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## **ECONOMETRIC MODELLING OF THE INNOVATION PROCESS IN UZBEKISTAN**

### **Abstract**

*This paper is dedicated to the analysis of factors affecting innovation in Uzbekistan taking the case of the Joint Stock Company “Uzkimyosanoat”. It involved obtaining primary data for 10 enterprises in the company and analysing this data. Factors to be looked at were chosen as research and development, intellectual knowledge, human abilities, level of satisfaction, demand for changes, usage of ICT and product development, growth of enterprise.*

*The results showed that after econometric analysis only 4 out of 8 the chosen factors had a significant effect on the innovation process in the enterprises of “Uzkimyosanoat”. These were intellectual knowledge, R&D, product development and enterprise growth levels. In order to develop innovation in the enterprise effectively, these factors need to be looked at more carefully and policies undertaken to increase their development.*

**Key Words:** innovation, variables, econometric model, factor, enterprise

### **INTRODUCTION**

Taking developed nations as an example, Uzbekistan as a developing nation and needs to expand its innovation strategy and the usage of knowledge economy in sectors in the economy. In the market economy, the progression of innovation effects GDP growth, employment, and increase the competitiveness in the world market.

Innovation is a very wide area of study, and each industry has its own particular factors which may influence the development of innovation more. Each industry needs its own particular type of innovation and development. This particular paper will analyse the chemical sector in Uzbekistan and in particular try to identify the main factors which affect the innovation in this sector, taking the JSC “Uzkimyosanoat” as an example.

The aims of the research were:

1. Clarify the meaning of innovation; critically identify the main factors which are affecting on innovation according to other research
2. Explore these factors for “Uzkimyosanoat” using primary data
3. Make econometric equations and model to show the quantitative influence of the factors of innovation

Innovation is becoming a topic which many firms and governments are paying bigger and bigger attention to. This is because of the fact that innovation means responding to the conditions, which are changing daily, and to the technologies

that are getting more and more developed as we speak. The more innovation you have the better the country grows and the enterprises develop<sup>1</sup>. Innovation influences the economy to prosper and grow thus leading to bigger employment levels and income in that economy<sup>2</sup>. Innovation is a process, a strategy, a benchmark, leadership skills, management techniques and much more<sup>3</sup>.

### LITERATURE REVIEW

Policies to support SME's are being implemented all over the world, and these policies include many factors in order to encourage innovations. Dr. Vigier stated that the EU stimulates an 'open innovation' model where knowledge and experiences are shared in between the people inside the networks. The EU aims to promote the interaction of a broad range of policy areas, such as structural funds, state aid policies, education and training<sup>4</sup>.

According to OECD, in the CIS countries Research and Development does not have a significant impact on innovation. In the case of Small and Medium Enterprises the innovation can have either "capital equipment or input-embodied innovation" or "design innovation". Although not all firms make innovations, many have the potential to do so and according to their research those companies who have higher educated employees, introduced at least one new product, give a considerable weight to client satisfaction and research their markets, have good relationships with other companies, don't get subsidies or own patent<sup>5</sup>.

The UNDP states that the biggest tool to improve innovation in Uzbekistan is education<sup>6</sup>. According to the research made by the International Finance Corporation in 2005 SME's comprised 38.2% of GDP and 66% of the employment in Uzbekistan<sup>7</sup>. Thus developing this sphere through the use of innovations is becoming more and more important by each day. Not many researches have been made in small countries regarding determinants of innovation and their effects<sup>8</sup>.

According to the 2007 Uzbekistan Presidential decree, industries are encouraged to innovate and modernize their technological process in order to be in the competitive world market.<sup>9</sup> Research regarding innovation development policies in Uzbekistan are being studied by authors such as Karimov (2005)<sup>10</sup>, Bekmuradov A., Ishmuhamedov A., Akabirova (2007) has discussed the ways of developing manufacturing industry in Uzbekistan through the usage of innovation<sup>11</sup>. Abdukarimova M., Madjidov Sh. and others.

