiator of innovation itself, it can rather adopt any of them from others without investing money or taking additional risks. The company is often gainful from imitating other firm's creations, even though the imitator enters the market later than the innovator. The R&D costs in this case are lower, and considering the drawbacks of innovator will often allow to produce more competitive products (Shylov, 2011).

New to the firm innovation activity is very closely related to diversification built on existing technologies (Neffke and Henning, 2013; Coad and Guenther , 2013). A good reason for such kind of a strategy is risk minimization by adding more items into production portfolio. Therefore, from the firm's perspective, it can be viewed as technological diffusion, when a firm acquires the existing product to its production line.

A vast majority of works concerning innovations (e.g. Hashi, 2012; Hall, 2009; Mairesse, 2009; Griffith, 2006) are based on some variant of the Crepon, Duguet, and Maitresse (1998) model (CDM). This model describes three-stage relationship among innovation input, innovation output and productivity level. In this model the capitalized R&D is often used as a proxy variable for innovation input. Three blocks of equations explain the following links: the decision to innovate and the amount of R&D performed; innovation output equations with R&D expenditures as input; productivity equation, in which innovation output becomes an explanatory variable.

In general, theoretical studies (Hall, 2011; Encaoua, 2006) suggest and empirical researches (Ernst, 2001; Brouwer and Kleinknecht, 1999) confirm some positive effect of new to the market and new to the world innovations on the future sales. The reason is that such kinds of innovation allow for the temporary monopoly

through the mechanism of patenting, which in many cases is the only serious barrier for firm-followers to entry. However, there is no definitive evidence about the effect of economic outcomes of new to the firm innovations. Lööf and Heshmati (2006) use a sample of 1309 innovative firms in Sweden and find a closer relationship between innovation output and the level of sales per employee for innovations new to the firms compared to cases where innovations are new to the market. On the other hand, as for manufacturing firms, growth rate of productivity increases only with new to the market innovations.

One of the main disadvantages of launching new to the firm innovations is rigorous competition with homogenous products because the firm enters into already saturated market. In this context, Isogava (2013) argues that innovation does not necessarily improve firm performance because of so-called cannibalization effect. To study this impact, the effect of product innovation was decomposed into sales of a new product and changes in sales of existing products. In this case the firm can face the situation when implementation of a new product reduces the sales of company's existing related products. Therefore, innovation and cannibalization effect cancel out each other and sales increases are negligible. As a conclusion: only radical innovation can improve firm performance since the increase in demand comes from the fact that completely new products benefit consumers higher compare to the previous ones.

Thus, theories provide quite alternative views on the relationship between innovation and firm performance. This is when empirical studies are appealed to decide between them.

2.2 Empirical evidence

All empirical studies on the relationship between innovation and firm performance can be divided into two groups. Researchers from the first group

consider innovation as the dependent variable and try to seek for its determinants, including indicators of firm performance. The second one looks into determinants of the firm performance, including innovation as one of explanatory variables. We will design this study mostly in accordance with the second group, considering innovation as the choice variable for explaining firm performance. But in addition, we also study the reverse causality and determine which firm characteristics mostly affect the ability to introduce new products.

Some researchers provide the results in support of the hypothesis of positive economic impact of new to firm product innovation. In this group, there are different indicators to measure firm performance: employment, sales, total factor productivity growth. Pauvels (2004, p.149) finds that “overall, new product introductions have a positive short- and long-term impact on the firm’s top-line, bottom-line, and stock market performance. Moreover, the impact persists over time”.

However, the empirical literature does not often distinguish between the degrees of innovation novelty. Therefore, below we present empirical results for any kind of innovations. We separate three measures of influence.

- **Productivity.** The main body of papers that investigates the effect of innovation on productivity uses CDM model, which was mentioned above. In Ukraine, Vakhitova and Pavlenko (2010) use a modified version of CDM model not only for innovative, but for all manufacturing firms, assuming that all of them have some innovation expenditures, but not all firms report about them. The results show that process innovation and productivity are positively related while the relationship between product innovation and productivity is not significant. In addition, they find that being innovator in the past increases the probability of introducing innovative product in the future.

In the paper by Rõigas (2011) productivity is measured as “value added per employee, which consists of labor costs, depreciation and gross profit per employee”. The positive linkage between productivity and product innovation is found for the sample of Estonian service sector firms. In particular, when the firm is product innovator (indicated by dummy variable), productivity increases by 21.9%, and gross profit per employee goes up by 43.6%.

- **Employment.** Lachenmaier (2011) studies the effects of innovation on employment in German manufacturing firms. Harrison (2008) considers manufacturing and services firms across France, Germany, Spain and the UK. Both papers determine that product innovation is associated with employment growth and “compensation effects resulting from the introduction of new products are significant even when the cannibalization of old products is taken into account” (Harrison 2008, p.27). The latest paper provides evidence that an increase in the sales growth due to new products by one percent leads to the same increase in gross employment.

