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A Perceptual Measure of Innovation Performance: Micro Level Evidence from Turkey

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Abstract

This paper aims to introduce a qualitative indicator to measure innovation performance of Turkish firms by using firm level data collected by Turkish Statistical Institute (TURKSTAT) in 2008 and 2009. We propose a new indicator to measure the innovation performance which is simply based on the perception of firms regarding to the impacts of innovation. In order to create performance indicators we conduct a factor analysis to group the firms' perceptions on the impacts of innovation. Factor analysis gives us product and process oriented impacts of innovation. There are significant differences among product innovators, process innovators and firms engaged in both product and process innovations with respect to their perceptions on product and process oriented impacts of innovation. Among these three groups, product and process oriented impacts provide a highest value for the firms that perform both product and process innovations. As far as the link between firm characteristics and the impact of innovation is considered, there is a significant difference between small and large firms with respect to their perceptions on product oriented impact of innovation.While product oriented impact are larger for small firms, large firms focus more on process oriented impact. Anova results also indicate that perceptions on process oriented impact significantly differ among exporter firms, domestic market oriented firms and firms being active in internal and external markets. Process oriented impact generate results in favor of exporting firms.

Keywords: innovation impact, product oriented impact, process oriented impact.
Jel Classification*: L2, L3*

1. Introduction

This paper deals with an important question for innovation studies: how do innovations influence the performance of firms? Now, it is accepted by everyone that new technologies and innovations are vital to the growth of output and productivity (OECD, 2005). Therefore creating innovative firms, eco-systems and supporting innovation capabilities at the firm level, regional and national level are important concern for policy makers, managers and researchers. But it is difficult to understand and measure the impact of innovations on firms. The aim of this paper is to understand the impact of product and process innovations on firm performance. Measuring the impact of innovation is one of the most commonly studied topics in innovation studies. However, in spite of the extensive research on innovation studies we still do not have a generally accepted indicator or a set of indicators for measuring innovation performance. Previous studies aiming to measure the impact of innovations have often focused on financial indicatorsor quantitative outputs; such as increase in productivity, increase in growth, increase in sales, and the percentage of sales from innovative products (Evangelista and Vezzani, 2010; Parisi et al. 2006).

Although the indicators used to measure the impact of innovations on firms are valuable contributions to the literature, we believe that more qualitative measurements are also necessary to understand the impact of innovations on products, markets and production processes, or product/service quality. For instance, sometimes the impact of innovations on performance might not be immediate, or might not be reflected to growth, market sales or productivity in the same period. In some cases the increase in market share or firm sales might not be a sole effect of a certain innovation but many other industrial and market changes can influence it. It might be the case for other financial indicators. Therefore we believe thathow the impact of innovation is perceived by firms or firm managers is also important to investigate. Firms which realize that making innovations positively influence their market presence, products and production capabilities are expected to be more willing to pursue innovations. However, there is a gap in the literature concerning qualitative indicators to measure the impact of innovations on firm performance. In this paper, we will fill that gap in the literature by using a qualitative measurement based on the perception of firms regarding to the strength of the impact of innovations on products and processes. This is also the main contribution of this paper to innovation studies.

The impact of innovations on firm performance is measured generally by increase in productivity, increase in sales, increase in the percentage of new products in total sales, or firm growth (e.g. Beers and Zand, 2014; Evangelista and Vezzani, 2010; Parisi et al., 2006). Moreover, these studies prove that innovations have a positive impact over these indicators of firm performance. However, these studies provide no clues about how firms perceive the impact of these innovations or whether they realize and feel the real impact of these innovations on their market presence, products or production processes. The impact of innovations on productivity, growth, employment are not always immediate. Specifically, perceiving the impact of process innovations on sales, productivity or other financial indicators might not always very possible in a short term, but firm managers and employees can evaluate such impacts and provide more information about whether a change in products or processes is achieved by an innovation or not. Therefore this paper focus on how the impacts of innovations are perceived by firms/ firm managers and aim to understand how the perceptions regarding to the impact of innovations on firm performance change regarding to the type of innovations (product and process innovations) at the firm level. We also control whether the perceptions regarding to the impact of innovations differ among firms with different characteristics (i.e. size, foreign ownership, doing R&D, being and exporter or using intranet).

This study adresseses at least three main contributions. First, we introduce a qualitative performance indicator to measure impact of innovation. Second, we use firm level datasets in this study, therefore, it is assumed that firms are heterogeneous in terms of their innovation behaviours. The last contribution is that this study aims to introduce a novel indicators to measure impact of innovation in Turkey which is a developing country. The number of studies elaborating innovation impact in developing countries is rare. This study will fill this gap in the innovation literature.

