Innovations in Manufacture with Some Evidence from Romania

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Abstract: *TThe aim of this article is to study the relationship between the type of industry and the rate of adoption of product innovation, process innovation and organizational innovation. In the traditional approach, being innovative is only effective in the short run because competition will begin to imitate that innovation. In an alternative approach, there is a distinction between innovative and non-innovative firms. We tried to capture this process by making two groups of industries: low-tech industries and high-tech industries. If they seek to be competitive in the long run, innovative firms are strategically proposing to adopt new technologies and to innovate in product, process or internally in the organization. A study is being conducted using the data provided by the European Bank for Reconstruction and Development through the Business Environment and Enterprise Performance Survey (BEEPS) database for Romania in the year 2012. At industry level, companies' innovative behavior is unclear, but after grouping them into low-tech and high-tech industries, results have become more robust, respectively, in high-tech industries, there is an average of more product or process innovations. An interesting observation is that the percentage of adopting organizational innovations remains constant for both low-tech and high-tech industries. An interpretation related to the long term competitive innovative behavior is that by product and process innovation, the firm has a strategic vision and will have a constant process of structural organization.*

Keywords: product innovation, process innovation, organizational innovation, low-tech, high-tech.
JEL Classification: L0, O3, M2

1. Introduction

There are at least two ways to differentiate innovative activity within the firm. In the traditional view, being innovative is efficient only on short term due to competition which will start to imitate that specific innovation. In an alternative view, there is a distinction between two behaviors of firms, some are innovative and some are non-innovative. The firms which have an innovative behavior, pursue to adopt new technologies or to develop new products and then follow an idiosyncratic organizational process to adapt specific technology to the internal conditions within the restrictions of economic efficiency. Tacit or explicit, firms must identify new technologies to adopt, or new products to develop. If the firm is willing to be competitive on long term by adopting new technologies, and willing to have a strategic vision on long term, they will have a permanent process of adaption to the market conditions and structural reorganization.

2. Literature review

In a traditional economic approach a producer adopts new technologies due to the rent offered by their ownership, and then they have a temporary monopoly until they start to be imitated by competitors. (Griliches, 1960), (Kogut and Zander, 1992), (Tire and Orlikowski, 1994). Viewed from this angle, the decision to invest in the new technology is related to the advantage of holding a temporary monopoly due to the increase in the market share, which gives the company a higher temporary profit and this is a competitive advantage. Alternatively to the vision of the company to adopt new technology for holding a rent is the vision where the innovative firm has a different structure from the non-innovative company, and develops specific "skills" and "features". Innovative companies have a different structural behavior than non-innovative firms and are strategically active for innovation. In order to adapt the newest technologies, efforts are needed from innovative companies consisting in allocating significant R & D expenditure stocks to a competitive position within an industry. Companies acquire specific knowledge and skills, and they give the firm some competitive advantages as they manage to leverage them through the market, relative to competitors. Zahra and Covin (1993) show that firms apply a set of strategies to explain the investment in new technologies by firms. Goedhuys and Veugelers (2011) show that Brazilian manufacturing companies which have both process and product innovations are constrained by companies' access to finance and workers' [human capital] skills and quality of management. Piergiuseppe and Giuseppina (2005) argue that firms that use process innovations increase their chances of having a higher level of revenue. Turcotte and Rennison (2004) show that there is an increase in firms' productivity when using more intensive technology in the company and as the share of workers using computer training.

Tether and Tajar (2008) studied 2500 firms from Europe and identified three patterns of innovations:

- Innovations based on research for products;
- Innovation based on technological processes;
- Innovations based on organizational changes.

In specialty literature is quite established the concept of technological innovations for the manufacture sector, and it includes both technological and product innovations, but Tether and Tajar (2008) argue that they can be statistical identified with organizational changes.

For a good understanding of the importance of the concept of an innovative firm as it will be addressed in the case study, it is reminded that the choices a firm has when it wants to benefit from specific technological changes are: (OECD, 2001)

1. Strategic - represents some internal decisions that a firm has to apply consistently, related to the mix of technologies they want to achieve, whether they want to operate on niche markets or seek to gain a more competitive position on the domestic or international market.