As for Ukraine, the most relevant research is done by Bogutskyy (2009), where the evidence of some positive effect of innovation activity on the employment level is found. However, it is shown that there is no distinguishing between the effect of product and process innovation as well as the insignificant industry spillover effect. Our research is different from the above mentioned in the sense that we look into other indicators of possible innovation influence.

- **Profit and sales.** Folkeringa et al. (2003) study 3000 Dutch small and medium enterprises. Researchers test four different performance measures: profit, growth in turnover, growth in employment and productivity. The

results show that regression for profit was not significant. As for productivity, the differences among firms were only explained by the sector dummies. Nonetheless, for employment and turnover, the firm size is a dominant factor. It is revealed that for small firms the innovative output has much bigger impact on the turnover growth than for medium-sized firms, but for employment growth the effect is the opposite.

Bayus et al. (2003) find a positive effect on ROA for current and lagged new product introduction in the personal computer industry. Estimated coefficients were 0.85 and 1.14 respectively, but in this study new product introductions are defined as the number of brand models introduced divided by total assets. So, they measure the effect of innovations per assets on earnings per assets.

Artz et al. (2010) studies not only the effect of innovation, but also the influence of R&D and patents on firm performance. The latter is measured as a return on assets and sales growth. Innovation is considered as “development of commercially valuable products or services”. Therefore, it, by definition, implies the gainful effect on firm performance. The sample consists of 272 firms in 35 industries. Researchers argue that if a firm is able to introduce continuous flow of innovative product it can generate high profit through brief monopoly.

Summary of empirical researches about the relationship between innovation and difference performance measures is shown in Table 1. As can be seen the existing studies provide strikingly similar results for innovation activities, but these findings cannot be simply extrapolated for Ukraine. We can expect different results compared to other countries due to a different country specification or production structure.

Table 1. Summary of previous empirical researches.

<i>Paper</i>	<i>Country</i>	<i>Performance measure</i>	<i>Relationship</i>	
			<i>Product</i>	<i>Process</i>
Vakhitova and Pavlenko (2010)	Ukraine	Productivity	Insignificant	Positive
Rõigas (2011)	Estonia	Productivity	Positive	
Lachenmaier & Rottmann (2011)	Germany	Employment	Positive	
Harrison et al. (2008)	France, Germany, Spain and the UK	Employment	Positive	
Bogutskyy (2009)	Ukraine	Employment	Positive	Positive
Folkerling et al. (2003)	Denmark	Profit	Insignificant	
Bayus et al. (2003)	USA	ROA	Positive	
Artz et al. (2010)	US and Canada	Sales growth	Positive	

Chapter 3

METHODOLOGY

In this chapter we will first show the model within which innovation effect on firm performance can be studied and then present the model which seeks for determinants of new product introduction, including indicators of firm performance as explanatory variables.

3.1 Effect of innovation on firm performance

The literature suggests many ways of measuring performance of the firm. Basic accounting ratios include return on assets (ROA), return on investment (ROI) and return on equity (ROE). The last two are expressed as net income divided by the total money invested and shareholders' equity respectively and both are similar in the way they assess how efficient financial resources are used. Following previous studies (e.g. Wang, 2002; Hitt, Hoskisson and Kim, 1997), ROA is measured as the ratio of earnings before interest and taxes to total assets.

Tellis, Prabhu and Chandy (2009) propose to use market-to-book ratio (relative value of the firm compared to its market value) to measure financial performance. They appeal to three main advantages: this indicator represents firm's valuation based on all activities and potential; it is future oriented measure; it assesses intangible value of the firm beyond its assets, due to factors such as innovation. However, this measure requires the information about the market price of the stock of the company and, therefore, it is suitable only for countries with efficient and liquid stock market.

Taking into account that literature suggests a strong relationship between innovation and productivity level, and consider that each performance variable has its own advantages and disadvantages, we use three measures of firm performance: return on assets, return on sales (or EBIT margin), and Total Factor Productivity (TFP). Return on assets is defined as operating income (EBIT) divided by the average book value of assets, and EBIT margin is defined as operating income divided by net revenue. This variable estimates firm's profitability on sales over particular period. EBIT margin is often used for comparison with other firms in the same industry. Total factor productivity was estimated for the paper "Ukraine case study: Jobs and Demographic Change" (Kupets et al, 2013) using Olley and Pakes (1996) procedure and was provided by one of the authors. TFP estimations are available only for 2004-2009 years and therefore models with TFP uses smaller amount of observations than models with ROA and EBIT margin.

The main variable of interest is *innovation*. A key challenge, however, is to find a clear indicator of innovative firm. The minimum level of novelty to enroll any changes in the production to the category "innovation" is defined as new to the firm. This is a sufficient level because any new to the market product is also automatically new to the firm. Therefore, for this empirical analysis, we define an innovative firm as follows: a firm is considered to have innovative activity into product market during a particular year, if a new item appears in its product line, which has not been listed before. To identify whether a firm introduces 1 or more products in a given year we use integer variable corresponding to the number of new product introductions. We also account for the relative size of innovation activity by including variable that measure the *share of the innovative products* introduced in the given year to the total number of products produced by the firm.