In the following section the literature on the impact of innovation on firm performance is reviewed. The third section provides comprehensive information about data and methodology. In the fourth section we will discuss the results of the analyses, and section five concludes the paper and discuss the possibilities for further research.

2. Literature review

Many people agree on that innovations have a positive impact on firm performance but there is no agreement on how we can measure the impact of innovations on firm performance. Moreover, empirical studies provide a positive relationship between innovations and firm performance (Bigliardi, 2013). The most oftenly used measurement of firm innovation performance is the share of innovative sales in total (e.g. Beers and Zand, 2014; Frenz and Letto-Gilles 2009). It is generally measured by the sales comes from radical or new to the market sales. Evangelista and Vezzani (2010) measure the performance of innovative firms by the growth in sales. They found that product, process and organizational innovations possitively associate to the growth of firm turnover.

Hagedoorn and Cloodt (2003), after emphasizing on the variety in performance indicators identify 3 types of firm performance which are linked to innovations. According to authors firms have inventive performance which can be measured by the number of patents and patent citations. Firms also have R&D performance which can be measured by R&D inputs. The third performance indicators is new product announcements which measure the new product development performance of the firm. Another measurement used frequently in the literature is productivity growth at the firm level and national level. Parisi et al. (2006) find out a positive relationship between process innovations and increase in productivity. Hashi and Stojcic (2013), based on CIS 4 results compare the impact of innovations for mature market economies of Western Europe and advanced transition economies of Central and Eastern Europe. They find out that there is a positive relationship between innovation activities and productivity. Rocchina-Barrachina et al (2010) based on a survey of Spanish manufacturing companies find that process innovations bring some extra productivity growth for both large and small firms.

Another group of indicators used by scholar to measure innovation performance is financial ratios and indicators. For example, Bigliardi (2013) employs a set of performance indicators which are related to financial situation of the firm. Among those indicators there are a firm's return on investment relative to its competitors, a firm's total operating costs relative to its competitors or a firm's return on assets relative to its competitors. Kostopoulos et al. (2011) on the other hand aim to understand the linkages between absorptive capacity and innovation and financial performance but also the link between innovation performance and financial

performance. The authors measure financial performance by return on assets and return on sales and found a positive relationship between a firm's innovative performance and financial performance.

The research model is constructed based on the idea that the perception on innovation impact can be an alternative indicator to measure innovation performance. The impact of innovation can be measured by its product and process effects (OECD, 2006). Product variation, product improvement, new markets and expansion of market share indicate product oriented impact of innovation. As far as product variation and product improvementsare considered it is assumed that knowledge and experience gained through innovation process will encourage firms to develop new products or update the existing ones (Schumpeter, 1934). Remained two product-oriented impacts of innovations are opening new markets and increasing market share. A new product should be developed based on the needs of the market (Balachandra, 1997). Firms, therefore, can achieve higher differentiation by innovating products to meet the needs of the market (Teece and Pisano, 1994; Verona, 1999). Product innovations are implemented based on the market signals to create new markets. In a similar vein, Damanpour et al., (2009) have argued that product innovations depend heavily on international markets and their introduction is expected to generate new markets.Considering the radical innovations in the fields of nanotechnology, biotechnology, and information and communication technologies, it is clear that those innovations generate new markets and firms with higher market shares benefit from those innovations (Blundell et al., 1999). Additionally, the extant of the benefits is larger for the first mover firms in those technology fields (Banburry and Mitchell, 1995).

Process innovations, contrary to product innovations, are much more internal to the firm (Abernathy and Utterback, 1978; Martinez-Ros, 2000; Boer and During, 2001). The drivers of these innovations are primarily reduction in delivery time, increase in operational flexibility, and lowering of production costs (Boer and During,2001). Process-oriented effects include, for instance, quality improvement, increasing flexibility in production processes and in production capacity, improvements in health and security conditions, and reduction in labour costs(OECD, 2006; Urgal et al. 2013). These subcomponents of the process-oriented effects represent the firms’internal organization.

The relation between the type of innovations (product and process)and the impacts of innovation is presented in Figure (1). The impact of innovation is examined at two levels: product-oriented impact and process-oriented impact. There is a reciprocal relation between innovation types and these two levels of innovation impact. The research question is that whether firms that have engage in product innovations have similar perceptions regarding to the impact of innovations with process innovators or vice versa.