As the topic of innovation is relatively new to Uzbekistan, there has not been a lot

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1 Industry Canada research publication programme, 2001. The economic determinants of innovation. Retrieved November 13, 2009 from <http://ftp.iza.org/dp3962.pdf>

2 Sloman, J. and Sutcliffe, M., 2004. Economics for Business, 3rd ed. London: Pearson education Limited.

3 Kuczarski, T., 2003. "What is innovation? And why aren't companies doing more of it?" Journal of Consumer Marketing, vol. 20, no. 6, p. 536 – 541

4 Leger, A. and Swaminathan, S., 2007. Innovation theories: Relevance and implications for developing country innovation. Retrieved November 19, 2009 from

5 OECD, 2000. Enhancing the competitiveness of SME's through innovation. (online)

6 United Nations Development Programme, 2008. "Catalyst of Innovation" Economic Outlook journal. Tashkent: CER

7 International Finance Corporation, 2009. Business environment in Uzbekistan as seen by Small and Medium Enterprises 2009.

8 Salavou, H., Baltas, G. and Lioukas, S., 2004. "The importance of strategic orientation and competitive structure" European Journal of Marketing, vol. 38, no. 9/10

9 Republic of Uzbekistan presidential decree, 2007. About Modernization of the production process, technical and technological development and competitiveness. Newspaper "People's Words" N52

10 Karimov, I., 2005. Our main aim is to make our economy a democracy and innovate, to modernize and develop our country. Uzbekistan

11 Akabirova, D. N., 2008. Methods of developing the manufacturing industry in Uzbekistan. Uzbekistan

of research done on it. Azamatov looked at the development of innovation and its.

The sampling made was for the whole SJC “Uzkimyosanoat” for 11 year period. 10 largest enterprises were looked at and analyzed, these were “Navoinazot”, “Maksam-chirchik”, “Ferghanaazot”, “Ammophos-maksam”, “Electrohimpzavod”, “Samarkandkimyo”, “Kukon superfosfat plant”, “Ferghana CPFC”, “Kungrad soda plant”, “Djizzak Plastmassa”, “UzkimyosanoatLoyiha”.

Innovation is a new meaning in both Uzbekistan’s research area and business area. Innovation is a word which has the meaning of “emerging with something new”. Something new means new method, new usage, new product, new idea, new way of doing something<sup>12</sup>. The process of thinking of this “new” thing and distributing it is called the “innovation process”. The period when the innovation is thought up of up to the time period when it is started to be used in real life is called the “Innovation period”<sup>13</sup>.

In order to move from one quality to another, better one, resources such as energy, time, money, workers and other inputs are needed<sup>14</sup>. The same can be applied to innovation, in order to bring it to life; it also needs some necessary inputs from which the most important are investments and time. Innovation, in the broad meaning is to increase the profitability by using new technology, new products or services, to make organizational decisions and using these “new” ideas in life<sup>15</sup>.

When reaching the first objective, Innovation has had many definitions and is a word used widely today, thus it was very difficult to obtain an exact meaning. Some authors as shown in the literature review stated innovation as anything that is new others as responding to changes. This case it was chosen to use innovation as the definition used by Kirzner<sup>16</sup> which stated that innovation is making new products from old technology or from new technology and making old products from old technology (lowering cost) or new technology

The Presidents book “The effectiveness of anti-crisis programs and priorities of post-crisis development (in the example of Uzbekistan)” states that in order to increase competitiveness in the market during the financial crisis, innovation technology programs should be thought of implemented<sup>17</sup>.

An “innovation center” was opened at Uzkimyosanoat in the year 2007 with the aim of developing innovation and attracting innovation projects. The companies innovation activities according to Republic of Uzbekistan presidential decree “Additional ways of Attracting Innovation projects and technology production”<sup>18</sup>, “Additional ways of increasing the growth and new product development in

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<sup>12</sup> Vasilyev, L., 2005. The development of innovation in the US or how to double GDP. Moscow

Kuzik, B and Yakovets, Y., 2004. Russia-2050 Innovation strategies. Economics

<sup>13</sup> Eshimov B., 2009. Choosing an innovation strategy and methods of implementing them. Tashkent

<sup>14</sup> Vasilyev, L. and Jelinskiy G., 2005. Methods of managing innovation activities.

<sup>15</sup> Norkulov, B., 2009. Developing the innovation technology usage in the markets in Uzbekistan. TDIU: Tashkent

<sup>16</sup> Kirzner “Entrepreneurial Discovery and the Competitive Market Process: An Austrian Approach.” Journal of Economic Literature, 35, 1 (March 1997): 60-85.