2. Research & Development includes: - Research to increase knowledge about technological processes within the firm; - Strategic research engagements applied in order to adopt patents, existing techniques or innovations made by other companies in the production process;

- Developing concepts, prototypes and testing or modifying them.

3. Non-Research & Development can influence the innovation process of the firm by:

- Identifying new products or new technological processes through suppliers or customers;

- Acquisition of technological information, patents, or collaboration with consultancy firms;

- Developing employee skills through training; - Acquisition of equipment incorporating the innovative work of other firms;

- It can reorganize the company's internal structure.

4. The adoption process of new technologies

In literature, it is argued that a new technology is not instantly adopted in the firm but it involves an adaptation process that requires a dynamic learning process from the firm that also leads to the accumulation of knowledge. Almeida and Fernandes (2008) argue for the question in the questionnaire "Have you introduced a new technology that has significantly changed how to obtain the main product?" for Business Environment and Enterprise Performance Survey (BEEPS) database that the manager's response captures both the creation of new knowledge and the adoption and adaptation of the production process. This knowledge may be new to the firm, to the industry or to the world. Parente and Prescott (1994) show that there are some barriers to technology adoption by firms. This variable captures the company's innovative behavior and involves its commitment to an innovative strategy. Some technologies - such as patents – can't be directly redeemed through new processes or products, and therefore firms are undergoing an internal restructuring process that may involve some innovations. Throughout this process of implementing new technologies, companies acquire knowledge and skills that give them a heterogeneous character. There are practical limits in the BEEPS database to highlight the heterogeneity of innovative firms, but these arguments have been brought to the idea that innovative firms

have different and idiosyncratic behavior different from non-innovative ones. Empirical studies show statistically significant that innovative firms "[...] develop some skills and behavioral patterns that allow them to face market changes better than non-innovative ones. Also, the effect of innovation on profitability is greater as companies innovate more. " (Cefis and Ciccareli, 2005)

Goedhuys and Veugelers (2011) show that there is a relationship between "technology make", "technology buy" and company growth and in order to study the relationship between innovation and growth, also takes into account the conditions for effective technology creation and technology absorption, and firms in developing countries prefer to acquire technologies that are embedded in production equipment and not to develop new technologies within the firm. A "new" technology has different meanings for industries in the sense that industries that use top-level knowledge also involve greater risks when, for example, changing a production line. For example, for a car industry, a new car model may require a new production line, and if the model is not well marketed, there is a risk of bankruptcy for the entire company. Also as an example for the automotive industry, there are repeated product innovations such as small facelift changes that can give the car the "innovation" status without significant changes in process innovation within the production line.

5. Differentiating product innovation from process innovation and organizational innovation

The OECD Manual (2001) states that "organizational innovation" is present in both the manufacturing and service industries. For example, "the introduction of just-in-time systems should be treated as process innovations as it has an effect on the production of products for the market," and in the service sector, "Innovations include improved skills embedded in the organization and routines that alter the measured output . For example, the implementation of ISO 9000 quality standards are not technological innovations in the product or process [...]".

Tether and Tajar (2008) distinguish between "hard" technology innovations specific to R&D intensive activity and between "soft" innovations that they associate with the service sector by showing that it involves innovations within the distribution chain, such as marketing innovations; on European companies the authors point out that several companies have introduced organizational innovations than technological innovations. High-tech manufacturing firms are more likely to achieve product innovations, low-tech firms are making process innovations, and service firms are innovating in the distribution chain rather than traditional research through technology innovation. Specialty literature shows that the innovation trend has a different pattern for service sector firms, meaning that there is more emphasis on innovation on the sales side than on the fundamental innovation of the equipment. This makes a distinction between innovation for manufacturing firms that is established in the literature and is associated with primary R&D activity to invent new production means or significantly modify existing production processes.