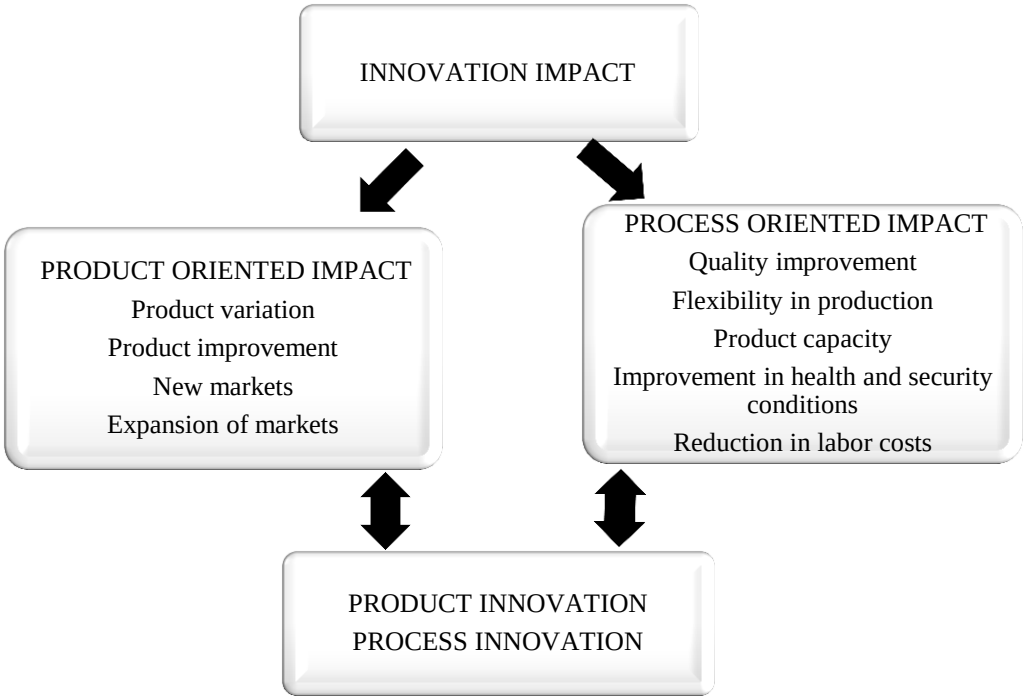

Figure 1. Innovation impact and innovation types

3. Data and methodology

The data for this study is collected from two sources. The first is 2009 'Community Innovation Survey (CIS)' of 5863 firms encompassing manufacturing and services sectors, administered by Turkish Statistical Institute (TURKSTAT, 2009). CIS is conducted in order to determine the innovation capability of firms in the fields of technological innovation, new product and process improvement, and the use of the new technologies. Additional dataset is 'ICT Usage in Business Enterprises (2008)' collected by TURKSTAT. Those statistics are applied to firms having 10 or more employees in the manufacturing and services sectors. This

dataset contains 2700 observations. With these two sources are combined, the final dataset contains 996 observations. In TURKSTAT(2009), only product innovators, process innovators, firms that have ongoing and abandoned innovation activities during 2006 to 2008 respond the questions on impact of innovation. Responses are gathered from 504 firms. Among those, there are four categories which are product innovators (N=91), process innovators (N=73), firms engaged in both product and process innovations (N=313), and firms that have ongoing activities (N=27). In this study, we focus on product and process innovators so our hypotheses do not include firms in the forth category. The final sample is composed of 477 observations. Table (1) presents the definition of variables.

Table 1. Variable Definition

Variables		Type	Definition
Impact of innovation	Product oriented	Continuous	It takes metric values generated by factor analysis
	Process oriented	Continuous	It takes metric values generated by factor analysis
Types of innovation		Categorical	It takes the value of 1 if the firm adopts any product innovation in the period 2006-2008; 2 for product innovators, and 3 for product and process innovators
Firm size		Categorical	It takes the value of 1 if the firm has employees equal and more than 250; and 2 for less than 250
Foreign share		Categorical	It takes the value of 1 if the firm has foreign share and 0 otherwise
R&D activity		Categorical	It takes the value of 1 if the firm implements any intramural R&D activity in the period 2006-2008; 2 for extramural activities, and 3 for both intramural and extramural R&D activities
Export		Categorical	It takes the value of 1 if the firm is exporter in the period of 2006-2008; and 2 for firms being active in domestic markets and 3 for firms in both categories
Technology variables		Categorical	It takes the value of 1 if the firm has ERP technology;2 for intranet ownership; and 3 for both activities