A number of studies show that the firm *size* is an important performance determinant and, in turns, is related to innovation activity since larger firms are usually more diversified and can benefit from the economy of scale. Lewin and Massini (2003) conclude a positive relationship between size of the firm and R&D activities, but innovation increases less than proportionately with firm size. Large firms have stronger cash flows and higher assets to found innovation (Rogers, 2004). As for the new product introduction strategy, “small firms are expected to rely more on innovative dynamics, while large firms are expected to rely more on market power strategies” (Vaona & Pianta, 2006).

There are two common ways to determine the firm size: the first one is based on the number of employees, while the second approach considers net revenue from sales of products or services. Official Ukrainian classification³ is the following:

Table 2. Classification of the firm size of Ukraine.

	<i>Number of employees</i>	<i>Net revenue (UAH)</i>
Small & medium	Up to 250	Up to 1 mln.
Large	More than 250	More than 1 mln.

We use 2004 as the base year and indicate innovative products starting from this year. The drawback of such method is that the firm can introduce some new product one year, then stop producing it, and then return to its production later. Therefore, we do not know what was before 2004 and it is possible that some new products in our data set are not really innovations for the firm. Nevertheless, it is best we can do with our data.

³ Legitimate act “On introducing changes concerning certain acts of law of on the questions of regulation of the entrepreneurship activities from 18.09.2008.

Current ratio is a liquidity measure (current Assets/current Liabilities) that shows how much of the firm's assets are working to grow the business. The current ratio can also give a sense of a company's ability to turn its product into cash.

Industry. Performance of innovating firms may be closely related to the performance of target industries. A number of studies (De Jong and Vermeulen, 2006) show that determinants of product innovation are different across industries. We account for the industry effect by including a set of dummy variables for industries using Ukrainian Classification of Economic Activities.

Year dummies. In order to capture the effect of business cycles, general economic environment and all external factors on firm performance, we included a set of year dummies.

The relation between innovation and performance is complex. Our dataset is an unbalanced panel and we should check for individual fixed effects for each firm. We will use fixed effects regression with robust standard errors in order to capture fixed effects and address possible heteroskedasticity issues. We believe that the influence of innovation persists more than one year and include lags of innovation to account for the previous innovation activity. The final equation is:

$$\text{PERF}_{i,t} = \beta_0 + \beta_1 \text{INNOV}_{i,t-j} + \beta_2 \text{PRODUCT_RATIO}_{i,t-j} + \beta_3 \text{CURRENT_RATIO}_{i,t} + \beta_4 \text{SIZE}_{i,t} + \beta_5 \mathbf{X}_{i,t} + \beta_6 \mathbf{Y}_{i,t} + u_i + \epsilon_{it}, \quad j \in [0;1] \quad (1)$$

where $\text{PERF}_{i,t}$ is a variable which measures firm performance (ROA, EBIT_margin, logarithm of TFP), $\text{INNOV}_{i,t-j}$ is the number of innovative products, $\text{CURRENT_RATIO}_{i,t}$ is a liquidity measure, $\text{SIZE}_{i,t}$ – number of

workers; and log of net revenue in linear and quadratic form in case of the financial measure, \mathbf{X}_{it} – set of industry dummies, and \mathbf{Y}_{it} – set of annual dummies.

Empirical studies also show the effect of other variables (R&D expenditures, return on innovation expenditures, age of the firm, ownership, number of patents) on firm performance, but it is hard to control for it due to the data limitations. As a consequence, we can have the omitted variable bias in our model. At the same time many of these variables are fairly constant over time and hence will be captured by fixed effects.

3.2 Determinants of innovation activity

It is interesting to look at not only the effect of innovations on firm performance, but also what kind of firms innovate: is it true that only most successful firms introduce new product? In contrast, there is a hypothesis that when financial performance is good managers are less likely to explore (Katila and Ahuja, 2002).

To study the determinants of innovations we used the number of new products as dependent variable. Since in this case the response variable is a count variable and we have an excess of zero counts (Figure 1) we used zero-inflated poisson regression. In addition to predicting the number of new products, there is interest in predicting the existence of excess zeroes. We assume that the total number of products can be suitable for this purpose. We used total number of products as a proxy variable for diversification of the firm (Montgomery, 1982) and included all variables in the previous period to see if they stimulate new product introduction in the current period. In this model we also control for size, industry and periods effects.