<sup>17</sup> Karimov, I., 2010. The effectiveness of Anti-crisis programs and priorities of post-crisis development (in the example of Uzbekistan). Ministry of Finance, Tashkent

<sup>18</sup> Uzbekistan Presidential decree, 2008 15 July. Additional ways of Attracting Innovation projects and technology production. Tashkent.

enterprises in the chemical industry”<sup>19</sup>, “Additional ways of modernizing production, to implement the most important projects that develop technology for the years 2009-2014”<sup>20</sup>

## METHODOLOGY

According to the aims stated in the presidential decree on the 12th march 2009, all enterprises in “Uzkimyosanoat” are implementing 3 building projects, 7 projects with foreign investment decisions and criteria, 5 new projects are under construction. By 2009, “Uzkimyosanoat” has started to produce 18 new products worth 15 billion soums.

Identifying the main factors which influence the innovation in this enterprise will help the chemical industry develop more by paying more attention to those factors and adopting necessary policy tools. Previous work of scholars will be reviewed and factors to be looked at identified. It has to be taken into account that this works make a sophisticated econometric model that will serve as a statistical tool but to analyse innovation and make a step further to try and find some influences to the innovation process and development.

The Center for innovations main aim is to work to develop the whole enterprise, find the best targets to achieve; control already implemented researches, think of new projects in order to produce new products. The innovation projects proposed are being implemented. A large proportion of the impenented projects are trying to produce new goods instead of imported goods used. “Uzkimyosanoat” has taken part in the 2008-2009 “Innovation ideas, technologies and projects” fair with 20 new projects. These projects were presented and certificates, patents, new product usage advices obtained.

The patents obtained for innovation usage, rationalizing certificates are the documents which show that they are new and giving them the ownership rights on the innovation. For example “Ammofos-Maksam” owns 9, “Maksam-Chirchik” owns 5 patent rights in the Republic of Uzbekistan<sup>21</sup>. According to the CEO of the Company, Mr Gulomov, this work in the shpere of innovation is still not enough and needs to be developed further<sup>22</sup>.

In order to make a regression and obtain an econometric equation, factors or independent variables to be tested needed to be chosen. As there is no exact model for calculating innovation, a model will be created. After looking through many researches made which has been discussed in the literature review above, it has been chosen to make a model by using the factors shown in the table below. The reason for this is that in my opinion is that these factors play a key role in the company and its management and affect innovation significantly. The dependant variable will be innovation.

Table 1: How to measure factors chosen to be looked at

<sup>19</sup> Uzbekistan Presidential decree, 2009 11 march. Additional ways of increasing the growth and new product development in enterprises in the chemical industry. Tashkent.

<sup>20</sup> Uzbekistan Presidential decree, 2009 12 march. Additional ways of modernizing production, to implement the most important projects that develop technology for the years 2009-2014. Tashkent.

<sup>21</sup> Gulomov, I., 2009. The innovation environment in SJC “Uzkimyosanoat” Report of company director. Tashkent

<sup>22</sup> Interview with Uzkimyosanoat director Gulomov I., 2010.

FACTOR	HOW TO MEASURE IT
Research and development	Money spent on R&D each year
Intellectual knowledge increasing	Qualification courses passed per year
Human abilities	Percentage of workers with higher education
Level of satisfaction	Satisfaction of workers through company surveys
Demand for change	Satisfaction of customers through surveys
Usage of ICT	Internet connection, computer availability
Product development	New products in production

It was planned to measure innovation through both the number of new products in the enterprises and with money spent on new technology. Through the course of the research it was found that technology that is new to the company and is being used efficiently is a better measure for this case. The reason behind this is that as “Uzkimyosanoat” is a very large company, the number of new products being produced is very small compared to total production thus after attempting several regression models it was seen that this dependant variable could be explained by all the independent variable and the results were unreliable.

### RESEARCH RESULTS

The Table in appendix shows the Log-Log regression results using 7 independent variables, looking at the probabilities of the coefficients, we can see that at a 5% significance only 3 independent variables are statistically significant, those are Research and development, Increasing qualification levels and higher education level. Thus the next regression was made for only the statistically significant independent variables using the method applied above.

The table above shoes the Log-Log model obtained with statistically significant independent variables used to try to explain the variation in the dependant variable. In this model, the coefficients are statistically significant at 5% and the standard errors are low. The adjusted R-squared of the model is 56% which is a significantly high results. No problems of autocorrelation and multicollinearity were observed. This particular model was deemed as the most appropriate model from those attempted.