Impact of innovation. In the survey, firms are asked about their perceptions on the impact of innovations introduced in the period of 2006-2008. These are a) increased range of goods or services b) improved outdated products/services c) entered new markets d) increased market share e) improved quality of the products/services f) improved flexibility in the production of goods and services g) increased capacity of production or services h) improvement in themes of health and security i) reduced labour costs per unit output. The degree of importance for

each item ranges from 1 to 4. If the observed effect is high, the item takes the value of 4. If there is no observed effect, the item takes the value of 1. On the basis of work by Urgal (2013), the impact of innovation is quantified by those 9 indicators in this study.

We applied factor analysis to classify the innovation impact based on the values generated by polychoric correlation technique[1]. Based on the kaiser criterion which excludes eigenvalues equal or less than 1, two factors are determined in the factor analysis. These two factors account for %70.43 of the total variance. Since varimax rotation procedure is applied these two factors are not correlated each other. The main reason for using this rotation technique is to identify variables to create new variables without intercorrelated components. Finally we had two types of innovation impacts. These are product oriented and process oriented innovation impacts (OECD, 2006).

Figure 2 demonstrates the factor loadings which indicate two-factor model. The first one is product oriented impact including the items namely increased range of goods or services (0.87), improved outdated products/services (0.75), entered new markets (0.80), and increased markets share (0.82). The second factor is named as process oriented impact, which is composed of improved quality of the products/services (0.64), improved flexibility in the production of goods and services (0.72), increased capacity of production or services(0.76), improvement in themes of health and security (0.83), and reduced labour costs per unit output (0.83).

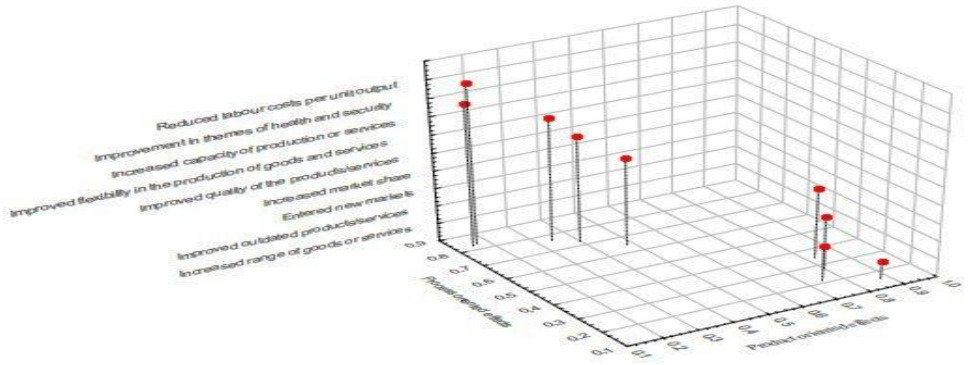

Figure 2. Factor loadings of product oriented impact versus process oriented impact

[1] This technique is applied when variables take ordinal values in the data.

Table 2 shows the number of observations and the share of each responses in total observations. Each item has adequate number of observations.As far as the product oriented impact is considered, the proportion of responses reflecting positive perceptions (great and/considerable) is larger than that of responses assigned to slight or none. Items in process oriented impact follow the similar pattern. This result validates the two factor model with a high Cronbach Alpha Scale coefficient (0.87) in this study (see, Table 2).

Table 2. Descriptive Statistics

How important were each of the following effects of your product (goods or service) and process innovations introduced during the three years 2006-2008*?		**Great**		**Considerable**		**Slight**		**None**	
		n	%	n	%	n	%	n	%
Increased range of goods or services	**Product oriented impact**	240	24	171	17,17	38	3,8	55	5,52
Improved outdated products/services		156	16	159	15,96	81	8,1	108	10,8
Entered new markets		163	16	165	16,57	74	7,4	102	10,2
Increased market share		164	17	182	18,27	81	8,1	77	7,73
Improved quality of the products/services	**Process oriented effects**	242	24	176	17,67	36	3,6	50	5,02
Improved flexibility in the production of goods and services		144	15	181	18,17	71	7,4	108	10,8
Increased capacity of production or services		155	16	172	17,27	78	7,8	99	9,94
Improvement in themes of health and security		110	11	156	15,66	75	7,5	163	16,4
Reduced labour costs per unit output		89	8,9	190	19,08	98	9,8	127	12,8

*Cronbach Alpha Scale Reliability Coefficient: 0.87

Two types of innovation such as product innovation and process innovation are used in order to detect the relation between innovation impact and innovation types. As introduced in hypotheses (see, Table 3), it is assumed that product and process innovators differentiate from each other with regard to their perceptions on the impact of innovation. The impact of innovation may vary in terms of the firm size, foreign share, intra-mural/extra-mural R&D activities, firm's exporting activities, ERP usage and intranet ownership. These firm-specific variables are introduced as control variables in this study.