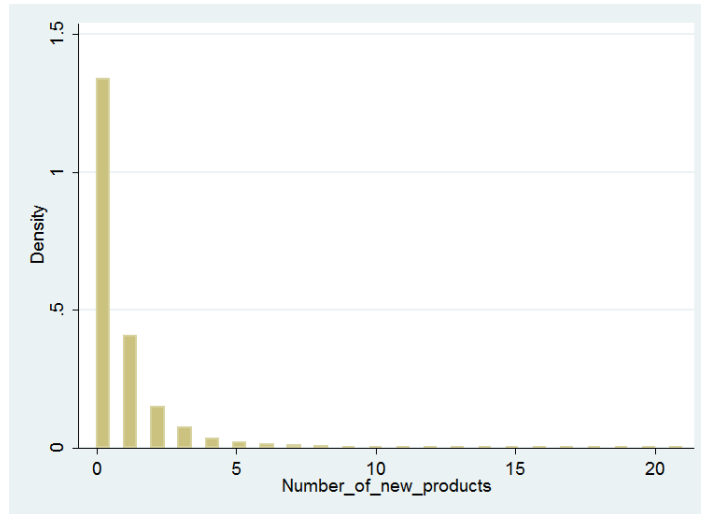


Figure 1: Density of number of new products

Chapter 4

DATA DESCRIPTION

According to the State Statistics Committee of Ukraine⁴, over 2007-2012 the total number of firms selling innovative products remains relatively stable over time with the slight decrease from 2008 till 2010 (Table 3). These companies introduced innovative products both new to the market as well as new to the firm. However, the number of firms introducing new to the market products decreases by 42.2% for 6 years. In addition, the share of innovative products in the total output of manufacturing goods in Ukraine decreases almost twice (from 6.6% in 2007 to 3.3% in 2012).

Table 3. The innovative activity of industrial enterprises of Ukraine.

	2007	2008	2009	2010	2011	2012
Number of companies that implemented industrial products	10346	10728	10995	10606	10350	10089
Number of companies that implemented innovative products	1035	993	994	964	1043	1037
Among them:						
new to the market products	420	322	288	270	260	243
new to the firm products	743	792	816	812	882	889
Adoption of innovative products, items	2526	2446	2685	2408	3238	3403
Share of sales of innovative products in sales of industrial products, %	6,7	5,9	4,8	3,8	3,8	3,3

⁴ <http://www.ukrstat.gov.ua>

To estimate the relationship between innovation activity and firm performance we used the firm-level financial data set available from KSE data center. It includes balance sheets and income statements of the sample of companies for the period of 2004-2010, as well as other firm-specific information (industry, organizational type etc.). The initial dataset consists of 6,848 enterprises and 30,360 observations.

The dataset is an unbalanced panel. Only 1,919 (27.5%) firms have observations for all 7 years. Total annual number of firms is shown in Figure 2.

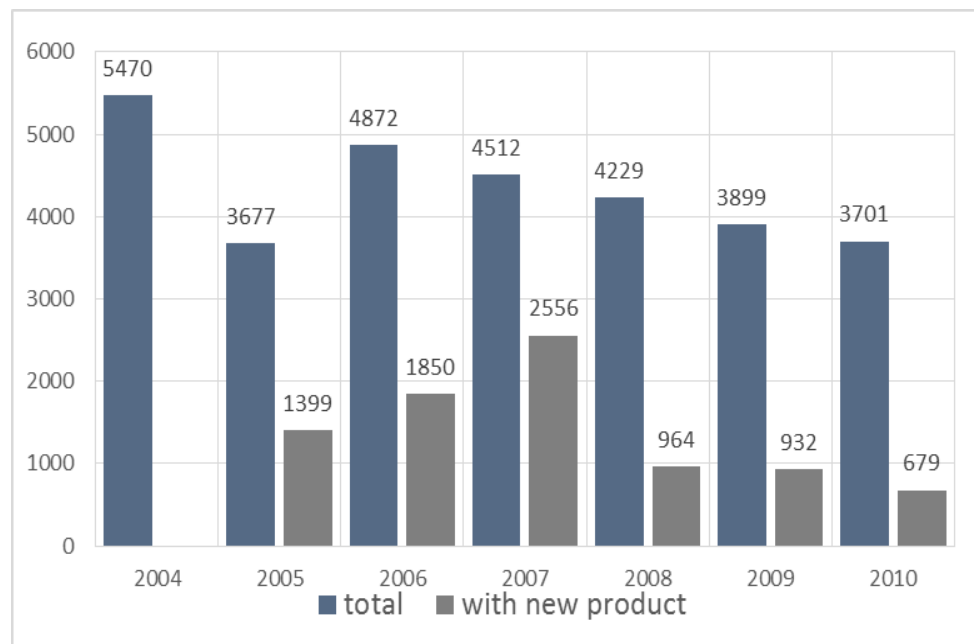


Figure 2: Annual number of firms

The number of innovative firms is characterized by strong upward trend up to 2008. However, starting from this year the amount of firms that introduces new products decreases dramatically (more than 2.5 times) and continues to reduce even further. It can be explained by the fact, that Ukraine was highly affected by

the economic crisis of 2008 and according to Derzhkomstat during 2008-2009 production of industrial output declined sharply and real GDP decreased by almost 15%.