6. Innovations in Romanian manufacture firms

Becheikh, Landry and Amara (2006) show that process innovations are an indicator for firms that compete through cost and thus seek economies of scale. In Eastern European countries, workforce is cheaper and thus allows a competitive advantage for companies operating in the region, in relation to the same industries operating in more expensive Western European regions. In the "Business Environment and Enterprise Performance Surveys" questionnaire, abbreviated BEEPS, coordinated by the European Bank for Reconstruction and Development, interviews were conducted with business managers with the objective to produce a statistical sample of company-level data on income levels, inputs of factors, outputs of factors, perception of competition intensity, etc. with the purpose of researching economic indicators on the dynamics of the business environment both in transition countries and for developed countries. The questionnaires collect data on the business environment, how it is perceived by firms, how it changes over time, and about the various constraints that affect the company's performance and growth. The full set of data is valid for the researchers and includes all the questions at the firm level. Specific series of data for some countries and standardized data sets are available. The standardized data sample allows for comparative economic analyses across countries and some country-specific questions are sacrificed. The data sample was simply random, and more information is available on the European Bank for Reconstruction and Development website, where an on-line form has to be filled in, and once the confidentiality agreement is given, company-level data is available https://ebrd-beeps.com/data/. The samples were randomly designed on the basis of national company registers or equivalent, and in some cases with a larger number of sampled firms than needed to ensure sample comparability. Sampled companies represent 4 categories of sectors: Manufacturing, Retail and Core. The boundaries of the BEEPS data series are related to the fact that there are relatively few firms surveyed, for Romania we have for the year 2012, 540 observations.

From the BEEPS 2012-20016 data, there are 540 valid observations for Romania, for the year 2012. Within the manufacturing sector we find 177 valid observations within: Garments, Food, Machinery and equipment, Fabricated metal products, Wood, Tobacco products, Textiles, Tanning & leather, Paper & paper products, Publishing, printing and recorded media, Coke & refined petroleum, Chemicals, Plastics & rubber, Non-metallic mineral products, Basic metals, Office machinery, Electronics, Communication equipment, Precision instruments, Motor vehicles, Other transport equipment, Furniture, Recycling.

Table 1 - Innovations in manufacturing sector in Romania in the year 2012

Industry	Frequency (%)	Product innovation (%)	Process innovation (%)	Organizational innovation (%)
Garments	32 (18%)	9 (28%)	15 (47%)	13 (41%)
Food	25 (14%)	14 (56%)	11 (44%)	10 (40%)
Machinery and equipment	19 (11%)	13 (68%)	8 (42%)	4 (21%)
Fabricated metal products	16 (9%)	10 (63%)	11 (69%)	8 (50%)
Wood	14 (8%)	4 (29%)	3 (21%)	4 (29%)
Other*	71 (40%)	38 (54%)	33 (46%)	28 (39%)
Total	177 (100%)	88 (50%)	81 (46%)	67 (38%)

Source: Author's calculations with data from https://ebrd-beeps.com/

Other include: Tobacco products, Textiles, Tanning & leather, Paper & paper products, Publishing, printing and recorded media, Coke & refined petroleum, Chemicals, Plastics & rubber, Non-metallic mineral products, Basic metals, Office machinery, Electronics, Communication equipment, Precision instruments, Motor vehicles, Other transport equipment,Furniture, Recycling.*

The data is distributed to industries according to the number of observations it has, respectively their weight in the total number of observations. For example, Garments has 32 observations and has a weight of 18% of the total of 177 observations, then Food has 25 observations representing 14%, etc. "Other" industries have a total of 71 observations representing 40%. Although the industries have been hierarchized according to the number of observations, they have not been ordered by an economic or other criterion. However, due to the large number of observations we appreciate that the results are robust and the variables observed are: Product innovation (%), Process innovation (%) and Organisational innovation (%). For example, in the Garments industry, 47% process innovation is higher than 28% product innovation. The highest product innovation rate is 68% in Machinery and Equipment, and the highest rate of process innovation is in Fabricated metal products. The smallest product innovation is found in Garments and Wood of 28-29%. The smallest process innovation is in Wood, 21%. In the Fabricated metal products industry we can see high innovation rates in the three analyzed forms, Product innovation 63%, Process innovation 69% and Organizational innovation 50%. On average, we have the following innovation rates for all manufacturing industries: Product innovation 50%, Process innovation 46%, Organizational innovation 38%.