Product Innovation. Product innovation indicates the adoption of a product that is new to the organization. It is measured as a binary variable taking the value of 1 if the firm has generated new products in the period 2006-2008 in Turkey (TURKSTAT, 2009). A vast amount of studies suggest that the introduction of a new product increases firm performance (Löfsten, 2014; Roberts, 1999; Deeds and DeCarolis, 1999; Cho and Pucik, 2005; Hua and Wemmerlov, 2006). Product innovations could generate positive effect on firm performance through increasing range of products. Firms with differentiated products could gain competitive advantage in the market which turns into increase in firm profits. In addition to these, new markets could emerge with the introduction of the new products. Damanpour et al. (2009) has found that product innovations are externally oriented and sensitive to market signals. The needs of the markets play a crucial role in the implementation of those innovations. Our hypothesis is constructed based on this rationale indicating that product innovations generate product oriented impact. Product innovations could also make process oriented changes for the firm. The features of the new product could enhance capacity of production or may require flexibility in production processes. To test these assumptions, we add hypothesis on the link between process oriented impact and product innovations.

Process innovation. Process innovation is defined as the adoption of a process that is new to the organization. It is measured as a binary variable taking the value of 1 if the firm has generated new products in the period 2006-2008 in Turkey (TURKSTAT, 2009). Camisón and López (2014) have found that process innovations positively affect firm performance. This effect, on the other hand, is mediated by product innovations. Process innovations are introduced to improve quality of the products, therefore, changes in the product quality will turn into increase in firm performance (Camisón and López , 2014; Cabagnols and LeBas, 2002). Process innovations reduce the operational costs (Damanpour, 2010). With the introduction of innovations in business processes, the interaction between interdependent units increases, therefore firms could allocate less amount of time for the production. In addition to these, process innovations could enhance health and security conditions of the work environment. To sustain competitive edge in the markets in the long term, firms integrate the rules of corporate responsibility (Zadek, 2004). Thus, societal issues are taken into consideration in process innovations. Firms operating in automobile industry should consider producing environmentelly friendly cars as much as providing healthy and secure environment for the workers. On the basis of the study by Camisón and López(2014), we

assume that process innovations could generate product oriented impact as much as process oriented impact which turn into increase in the firm performance.

We use firm size, foreign share, internal and external R&D, export share, the use of ERP, and intranet ownership as control variables in this study. Firm size is expected to have a positive effect on both product oriented and process oriented impact of innovation. Large firms commonly have a higher expectation on profits while investing in R&D activities or deciding on innovation. Firm size positively affects decision to innovate (Rogers, 2004) and large firms increase their performance through investing in innovation activities (Camisón and López , 2014). While some studies emphasize that small firms could benefit from flat type of work organisation which eases the implementation of innovation (Tether, 1998), large firms due to the stock of knowledge and human capital, are much prone to innovate. In this study, we reveal the motivation(s) for the positive relation between firm size and innovation. Do large firms expect product oriented impact or process effect in decision to innovate? We assume that large firms due to having strategic resources such as financial assets, human capital, knowledge and experience tend to produce new products and processes than do their smaller counterparts (Ettlie and Rubenstein, 1987; Acs and Audretsch, 1988). We include both product oriented and process oriented impact in terms of firm size in our hypotheses.

As far as the link between foreign share and innovation is considered, foreign firms or firms having foreign share are more likely to innovate since they access to new knowledge and technology faster than that of their domestic partners (Almeida, 1996; Almeida and Fernandes, 2008). Girma et al. (2009) found that the higher levels of foreign share at the firm increase the innovation activity using firm level panel data for Chinese state-owned enterprises during the period 1999-2005. In a similar vein, Luong et al. (2014) revealed that the presence of foreign institutional investors positively affects the firm's innovation activities. Three factors are mentioned to explain the success of foreign institutional investors. These are active monitoring, eliminating innovation failures, and facilitating technology transfers from innovative countries to non-innovators. Angeli (2014) examining 123 Indian biopharmaceutical firms between 1999 and 2009, have found that firms with foreign partners became more successfull at implementing innovation activities. Bertschek (1995) found that foreign direct investment through technology transfer from foreign investors to domestic firms, facilitates process innovations.