In our dataset, all firms operate in 54 sectors according to the Ukrainian Classification of Economic Activities. These activities were aggregated into 10 industry groups: food production, mining, manufacturing, transport/energy, construction, retail/wholesale, hotels, services, education/health/sport. However, a significant number of firms (more than 65%) belongs to manufacturing industry and this tendency persists over time (Figure 3).

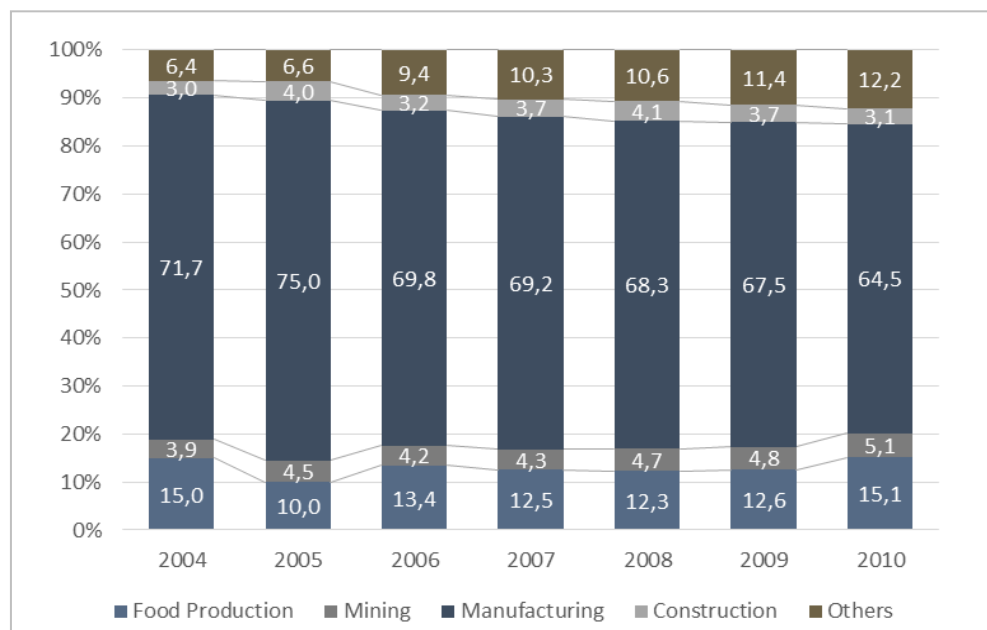


Figure 3: Distribution of firms across industries

The main variable of interest is the number of new product introduction. As can be seen in Figure 4, more than 50% of firms introducing new products over studied period introduces only one and with time passing this number rises to 63.7% in 2010. About 20% of firms introduces two products and in recent years

slight minority deals with more than three new product per year. For the entire studied period the maximum number of innovative product per year is 21.

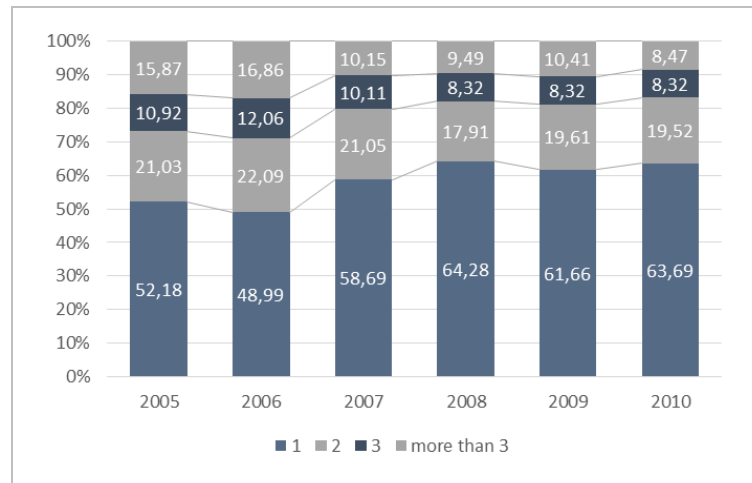


Figure 4: Number of new product introduction

Descriptive statistics and correlations are shown in Table 4. Return on assets is mostly correlated with return on sales (0.62), however, correlation between TFP and other performance variables are quite low. Also, we check for outliers and drop from our data firms with ROA and EBIT margin more than 1 and less than -2. Nevertheless, the mean value for return on sales is still negative (-5%). Also we exclude as outliers firms that have in its portfolio more than 50 products.

Table 4. Descriptive statistics and correlations

<i>Variable</i>	<i>Mean</i>	<i>S.D.</i>	<i>Min</i>	<i>Max</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1 ROA	0,02	0,15	-1,00	0,98					
2 EBIT margin	-0,05	0,28	-2,00	1,00	0,62				
3 TFP	1,20	1,25	-10,59	7,59	0,18	0,20			
4 Number of new products	0,69	1,45	0,00	21,00	-0,005	-0,003	0,05		
5 Total number of products	5,61	5,49	1,00	50,00	0,03	0,06	0,08	0,53	
6 Ln (employment)	5,18	1,21	0,00	11,07	0,15	0,17	0,06	0,16	0,40

EMPIRICAL RESULTS

First, we present the results for the determinants of the firm performance, including innovation as one of explanatory variables and further for determinants of innovative activity.