Thus the model is:

$$\text{Log(Innovation)} = 0.470273 \cdot \text{log(R\&D)} + 0.444175 \cdot \text{log(increasing qual)} + 0.307230 \cdot \text{log(new products)} + 0.273577 \cdot \text{log(growth of employees)} + \varepsilon$$

As we know, the world financial crisis has caused many firms to decrease the number of its employees but we can observe from the given charts that “Uzkimyosanoat” was quite stable and the total employee percentage change was positive most of the period observed.

The third chart, namely the number of employees who pass increasing qualification courses shows us how important this factor is becoming to “Uzkimyosanoat”. The company is paying higher attention to educating its employees and the qualifications they have. “Uzkimyosanoat” has made special agreements with universities where they pay the tuition fee of some employees while they go to university and after graduations come to the firm to work.

The IT literacy, money spent on research and development, new product development and technological progress are all increasing significantly in the firm in hand. Especially during the past 3 years as the development of these spheres were paid higher attention to due to the fact that they are a large factor affecting development of the innovation activities in the firm. Thus it can be concluded from this fact that the enterprise think that these factors in particular affect innovation activities.

During the econometric modelling, panel data was analysed. This type of data is more complicated than simple time-series or cross sectional as it combines them together. It requires careful handling and manipulation. As Baltagi stated panel data shows more variability, more degree of freedom, higher efficiency and less collinearity of the data source<sup>23</sup>. Panel data estimations are assumed to be more accurate as the data varies across 2 dimensions as the data observed becomes more realistic and accurate.

## CONCLUSIONS

After 4 estimations of different models were attempted, the last estimation of the Log-Log model was chosen to be the most accurate model. The reason for this is the fact that the previous models such as the Linear model had very high coefficients, large p-values, small t-statistics, low D-W and the explaining power of the model other models were lower than the Logarithmic model. This model will further be discussed below and conclusion obtained from them analysed.

The biggest problem of panel data is the fact that the problem of multicollinearity and autocorrelation among observations may occur; the reason is the fact that as observations are repeated this may mean that the observations are no longer independent from each other.<sup>24</sup> It can be seen that in this model that the sign showing that multicollinearity exists are not there. These signs are large variance and large confidence intervals, low t-stats but very high R-squares. Looking at the model we can see that these problems are not present. The problem of autocorrelation is tested using the Durbin-Watson D-statistics. The model that was chosen as the best representative, which is the Log-Log model has a DW d-stat of 1.89. From econometrics lessons we know that the closer the DW is to 2, the more it means that autocorrelation does not exist.

The fixed effect approach was used when regressing the panel data (results shown in previous chapter) because it decreases the problem of correlation between the individual effects of the explanatory variables in independents. As was stated previously, these measurement tools (R&D expenditure, number of

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<sup>23</sup> Baltagi, H., 2002. *Econometric Analysis of Panel Data*, ed.2. John Wesley & Sons Ltd.: New York

<sup>24</sup> Verbeek, M., 2004. *A guide to modern econometrics*, 2<sup>nd</sup> ed. John Wiley & sons Ltd: England

increasing qualifications passed, new products in production, growth of employment) are in fact used to measure Research and development, Intellectual knowledge, Product development and enterprise growth. Thus those particular factors are significant in the explanation of the dependant variable innovation. We can state that a 1unit increase in the log of Research and development activities, while other variables are held constant, will cause a 0.47unit increase in the logarithm of innovation activities undertaken at “Uzkimyosanoat”. A unit increase in the logarithm of the intellectual knowledge will lead to a 0.44 unit increase in the logarithm of innovation. A 1 unit increase in the product development after holding other factors constant will cause a 0.3072 unit increase in the innovation levels.

The Adjusted R-squared of the model is equal to 0.564. R-squared shows the explanatory power that the independent variables have over the dependant variables. Adjusted R-squared is adjusted for the number of independent variables in the model. Thus in this equation, 56% of the change in Innovation is explained by the changes in the research and development activities, intellectual knowledge, product development and enterprise growth.

Total money spent on Research and Development is one of the biggest factors and it has the biggest influence on the innovation in any firm. This statement has been proven by all the equation where this variable was statistically significant everywhere. While it was concluded that factors such as demand for change, usage of ICT did not have a significant role in any of the models attempted. Level of satisfaction of workers and human abilities had their own effects but these effects were insignificant at the 5% level. The reason for this is that without worker satisfaction and human abilities, the companies would not be able to exist. As these factors are already playing a huge role in maintaining the companies’ production and quality levels, they have a lower effect on the innovation activities that the SJC would like to increase.

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