Research and development (R&D) activities, as part of innovation activity, are strongly linked to decision to innovate. R&D activities could be classified as extramural and intramural R&D. Tsai(2001) have found that organizations investing in their own R&D are much able to innovate and achieve high performance. The main reason is that internal R&D activities provide transfer of knowledge from one unit to another and this in turn increase firm's performance. Nelson and Chuang (2014) have found that domestic firms' innovation performance is positively linked to domestic firms' R&D activities. As firms focus more on increasing internal R&D capacity, they exploit external knowledge much easily (Cohen and Levinthal, 1990).

Product and process oriented impact could differ as regards exporting activities. Firms being active in international markets are much able to access to knowledge and capabilities required for innovating new products and processes (Van Biesebroeck, 2005; De Loecker,2007). Empirical literature on the link between innovation and exporting activites provides some evidence on the positive effect of exporting activities on innovation (Nieto and Santamaría, 2010; Hsu and Chuang, 2014; Bratti and Felice, 2012) while some others found no significant effect (Schubert and Simar, 2011; Woerter and Roper, 2010).

Enterprise resource planning (ERP) is a system which integrates different functions of the firm into a single computer system (Nelson and Somers, 2001). Therefore, with the contribution of ERP system, firm resources could be managed by using both internal and external information. Srivardhana and Pawlowski (2007) have found that there is a positive link between innovation capabilities and the use of ERP systems. ERP system through a centralised enterprise wide database delivers necessary data in real time and enables employees to be more innovative and flexible (Davenport et al. 2004). ERP system generates process oriented impact such as reduction in production costs and improvement in quality of goods and services for the firms (Shang and Seddon, 2000; Umble et al. 2003; Hong and Kim, 2002). ERP system integrates manufacturing function with all of the functions in an organization, thus, incompatibility between software and hardware platforms reduces with the implementation of the ERP system. This results in improvement in production processes and increase firm performance (Rajagopal, 2002). The success of the ERP system, on the other hand, heavily depends on compatibility between the system and organizational needs of the firm (Hong and Kim, 2002).

Intranet ownership is used as another technology variable in this study. The presence of intranet within the organization facilitates internal knowledge diffusion (Carr, 1996;Yen and Chou, 2001). This system works on the basis of confidentiality, i.e. only authorized subjects are able to connect with each other. Andersen (2001) found positive association between intranet and innovation. Intranet is a knowledge sharing mechanism within the firm. Swann et al. (1999) found that firm's innovation processes are facilitated by intranet which enables knowledge flows within the firm when firms succeed active networking. Accordingly, knowledge is inherently sticky and requires face to face interaction in most cases (Lin, 2007).

Table 3 demonstrates the set of hypotheses introduced to reveal the relations between firms' perceptions on the impact of process and product innovations and certain firm characteristics. The hypotheses are based on the arguments that firm characteristics such as firm size, being international, conducting intramural R&D activities or receiving external R&D support, being an exporter, or having certain IT systems would feel the impact of innovations in different ways and therefore their perceptions about the impact of innovations would be at different directions (product or process).

Table 3. Hypotheses

Product oriented impact	
H1	There are differences among product innovators, process innovators and firms engaged in both product and process innovations with respect to their perceptions on product oriented impact of innovation
H2	There are differences between small and large firms with respect to their perceptions on product oriented impact of innovation
H3	There are differences between foreign firms and domestic firms with respect to their perceptions on product oriented impact of innovation
H4	There are differences among firms engaged in intramural,extramural R&D activities and firms engaged in both activities with respect to their perceptions on product oriented impact of innovation
H5	There are differences among exporter firms, domestic markets oriented firms and firms in both categories with respect to their perceptions on product oriented impact of innovation
H6	There are differences between erp users, intranet owners, and firms using both erp and intranet with respect to their perceptions on product oriented impact of innovation
Process oriented impact	
H7	There are differences among product innovators, process innovators and firms engaged in both product and process innovations with respect to their perceptions on process oriented impact of innovation