5.1 Results for the determinants of firm performance

Results of the fixed effect⁵ regressions are presented in Table 5. We can see that from our variables of interest lagged innovation activity has an impact on return on assets and this effect is with a negative sign in case of the number of new products and with a positive sign in case of the relative innovative activity. So, some time should pass until the clear impact of innovation on firm performance could be determined. More specifically, if in the previous year the firm introduced one more new product then in the following year return on assets would decrease by 0.2%, so the earnings per unit of assets would go down. The coefficient itself is not so high, but taking into account that mean ROA for our sample is 2% we can conclude that for an average firm a new product introduction decreases ROA in the next period by one tenth.

The return on assets ratio measures firm's earnings on its overall resources, so we can see how profitable a company's assets are. ROA is directly affected by both operating income and average value of assets. So, ROA can decrease either if EBIT decreases or if firm's assets increase. When the firm is going to expand and

⁵ We also estimated random effect regressions, but according to Hausman test fixed effect regressions should be used

introduce a new product line it needs to acquire additional equipment, buildings or other property. In other words, the firm incurs some capital expenditures that are the long-term assets. Capex will increase the total assets by the amount spent in the period. In addition, when a new product is just implemented the manufacturing process may not yet be debugged and not perfect in terms of cost optimization. The firm, therefore, may not immediately effectively produce this new product. It may need some time period to increase its efficiency.

Table 5. Regression results for the entire sample

	ROA	EBIT margin	TFP
innov _t	-0.001	-0.002	-0.005
	0.001	0.002	0.006
innov _{t-1}	-0.002**	0.000	0.002
	0.001	0.002	0.005
product_ratio _t	-0.001	0.010	0.024
	0.008	0.012	0.044
product_ratio _{t-1}	0.014*	0.003	-0.078**
	0.007	0.012	0.036
current_ratio	0.000	0.000	0.001*
	0.000	0.000	0.001
employment	-0.000*	-0.000	-0.001***
	0.000	0.000	0.001
ln(sales)	-0.068***	0.435***	0.412***
	0.022	0.083	0.105
ln(sales)_sq	0.006***	-0.011***	-0.002
	0.001	0.003	0.004
_cons	-0.057	-3.545***	-2.087***
	(0.131)	(0.510)	(0.632)
N	14917	14917	14828
R ²	0.131	0.228	0.132

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(i) All equations include 8 industry dummies and 4 years dummies

(ii) Fixed effects (FE) are included with robust standard errors

In some research the total number of products is a proxy variable for firm diversification and it can have both positive and negative effects on a new

product. As our results show, if in the previous period the share of new products to the total number of products increased by 10% then in the current period ROA would go up by 14%. It implies that less diversified firms could benefit more from the new product introduction because it is easier for them to increase the share of a new product. However, a large firm has higher total assets, so in absolute value earnings per asset can be higher.

The relationships between EBIT margin and innovation activity are not statistically significant, so we can conclude that firm's ability to generate profit is not related to the number of new products the firm implements. As for TFP only the lagged product ratio has a negative effect on productivity. So, if in a particular year the firm that has in its portfolio 10 products introduces one more product then in the next year productivity will decrease by 0.78%. Despite the fact, that this coefficient is statistically significant it is a big question whether it is economically significant. These results can be treated as similar ones obtained by Vakhitova and Pavlenko (2010), where the relationships between product innovation and productivity was insignificant. According to Harrison, et. al (2008) with product innovation there is productivity differences of the new product and the effect can be positive or negative. A new or improved product may imply a change in the production method and input mix, which could either reduce or increase productivity.

The firm size impact on firm performance is positive when EBIT margin or TFP as the measure of performance is used, but is negative when ROA is used.

5.2 Results for innovation determinants

Finally, we try to seek for determinants of innovative activity according to firm characteristics. Our initial hypothesis was that good performance encourages the firm to explore a new product.

According to the Vuong test, which compares the zero-inflated model with an ordinary poisson regression model a significant z-test indicates that the zero-inflated model should be used. We performed two models with different measures of the firm size but the obtained results are quite similar. As Table 6 shows there is a positive relationship between past and current innovation activity. In particular, for each unit increase of innovation in the previous period the expected count of the innovation in the current period increases by 1.13.

