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THE ROLE AND EFFECT OF HUMAN CAPITAL AND R&D ON THE SALES OF NEW PRODUCT: A STUDY ON THE INNOVATION PERFORMANCE OF THE MANUFACTURING INDUSTRY OF KEIHANSHIN REGION IN JAPAN

BEŞERİ SERMAYE VE AR-GE'NİN YENİ ÜRÜNÜN SATIŞLARDAKİ PAYI ÜZERİNE ROLÜ VE ETKİSİ: JAPONYA KEİHANSHİN BÖLGESİNİN İMALAT SANAYİSİNİN İNOVASYON PERFORMANSI ÜZERİNE İNCELEME

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Abstract
In this study, the updated version of the survey designed to examine the Finnish[5] national innovation system has been applied to analyze the manufacturing industry in Osaka, Kyoto, Kobe and Sakai in the Keihanshin region. The innovation performance of Japan in 2018 has been evaluated by using the data obtained from the survey. The study has examined the influence of innovation factors on company performance and searched the amount allocated to R&D expenditures and the effects of university graduates on the new product through modeling technique and directly referring to innovation (the percentage of the new product in sales). The data obtained as a result of the survey in the study; the factors affecting innovation performance were tabulated and interpreted on behalf of the region. The findings have indicated that big companies are more innovation-oriented. It has also been concluded that the most significant factors ensuring innovation within the companies are R&D and the experience of the companies. Moreover, it has been noticed that companies view know-how as a key in gaining an advantage in competition. After examining the innovation performance, Least Squares (Least Squares) regression analysis was used under the assumption of normality since the share of the new product in sales, which is used as an innovation production function output, is a continuous variable for the model established. Econometric findings show that human capital and R&D expenditures positively affect the share of new products in sales. The results of the econometric analysis show that the findings of the model are reliable.
Key Words: Innovation, New Product Development, Manufacturing Industry, Regional Development, R&D, Human Capital.

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Özet

Bu makalede, Finlandiya ulusal yenilik sisteminin tespitine yönelik düzenlenen anket formunu temel alınıp güncellenerek Keihanshin bölgesindeki Osaka, Kyoto, Kobe ve Sakai şehirlerinde imalat sektörü üzerine uygulanmıştır. Anketten elde edilen veriler kullanılarak Japonya'da, 2018 yılı inovasyon performansı değerlendirilmiştir. Çalışma hem şirketlerin inovasyon faktörlerinin şirket performansına etkisini incelemekte hem de inovasyona doğrudan atıf yaparak (yeni ürünün satışlar içindeki yüzdesi) Ar-Ge harcamalarına ayrılan pay ile üniversite mezunlarının yeni ürün üzerindeki etkisini modelleyerek araştırmaktadır. Çalışmada anket sonucu elde edilen veriler; inovasyon performansını etkileyen etmenler, tablolaştırılmış ve bölge adına yorumlanmıştır. Elde edilen bulgular, büyük şirketlerin daha yenilikçi olduğuna işaret etmektedir. Şirketler için yeniliğin gerçekleşmesini sağlayan en önemli faktörlerin Ar-Ge ve firma tecrübesi olduğu anlaşılmıştır. Ayrıca firmalar, know-how'u rekabette avantaj sağlamada en önemli etmen olarak görmektedir. İnovasyon performansı incelendikten sonra kurulan model için inovasyon üretim fonksiyonu çıktısı olarak kullanılan satışlarda yeni ürünün payı sürekli bir değişken olduğu için normallik varsayımı altında En Küçük Kareler (EKK) regresyon analizi kullanılmıştır. Ekonometrik bulgular, beşeri sermaye ve Ar-Ge harcamalarının satışlardaki yeni ürünün payı üzerinde pozitif etkisi olduğunu göstermektedir. Yapılan ekonometrik analiz sonuçları modelin anlamlı ve güvenilir olduğunu göstermektedir.

Anahtar Kelimeler: İnovasyon, Yeni Ürün Geliştirme, İmalat Sanayi, Bölgesel Kalkınma, Ar-Ge, Beşeri Sermaye.