H8	There are differences between small and large firms with respect to their perceptions on process oriented impact of innovation
H9	There are differences between foreign firms and domestic firms with respect to their perceptions on process oriented impact of innovation
H10	There are differences among firms engaged in intramural, extramural R&D activities and firms engaged in both activities with respect to their perceptions on process oriented impact of innovation
H11	There are differences among exporter firms, domestic markets oriented firms and firms in both categories with respect to their perceptions on process oriented impact of innovation
H12	There are differences between erp users, intranet owners, and firms using both erp and intranet with respect to their perceptions on process oriented impact of innovation

The descriptive statistics of each item that creates factors are demonstrated in Table (4). The main values of each item are clustered around the value of 1 indicating positive perceptions of the respondents[2]. As far as the shares of product and proces innovation are considered, they are 0.41 and 0.39 respectively. Considering the descriptive statistics of the control variables, the sample in this study is composed of large firms (67%). 41 percent of the sample has foreign owned firms. The share of firms engaged in intramural activities (32%) is higher than that of firms having extramural activities (16%). 65 percent of the sample are active in export markets. The shares of ERP users and intranet ownership are more than half of the sample which indicates the technological advancement of the firms in the sample.

Table 4. Descriptive statistics

Variables	**Mean**	**Std. Dev.**	**Min**	**Max**
Increased range of goods or services	1.61	1.74	0	4
Improved outdated products/services	1.38	1.58	0	4
Entered new markets	1.40	1.60	0	4
Increased market share	1.45	1.60	0	4
Improved quality of the products/services	1.62	1.74	0	4
Improved flexibility in the production of goods and services	1.37	1.57	0	4
Increased capacity of production or services	1.40	1.58	0	4
Improvement in themes of health and security	1.23	1.46	0	4
Reduced labour costs per unit output	1.25	1.45	0	4
Product innovation	.41	.49	0	1

[2]Values of each response is range from 1 to 4 in the questionnaire. We recoded the values in order to employ polychoric correlation procedure.

Process innovation	.39	.49	0	1
Firm size	.67	.47	0	1
Foreign share	.41	.49	0	1
Intramural R&D activities	.32	.47	0	1
Extramural R&D activities	.16	.37	0	1
Export	.65	.48	0	1
Erp	.52	.50	0	1
Intranet	.65	.48	0	1

4. Estimation results

Table 5 demonstrates the test results. Based on the results of anova procedure, there are significant differences among product, process innovators and firms engaged in both product and process innovations with respect to their perceptions on product and process oriented impacts of innovation. We have found that product oriented impact is larger for the third group including product and process innovators (μ=3,16; F=41,47; p<0,001). Product and process innovators have the largest mean with respect to process oriented impact of innovation (μ=2,54;F=14,81;p<0,001). Product innovations create some impact on the number and variety of firm products provided to customers, increasing firms' market share, creating new markets, etc. Their effects on process improvements are perceived significantly by firms. Process-oriented impacts of innovation, i.e. quality improvement, flexibility in production, product capacity, health and security improvement and labor costs are observed directly as the consequences of product innovations. Performing these complementary activities (product and process innovations) generate both product and process innovation impacts.

Considering the control variables, it can be argued that there is a significant difference between small and large firms with respect to their perceptions on product and process oriented impact. While product oriented impact generate highest mean for small firms (μ=3,01;F=3,61;p<0,10), large firms acknowledge the process oriented impacts of innovation more than small firms (μ=2,44;F=3,92; p<0,05). Additionally, anova test provides that there are differences among exporter firms, firms being active in domestic markets, and firms in both categories. Accordingly, process oriented impact gives a highest mean for exporter firms (μ=2,82;F=1,41;p<0,10). With regard to the link between impacts of innovation and remained variables, there is no significant difference between groups with respect to their perceptions on product and process oriented impacts.