Our inflated logit model deals with predicting membership in category “innovator”. In other words, it estimates the odds that the firm introduces any new product given the level of diversification. Our results show negative effect of diversification (total number of products) on probability to implement a new products. Previous researches provide controversial argument on this topic. More diversified firm faces higher variety of opportunities for use of new knowledge and innovative activity may increase through economies of scope (Katila and Ahuja, 2002), when a firm decides not about making a lot versus a little of the same product, but about making different but compatible products within similar categories. On the other hand, as Hoskisson and Hitt (1988) show, the relationship between R&D intensity and market performance can be negative and as firm becomes more diversified, corporate management values the firm's R&D activities less, so innovation decreases. Our results seem to be more consistent with the latter evidence.

Table 6. Regression results for innovation determinants

	(1)	exp(β)	(2)	exp(β)
innov _{t-1}	0.125***	1.132	0.131***	1.139
	(0.006)		(0.006)	
ROA _{t-1}	-0.344***	0.709	-0.280**	0.758
	(0.105)		(0.111)	
TFP _{t-1}	0.031**		0.037***	
	(0.013)		(0.014)	
ln(employment) _{t-1}	0.107***			
	(0.014)			
ln(sales) _{t-1}			0.018**	
			(0.009)	
_cons	0.231	1.261	0.489**	1.632
	(0.183)		(0.194)	
inflate				
product_number _{t-1}	-0.204***	0.825	-0.215***	0.815
	(0.014)		(0.013)	
_cons	0.744***	2.105	0.842***	2.321
	(0.058)		(0.055)	
N	18201		18201	
nonzero N	6194		6194	

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(i) Dependent variable: innov_t

(i) All equations include 9 industry dummies and 5 years dummies

The firm size has a positive effect in both models and these results are consistent with many previous research. Smolny (2003) confirm direct relationship between firm size and product innovation for German manufacturing firms. Santarelli and Sterlacchini (1990) suggest that systematic innovation in large firms is more effective than in small ones. In our case, the effect of size indicated by employment is much stronger than effect indicated by sales.

Chapter 6

CONCLUSIONS

On a sample of 6,8 thousand Ukrainian firms we tested the relationship between the innovation activity and firm performance and examine the determinants of the new product introduction. We found that:

- New product introduction decreases return on assets in the next period since innovation requires capital expenditures.
- Larger lagged share of new products in firm production portfolio has a positive effect on ROA implying that more diversified firm can benefit from economies of scope.
- Relationships between the number of new products and EBIT margin are insignificant.
- RAO, TFP and firm size positively affect the number of the new product introduction, but less diversified firms are more likely to innovate

As for further researches, it would be interesting to see on the effect of other characteristics concerning innovations such as R&D expenditure, age of the firm, type of ownership on the firm performance. A good extension can involve the analysis of market and production structure in order to see whether probability of implementation of a new product increases if the firm is among leaders in producing some goods and what time period should pass after the firm becomes a leader with its innovative product.

WORK CITED

- Arrow, Kenneth. 1962. Economic welfare and the allocation of resources for invention. *The rate and direction of inventive activity: Economic and social factors*: 609-626.
- Artz, Kendall, Norman Patricia, Hatfield Donald, and Cardinal Laura. 2010. A longitudinal study of the impact of R&D, patents, and product innovation on firm performance. *Journal of Product Innovation Management* 27.5: 725-740.
- Bayus, Barry L., Gary Erickson, and Robert Jacobson. 2003. The financial rewards of new product introductions in the personal computer industry. *Management Science* 49.2: 197-210.
- Brouwer, Erik, and Alfred Kleinknecht. 1999. Innovative output, and a firm's propensity to patent: An exploration of CIS micro data. *Research Policy* 28.6: 615-624
- Coad, Alex, and Christina Guenther. 2013. Processes of firm growth and diversification: theory and evidence. *SPRU Working Paper Series*.
- Crépon, Bruno, Emmanuel Duguet, and Jacques Mairessec. 1998. Research, Innovation And Productivity: An Econometric Analysis At The Firm Level. *Economics of Innovation and new Technology* 7.2: 115-158.
- Damijan, Jože P., Črt Kostevc, and Matija Rojec. 2011. Innovation and firms' productivity growth in Slovenia: Sensitivity of results to sectoral heterogeneity and to estimation method. *Springer Berlin Heidelberg*.
- De Jong, Jeroen PJ, and Patrick AM Vermeulen. 2006. Determinants of Product Innovation in Small Firms A Comparison Across Industries. *International Small Business Journal* 24.6: 587-609.
- Encaoua, David, Dominique Guellec, and Catalina Martinez. 2006. Patent systems for encouraging innovation: Lessons from economic analysis. *Research Policy* 35.9: 1423-1440.
- Ernst, Holger. 2001. Patent applications and subsequent changes of performance: evidence from time-series cross-section analyses on the firm level. *Research Policy* 30.1: 143-157.