1. Introduction

It is stated that the dynamics of innovation are at the core of the evolution industrial. Also, innovation is depicted as the new Industrial Revolution. Despite all these, it is also known that it does not always make up the whole story. It is also stated that there are other factors such as spillover of knowledge from other sectors of the economy, additional research opportunities and the factors in basic research (like technological advancements) affecting the competition in a sector directly (Maurer, 1996: s. 1). It is of crucial importance to know what innovation symbolizes as output and make evaluations within this scope. In the literature, innovation output is mainly associated with the patent (Bhattacharya and Bloch, 2004). In this evaluation, the measurement of innovation output under knowledge production function (KPF) has first been made by considering the patent acknowledge output by Griliches (1979) and then it has been applied by Pakes and Griliches (1980) and Jaffe (1986). Moreover, Jaffe (1989) formed the geographical convergence index of the university and industrial R&D by using this function. This area has shown significant progress with KPF. It has also been effective in information dissemination, information overflow, and identification of innovation outputs and performance analysis of innovation indicators.

The patent is given as an output of information in KPF. Patents don't represent all innovations, even if they only serve as a means of protecting the innovation introduced. Some of them show the invention, but that invention may not turn into an innovation as some types of inventions cannot be patented. Patent is an intermediary output (Greenhalg and Rogers, 2010: 61). Patent data can sometimes be misleading since innovation, in economic terms, is not just about having ideas but applying novel ideas and technologies to make human life better. High patent numbers do not necessarily mean high levels of innovation (Morck and Yeung, 2001: 7). In this context, direct reference to innovation will be more effective and will provide accurate innovation outputs as well as innovation measurement (Acs et al., 1994). This study is intended to measure the direct results of innovation, not the knowledge. Therefore, it is essential to know the definition of innovation to specify the dependent variable in the model that will be developed.

Özbay (2020: 14) has formulated what innovation refers to by using important innovation and creativity definitions in the literature after revising them under the process given below.

(A) **Creativity**: Creative thinking ability (1. Stage) + expertise (kind of knowledge) + determination and outcome: **Invention.**

(B) Creativity + converting to production+ inability to earn income or failure (risk) = **Learning (Kind of Knowledge: Know-How + Know-Who[6]).**

(C) Creativity/learning + converting to production (commercialization) + earning income = **Innovation.**[7]

This definition seems to be open to improvement. In another definition, Olefirenko and Shevliuga (2017: 8) discussed the commercialization process of innovation in three stages:

Stage 1. Evaluation and selection of the best innovation generating ideas,

Stage 2. Searching and finding consistent financial support sources for the development of innovations,

Stage 3. Introduction and implementation of innovative products.

As a result, invention brings something new while innovation is the implementation of the novel (Kennedy and Thirlwall, 1972: 56; Mohr, 1969: 112; Oğuztürk, 2003; Trott, 2005: 15). Based on these definitions, it can be concluded that developing and implementing an existing product, benefiting from an existing product or creating a new product or process and applying it are required to create innovation. Moreover, gaining profit from these and utilizing them also seem to be necessary. This is because, even after all development and quality tests, around 40% of all new products are anticipated to fail at launch. Furthermore, only one of 7 to 10 new product concepts gain commercial success, and it is also stated that only 13% of the companies can achieve their annual profit targets of their new product efforts (Cooper, 2017: 1).

In this study, the share (percentage) of the new product in the sales has been taken as the dependent variable. In this context, it is beneficial to call the model established as an innovation production model rather than KPF. Furthermore, there are lots of innovation-oriented studies on the new product and development of the new product (Bouncken et al., 2018; Cooper, 2019; Roper et al., 2008). In these studies, it is known that the new product is used as a performance tool and has a room for research on innovation culture (Michaelis et al., 2018). Based on innovation definitions, it can be concluded that we need to check the sales rate of a product to see if a new product development or an invention has turned into innovation. It is observed that the percentage of the new product in sales is used as dependent variable in the studies on innovation or new product development (Leiponen, 2005; Leiponen and Helfat, 2010; Love et al., 2011; Roper et al., 2016). In the literature, moreover, it is claimed that studies on success

[6] Know-How: It refers to technical knowledge and capacity and it is briefly defined as experience, and learned knowledge. Know-Who: It refers to who knows what and what he should do.