Table 5. Test Results

Factors	*Types of innovators*	*Mean*	*SD*	*F*	*p*	Accept /Reject
product oriented impact	Product innovators	2,70	1,01	41,47	0,00***	Accept
	Process innovators	2,11	1,19			
	Product and Process innovators	3,16	0,82			
	Large firms	2,82	0.98	3,61	0,06*	Accept
	Small firms	3,01	1,03			
	Foreign firms	2,83	1,05	0,29	0,6	Reject
	Domestic firms	2,88	1			
	IntramuralRD performers	2,99	0,95	1,15	0,32	Reject
	Extramural RD performers	3,21	0,39			
	Intramural and extramural RD performers	3,13	0,87			
	Export oriented firms	2,51	0,89	0,87	0,42	Reject
	Domestic market oriented firms	2,91	1,03			
	Exporters and domestic market oriented firms	2,87	1,01			
	ERP users	2,79	0,95	0,16	0,85	Reject
	Intranet owners	2,84	1,05			
	ERP users and intranet owners	2,88	1,03			
process oriented impact	Product innovators	1,88	1,07	14,81	0,00***	Accept
	Process innovators	2,44	1,07			
	Product and Process innovators	2,54	0,99			
	Large firms	2,44	1,05	3,92	0,04**	Accept
	Small firms	2,23	1,02			
	Foreign firms	2,42	1,05	0,21	0,6	Reject
	Domestic firms	2,37	1,05			
	Intramural RD performers	2,39	1,1	1,44	0,24	Reject
	Extramural RD performers	2,21	1,02			
	Intramural and extramural RD performers	2,57	1,03			
	Export oriented firms	2,82	1,41	2,84	0,06*	Accept
	Domestic market oriented firms	2,42	1,04			
	Exporters and domestic market oriented firms	2,22	1,02			
	ERP users	2,25	1,03	1,6	0,2	Reject
	Intranet owners	2,29	1,08			
	ERP users and intranet owners	2,47	1,06			

*** p<0.01, ** p<0.05, *p<0.1

5. Conclusion

This study presents a novel approach to measure innovation performance of the firms in Turkey. We introduce two qualitative performance indicators based on the firms' perceptions on the impact of innovation. These are product oriented impact and process oriented impact. Product oriented impact include variation in product range, product improvement, new markets and expansion of markets. Process oriented impact cover quality improvement, flexibility in production, improvement in production capacity, improvement in health and security conditions, and reduction in labor costs.

We observe a significant difference among process innovators, product innovators and firms that introduce both product and process innovations in terms of their perception on innovation impact. To measure the effect of process innovation on firm performance is difficult since the improvements in the business proceses are less tangible. Process innovations, contrary to product innovations, generate minor changes in the processes at an early stage of production but its effects on production becomes larger than that of product innovation after a certain point (Adner and Levinthal, 2001). Process innovations play a dual role in the business world (Gopalakrishnan et al., 1999). First, process innovations can be used to improve the efficiency of generating new products and processes. Second, the presence of process innovations increases the quality and reliability of the production which in turn add value to the customers. Process innovations, therefore, could facilitate product innovations. The innovation rate of product innovations at an early stage is much faster(Abernathy and Utterback, 1978) so it is less probable that product innovations generate process oriented impact. In this study, product oriented impact as much as process oriented impact are highest for firms that introduce both product and process innovations. While process innovations focus on internal organization of the firm (Abernathy and Utterback, 1978; Martinez-Ros, 2000; Boer and During, 2001), product innovations are externally oriented (Damanpour et al., 2009). This result implies that product and process innovations have complementary functions that generate results in favor of firms introducing both product and process innovations.

Firm characteristics such as firm size, R&D activities, foreign share, export activities, intranet ownership and the use of ERP are also included in this study to examine the relation between these features and product/ process oriented impact. Only firm size and export activities

generate significant differences among firms with respect to firms' perceptions on product and process oriented impact.

As for the link between firm size and impacts of innovation, we observe significant difference between large firms and small firms in terms ther perceptions on product and process oriented impact. In this study, firms tend to pursue process innovations, when the size of the firm gets bigger. Large firms due to the availability of financial resources could invest in new processes which are costly for small firms (Lejjaraga and Martinez-Ros, 2014). Ettlie and Rubenstein(1987) found that large firms are unlikely to introduce radically new products. Those firms tend to adopt process innovations to introduce new products. In a similar vein, we have found that small firms focus more on product oriented impact in this study.

We have found a significant difference between exporter firms and firms in other groups in terms of their perceptions on innovation impact. In the literature, product innovations are positively affected by export performance of the firms (Lages et al., 2009). Exporter firms in contrast to our expectations, do not observe product oriented impact of innovation in this study. Rather, they focus on process oriented impact. This result indicates that exporting activities provide external knowledge spillover for firms which in turn generate impacts on internal organisation of the firm.

5.1. Limitations and further research

This study has some limitations in terms of the time span and the methodology. Due to the availability of data, we could conduct cross section analysis which provides a snapshot of the relations between performance indicators and other types of variables in this study. Further study could be implemented using panel data to observe robustness of the results. As a methodological point of view, the estimation results are derived from anova procedure. A future study could be implemented by using other methodologies to examine the qualitative performance indicators.

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