- Folkeringa, Mickey, Jeroen PJ De Jong, and Emiel FM Wubben. 2003. Innovation and firm performance. *Zoetermeer: EIM Business & Policy Research*.
- Griffith, Rachel, Elena Huergo, Jacques Mairesse, and Bettina Peters. 2006. Innovation and productivity across four European countries. *Oxford Review of Economic Policy* 22, no. 4: 483-498.
- Hall, Bronwyn H., Francesca Lotti, and Jacques Mairesse. 2009. Innovation and productivity in SMEs: empirical evidence for Italy. *Small Business Economics* 33.1: 13-33.
- Hall, Bronwyn H. 2011. Innovation and productivity. No. w17178. *National Bureau of Economic Research*.
- Harrison, Rupert, Jordi Jaumandreu Balanzo, Jacques Mairesse, and Bettina Peters. 2008. Does innovation stimulate employment? A firm-level analysis using comparable micro-data from four European countries. No. w14216. *National Bureau of Economic Research*.
- Hashi, Iraj, and Nebojša Stojčić. 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.
- Hitt, Michael A., Robert E. Hoskisson, and Hicheon Kim. 1997. International diversification: Effects on innovation and firm performance in product-diversified firms. *Academy of Management journal* 40.4: 767-798.
- Hoskisson, Robert E., and Michael A. Hitt. 1998. Strategic control systems and relative R&D investment in large multiproduct firms. *Strategic Management Journal* 9.6: 605-621.
- Isogawa, Daiya, Kohei Nishikawa, and Hiroshi Ohashi. 2012. New-to-Market Product Innovation and Firm Performance: Evidence from a firm-level innovation survey in Japan. No. 12-E. *RIETI Discussion Paper Series*.
- Katila, Riitta, and Gautam Ahuja. 2002. Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of management journal* 45.6: 1183-1194.
- Kupets, Olga, Volodymyr Vakhitov, and Svitlana Babenko. 2013. Ukraine Case Study: Jobs and Demographic Change. *Background paper for the World Development Report 2013*.

- Lachenmaier, Stefan, and Horst Rottmann. 2011. Effects of innovation on employment: A dynamic panel analysis. *International journal of industrial organization* 29.2: 210-220.
- Lewin, Arie Y., and Silvia Massini. 2003. Knowledge creation and organizational capabilities of innovating and imitating firms. *Organizations as knowledge systems*: 209-237.
- Lööf, Hans, and Almas Heshmati. 2006. On the relationship between innovation and performance: a sensitivity analysis. *Economics of Innovation and New Technology* 15.4-5: 317-344.
- Mairesse, Jacques, and Stéphane Robin. 2009. Innovation and productivity: a firm-level analysis for French Manufacturing and Services using CIS3 and CIS4 data (1998-2000 and 2002-2004). *Paris, France: CREST-ENSAE*.
- Manual, Oslo. 2005. Guidelines for Collecting and Interpreting Innovation Data. 2005. *A joint publication of OECD and Eurostat, Organization for Economic Co-Operation and Development. Statistical Office of the European Communities*.
- Montgomery, Cynthia A. 1982. The measurement of firm diversification: Some new empirical evidence. *Academy of Management journal* 25.2: 299-307.
- Neffke, Frank, and Martin Henning. 2013. Skill relatedness and firm diversification. *Strategic Management Journal* 34.3: 297-316.
- Olley, Steven, and Pakes Ariel. 1996. The Dynamics of Productivity in the Telecommunications Industry. *Econometrica*, 64(6): 1263-1298.
- Pauwels, Koen, Silva-Risso Jorge, Srinivasan Shuba, and Hanssens Dominique. 2004. New products, sales promotions, and firm value: The case of the automobile industry. *Journal of marketing* 68.4: 142-156.
- Rogers, Mark. 2004. Networks, firm size and innovation. *Small Business Economics* 22.2: 141-153.
- Rõigas, Kärt. 2011. Linkage between productivity and innovation in different service sectors. No. 2011-02. *Ordnungspolitische Diskurse*.
- Santarelli, Enrico, and Alessandro Sterlacchini. 1990. Innovation, formal vs. informal R&D, and firm size: some evidence from Italian manufacturing firms. *Small Business Economics* 2.3: 223-228.

- Shilov, Andrey. 2011. Innovation Economy: Science, Government, and Business. *Voprosy Ekonomiki* 1: 127-137.
- Smolny, Werner. 2003. Determinants of innovation behaviour and investment estimates for West-German manufacturing firms. *Economics of Innovation and New Technology* 12.5: 449-463.
- Tellis, Gerard J., Jaideep C. Prabhu, and Rajesh K. Chandy. 2009. Radical innovation across nations: the preeminence of corporate culture. *Journal of Marketing* 73.1: 3-23.
- Vakhitova, Ganna, and Tetyana Pavlenko. 2010. Innovation and Productivity: a Firm Level Study of Ukrainian Manufacturing Sector. *Discussion Papers* 27.
- Vaona, Andrea, and Mario Pianta. 2008. Firm size and innovation in European manufacturing. *Small Business Economics* 30.3: 283-299.
- Wang, Yung-Jang. 2002. Liquidity management, operating performance, and corporate value: evidence from Japan and Taiwan. *Journal of Multinational Financial Management* 12.2: 159-169.