[7] **A:** It can also be the definition of a scientist. Here what distinguishes an entrepreneur from a scientist is his adapting the existing invention to commerce. An entrepreneur might come up with new inventions. From this aspect, an entrepreneur can be considered a scientist. Items **B** and **C** can be seen as a systematic definition of an entrepreneur. **A+B+C,** on the other hand**,** can be regarded as the most systematic and comprehensive definition of the innovation and innovation process (Özbay, 2020: s. 14).

factors of new products and new NPD implementations should continue since product renewal is essential for the welfare of a business and the keys of success of innovation are still not clear (Cooper, 2019: 11).

In this study, human capital (the number of university graduates in the workplace) and R&D expenses have been taken as independent variables. Human capital has been used because human resources are essential in R&D (Kim et al., 2018). It is emphasized that the use of human resources in innovation is an important measurement tool in input (R&D) and output (innovation result) relation (Almeida et al., 2019: 473). It is claimed that companies benefit from innovation less without sufficient skills as they lack subsidiary skills and absorptive capacity. Moreover, it is stated that high technical skills are complementary to R&D collaboration and product or process innovation. Human capital, therefore, can be regarded as a facilitating factor in profitable innovation (Leiponen, 2005). Human capital plays an important role in knowledge and innovation development, and it provides many profits for countries in several areas (Özbay, 2020). Also, human capital, which is quantified with academic success determines the innovation speed of a country (Morck & Yeung, 2001: 53). In literature, it is emphasized human capital is essential for innovative companies to have continuous competitive power and guarantee their market share (Kim et al., 2018). In literature, it is said that R&D is the main variable in determining innovation output, and companies commonly use it for innovation investment (Greenhalg & Rogers, 2010: 59; Morck & Yeung, 2001: 7; Pakes & Griliches, 1980).

In this study also other innovation factors such as patent rights, in-house R&D, external R&D, know-how, cooperation between university and industry, business size, method variety and how organizational structure affects a company's innovation performance are investigated. As a result, the study analyzes both the influence of innovation factors of companies on their performances and the budget allocated to R&D expenses, as well as the effect of university graduates on the new product.

The limitation of the study is that the determining variable is thought to reflect the overall outcome of product renewal rather than that of innovation. Innovation activity studies generally distinguish between product and process innovation (Leıponen And Helfat, 2010: 225). This study partly represents process innovation. Another limitation of the study is the questionnaire part. In order to measure innovation performance of manufacturing industry in Keihanshin, Japan[8], face-to-face questionnaires were conducted on 53 medium-sized manufacturing companies selected in this region in the first half of 2018. Since 10 of these questionnaires were incomplete or erroneous (such as absence of variables subject to analysis), they could not be used in the study. Furthermore, conducting another survey in this area has been seen as the limitation of the study due to pandemic conditions and the financial burden it would bring. As a result, 43 companies, including 39 manufacturing and 4 service sectors, have been subject to the study.

This study is based on survey data from Keihanshin. The study seeks to answer two critical questions for the region. First question: what is the innovation performance of the region? Moreover, how does it differ from the literature? The second question of the study is what effect

[8]Keihanshin Region; Osaka, Kyoto, Kobe and Sakai. This region covers 4 big metropolitan cities in Japan.

does the innovation production function, human capital, and R&D expenditures have on innovation? In this context for the first question, the study's data obtained from the questionnaire were tabulated and discussed the results with the literature. In this regard, innovation factors and components such as patent rights, internal R&D, external R&D, know-how, university-industry cooperation, business size, method diversity and how organizational structure affects a company's innovation performance were examined. The innovation production function, which reflects the innovation output best, has been established for the second question.