The disadvantage of grouping "Other" from Table 1 in the same group of industries both in the low-tech, high-tech is due to the heterogeneity of firms, with the risk of offsetting effects when companies from intensive industries are simultaneously analyzed technology and industry firms with traditional technology. Paris, Schiantarelli and Sembenelli (2006) propose to control the heterogeneity of manufacturing technology, with two groups of industries: high technology industries ("high-tech") and traditional technology industries ("low-tech"). The authors argue that companies operating in a high-tech industry are forced to adopt more innovative behavior than firms operating in a low-tech industry. For industries with high technology it proposes the automotive industry and automotive components, chemicals and pharmaceuticals, electronics, metallurgy and machinery. It associates low technology to those industries: soft drinks, food, textiles, leather, plastics and non-metallic and other manufacturing. I have mentioned here the classification of the industries proposed by the authors, because in the literature there is a distinction between companies choosing to compete by cost advantage compared to cheap labor or to try to develop some competitive advantages resulting from the accumulation of tacit knowledge and innovations. Low technology industries offer fewer opportunities to gain knowledge about a particular technology relative to high technology industries.

Piergiuseppe and Testa (2005) associate traditional sectors: food, juice and tobacco production; textile or clothing manufacture; leather clothes; manufacture of handbags, footwear, etc.; manufacture of furniture and wood products. Piergiuseppe and Testa (2005) consider these industries vulnerable to international competition, especially from countries where the workforce is less paid, thus highlighting the comparative advantage of using a relatively cheaper workforce. The author argues that the probability of exclusion on the international markets of small-scale

intensive firms operating in countries where the workforce has on average high incomes will increase. He points out that Italian firms operating in the traditional sectors will have in the future a serious domestic competition on national markets and will be excluded from international markets precisely because of labor migration from less developed countries where the workforce has, on average, lower incomes.

Table 2 - Innovations in low-tech and high-tech manufacturing sector in Romania in the year 2012

Industry	Frequency (%)	Product innovation (%)	Process innovation (%)	Organizational innovation (%)
Low-tech*	91 (60%)	36 (40%)	39 (43%)	37 (41%)
High-tech*	61 (40%)	35 (57%)	31 (51%)	25 (41%)
Total	152 (100%)	71 (47%)	70 (46%)	62 (41%)

Source: Author's calculations https://ebrd-beeps.com/

Low-tech include: Food, Wood, Furniture, Tobacco products, Textiles, Garments, Tanning & leather, Paper & paper products.*

High-tech include: Publishing, printing and recorded media, Chemicals, Plastics & rubber, Non-metallic mineral products, Fabricated metal products, Electronics, Precision instruments, Coke & refined petroleum, Office machinery, Communication equipment, Motor vehicles, Other transport equipment, Recycling.*

In order to see if there is an innovation behavior distinction between economic sectors, two groups of industries were made in Table 2 for manufacturing sector: "high-tech" industries and "low-tech" industries, with the objective of capturing some effects generated by industries using advanced technologies or traditional technologies. In Table 2, Low-tech include: Food, Wood, Furniture, Tobacco products, Textiles, Garments, Tanning & leather, Paper & paper products and High-tech include: Publishing, printing and recorded media, Chemicals, Plastics & rubber, Non-metallic mineral products, Fabricated metal products, Electronics, Precision instruments, Coke & refined petroleum, Office machinery, Communication equipment, Motor vehicles, Other transport equipment and Recycling. We can see that the results are becoming more robust: In high-tech industries, both product and process innovations are higher than in low-tech industries.

7. Conclusions

In order to see if there is an innovation behavior distinction between economic sectors, two groups of industries were made for manufacturing sector: "high-tech" industries and "low-tech" industries, with the objective of capturing some effects generated by industries using advanced technologies or traditional technologies. In high-tech industries, both product and process innovations are higher than in low-tech industries An interesting observation is that Organizational innovation is the same in low-tech and high-tech industries, of 41%. An interpretation related to the long term competitive innovative behavior is that by product and process

innovation, the firm has a strategic vision and will have a permanent process of adaption to the market conditions and structural organization.

8. Future research

For a better understanding of the sources of innovations, future research could be interesting related to the sources of innovation regarding the product innovation, process innovation and organizational innovation. A different grouping of industries could generate different coefficients for the rate of adoption of innovations by firms. Interesting results could also be achieved if large companies and SMEs are ranked in order to understand better the relationship between company size and the type of innovation for Romanian companies. Because the BEEPS database is constantly updated, research can be done at the company level and increasingly complex studies on data panels.

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