2. Evaluation of Innovation Performance of Keihanshin Region in Japan and Comparison with Literature

It is observed that innovation studies of manufacturing companies do not only affect themselves and all other companies but also they boost the competitive environment. One of the new approaches in competition is innovation competition. The fact that innovation has become a competitive instrument has highlighted the importance of the factors affecting innovation (Batmaz and Özcan, 2008). In this part, the innovation factors of the companies are discussed and how these factors affect their competitiveness is analyzed. First, the statistics describing the manufacturing industry in Keihanshin Region in Japan will be given.

The scope of the companies is given in the Table 1 below.

Table 1. Distribution of Scope of Companies

Manufacture	39	0.907
Others (diner, insurance etc.)	4	0.093

The questionnaires conducted in the region show that 90% of the companies are manufacturing businesses while the rest are in the service sector.

2.1. Companies' Innovation Strategies, Competitiveness, and Key Factors for Innovation Realization

One of the most important innovation strategies of the companies in manufacturing industry is to increase service/production quality and their market share and to decrease manufacturing expenses (Sirilli and Evangelista, 1998). As a result of the studies on the manufacturing industry, it is seen that innovation types and collaborations positively affect the innovation performance (Güler and Kanber, 2011). In manufacturing industry, developing stronger links among companies, government laboratories and universities in the manufacturing industry increases innovation (Vega-Jurado et al., 2009).

Major technological advancements make the existing knowledge older. Interactive learning allows companies to increase their know-how knowledge and provide external expertise in innovation processes through the connections they establish (Doloreux, 2002, 249). However, such knowledge is difficult to access because it is implied knowledge. At the same time, that kind of knowledge can be considered one of the keystones for actualizing a product or process innovation. As a result, know-how cannot be obtained from documented sources and its transfer requires time and resource investment both by the receiver and the source. This knowledge is proprietary, not patented, doesn't constitute a company-specific trade secret, and requires noofficial embargo on its transmission. This type of knowledge is subtle (tacit), non-materialized, and technological, and it is called 'know-how'. Only direct cost of sharing knowledge is the opportunity cost of making the transfer to the receiver (Kachra & White, 2008, 426). Another argument is that experience on its own is not sufficient to gain the greatest benefits from collaboration. In this argument put forward by Simonin (1997), it is stated that experience must first be internalized, and know-how based on collaboration must be developed in order to contribute to future collaborative benefits.

On the other hand, the collaboration between companies is discussed under the "open innovation" theory. Chesbrough (2003) stated that "When we develop our own business model, we should benefit from intellectual property right of others and buy the intellectual property right of others. That is because innovation investments involve great risks. Companies should expand innovation limits by cooperating with other parties and external knowledge sources to share expenses and ideas." Benefits of cooperation among companies briefly called as "Open Innovation" or "Open Business Models" put forward by Chesbrough are as follows (Chesbrough, 2007: 22):

1-) It enables a company to be more effective in gaining value as well as creating value.

2-) It helps create values by benefiting from more ideas because they involve external concepts. Besides, it results in gaining more values not only from their own operations but also from other companies by using the key assets, resources or positions in other companies' businesses.

Nieto and Santamaría (2006) state that technological collaborative networks are crucial in achieving a higher innovation degree in innovation. In turn, cooperating with suppliers, customers or research organizations has a positive effect on innovation while some claim that, unlike Chesbrough, cooperation between companies or with competitors might have negative effects.

Know-who and know-how are of crucial significance for companies in innovation performance. Besides, it is also known that cooperation with university is essential for innovation in external R&D and patents. From this aspect, the factors affecting innovation performance and realization of innovation in the Keihanshin Region in Japan have been analyzed based on the literature Table 2 below shows the factors that make innovation happen in Japan (Keihanshin Region).

Table 2. Factors Ensuring Innovation

	Company's Current Experience	In-house R&D	Out-house R&D	Cooperation with the university	Patent right
Very important	0.86	0.86	0.07	0.28	0.79
Important	0.02	0.02	0.40	0.40	0.09
Partial important	0.00	0.00	0.40	0.19	0.00
Unimportant	0.12	0.12	0.14	0.14	0.12

It is understood that the experience of companies and in-house R&D with a rate of 86% are very significant on the innovations made. The study conducted in this area has also shown that the importance of patents comes after these two factors. Another vital factor is the cooperation between industry and university. External R&D also seems to be a crucial innovation factor for the region, as expected.

Table 3. What is the most important way of gaining a competitive advantage?

	Product Innovation	Method Innovation	Reducing Costs	The technical Expertise(Know-How)	Organizational Structure
Highly important	0.77	0.88	0.86	0.98	0.86
Important	0.16	0.05	0.12	0.00	0.14
Partially Important	0.02	0.05	0.02	0.00	0.00
Unimportant	0.05	0.02	0.00	0.02	0.00

According to Japan, the most important way of gaining a competitive advantage is know-how. Method innovation gains importance as long as cost reduction, organizational structures and product innovations (Seen Table 3). Table 4 below shows the distribution of these levels of importance.

Table 4. What is the most effective way of gaining a competitive advantage?

	Product Innovation	Method Innovation	Reducing Costs	The technical Expertise (Know-How)	Organizational Structure
Highly important	0.77	0.88	0.86	0.98	0.86
Important	0.16	0.05	0.12	0.00	0.14
Partially important	0.02	0.05	0.02	0.00	0.00
Unimpotant	0.05	0.02	0.00	0.02	0.00

In conclusion, organizational structure and know-how are important factors for companies in gaining competitive advantage. However, the key factors affecting competition and innovation are not only ones mentioned above. The other important factor affecting innovation performance is the size of the company. The size of the companies, regional economic performance and even age are among the other factors used as determinants of innovation (Avermaete et al., 2003). In this context, the analysis of the effect of size of companies in the Keihanshin Region in Japan on innovation performance is given below.

2.2. The Effect of Size of Companies on Innovation Performance

The companies with similar sizes might show differences in their activities. They might have good or poor management resources, and they might be integrated improperly or adequately. They can be dynamic, static, rigid or flexible, modern or outdated. It is known that the effectiveness of companies depends on the innovators in a Schumpeterian sense, especially when they grow. Huge investments made on machines and processes are generally associated with relatively big companies. A big company that is more complicated than a small company naturally requires more talent management resources (Harbison, 1956: 367–369). Moreover, big companies are more innovative in many sectors (Acs and Audretsch, 1988; Audretsch and Acs, 1991: 744).

The studies conducted display that only large companies are innovative. In fact, there is no consensus on this. The latest technological advancements do not only tend to allow economic production in small-scale plants, but they have also boosted effective competition for old products by expanding substitution variety (Kamien and Schwartz, 1975: 12). Competitive strategy, in time, can be affected by technological innovations and technological change, which is a process called dynamic change. Innovation performance and the technological performance of the outputs of the company's innovation performance are represented by new products. Small-scale firms in the technology industry display a high dynamic innovation performance (Stock et al., 2002: 537). The firms which can successfully innovate can grow on average about twice as fast as other comparable firms in the relevant period. Therefore, the rewards of successful innovation are important, especially for small-scale firms (Mansfield, 1962: 1044).

Meanwhile, big-scale companies tend to have an innovative advantage in industries that are capital-intensive, concentrated, syndicated and which are manufacturing a differentiated product. In contrast, small-scale ones are likely to be relatively more advantageous in industries consisting of large companies which use labor power efficiently and are pretty innovative (Acs and Audretsch, 1987). It is seen that small-scale firms benefit from external institutions and resources. It is also observed that the innovative effectiveness of big companies stems from the existing knowledge sources while it is the location in small-scale ones (Feldman, 1994: 363). In an innovation research of Kleinknecht, it was concluded that SMEs (small and medium-sized enterprises) have fewer R&D activities, and there is no significant correlation between the size and R&D if the observations are limited to enterprises having effective R&D (1989: 215). Akın and Reyhanoğlu (2014) claim that there is a positive correlation between size and innovation types, while the innovation does not differ a lot due to the size of enterprises. That the correlation between innovation expenses and the size of the companies is positive but relatively weak also justifies this finding. On the other hand, Bhattacharya and Bloch (2004) found a positive correlation between size and innovation.

It is clear that this topic will remain controversial in the literature. The main reason behind the differences in results is the regional difference of the subject of the study. In conclusion, it is understood that innovation provides a great competitive advantage for small-scale companies. However, large companies are more advantageous in innovation.

The size of the enterprises in the Keihanshin Region, Japan, was determined by the number of employees. The staff number of the companies is given in Table 5 below. When companies were analyzed based on the employee number, we saw that 7 companies have fewer than 50, 27 companies have more than 50 or fewer than 250 personnel, and 8 companies have more than 250 personnel. However, the number of employees of a company operating in the field of health insurance could not be obtained.

Table 5. The Employee Number of Enterprises

The Size	Enterprise Number	The Share of the New Product Based on the Size of Enterprises (The Average value based on the Size of Enterprises)
Small Enterprises	8	% 27.00
Medium-Sized Enterprises	27	% 52.11
Large Enterprises	7	% 62.85

The percentage distribution of employee numbers is shown in Table 6 below. In this context, it is the medium-sized enterprises with the highest number of employees.

Table 6. Distribution of Staff Number of Enterprises

Business Size	Number of Staff	Share of New Product in Sales of Businesses by Business Size (By Business Size, Average Value)
Small Enterprises	8	% 27.00
Medium-sized Enterprises	27	% 52.11
Large Enterprises	7	% 62.85

Finally, the share of the new product based on the size of the enterprises is given in Table 6 above. As seen in the graph, as the size of the companies increases, the share of the new product in sales also increases. As a result, we found a positive correlation between the size and innovation in the Keishanshin region, Japan.

It is also essential to understand the influence of innovation on the firm itself and rival firms. Therefore, it will be beneficial to see the creative destruction theory of Schumpeter (1934) in the Keihanshin region, Japan.

2.3. The Influence of Innovation on Rival Firms

For this purpose, it was aimed to determine whether the firms kept the existing strategy, resorted to innovation, decreased the prices or observed any creative destruction effect of the innovation as a result of innovation of rival firms through questionnaires. The percentage of the results of these questions is given in Table 7 below.

Table 7. The Pie Chart of the Influence on Innovation on Rival Firms

	Yes	No
Continued the current strategy	2	41
Orientation to innovation	12	31
Towards a price reduction	8	35
Withdrawal from the market	0	43
Others	7	36

It is known that innovations contribute to social welfare in the long run even though they provide a monopoly right at first if the intellectual property right is acquired. It is even obvious that if the innovation results in a decrease in the costs, consumer welfare increases (Greenhalg and Rogers, 2010: 33). While more competition brings faster technological changes, rapidly advancing technology and expanding application potentials will attract more participants

(Utterback and Suárez, 1993: 1). As seen in Table 7, the most common reaction of the firms with 41% is that companies tend to innovate against the innovations made. In this context, it is seen that innovation provides the firms with the opportunity to attempt to increase the total welfare. That 28% of the firms tend to go for a reduction in the prices is a positive reaction for the customers. The absence of a withdrawal from the market indicates that there is no radical innovation or creative destruction effect of an innovation. Moreover, 7% of firms didn't even change their strategies.

2.4. The Size of the Innovation and Its Influence on the Firm Itself

The size of the innovations of the companies studied is shown in Table 8 below.

Table 8. The Size of the Innovation

Innovation in Regional Market	0.21
Innovation in Country Market	0.44
Innovation in World market	0.35

While 44% of the innovations made are nationwide, 35% are worldwide, and the rest is regional innovations.

Table 9. The Effects of Innovation on the Firm

	Yes	No
Entering new markets	22	21
To increase market share	37	5
Reduce costs	32	10
Create image	4	39
Others	0	43

It is seen that the innovations made caused 39% of the companies to increase their market share, 34% of them to reduce their costs and 23% to operate in new markets. Moreover, they enabled 4% of the companies to gain a new image (seen in Table 9).

3. Data and Methodology

3.1. Data and Model

The study entitled "The Role of Innovation in Regional Development and an Implementation on Lakes Region" was accepted as a Ph.D. A thesis by Istanbul University Social Sciences Institute in 2003 was utilized for the questionnaire used in this study. The original form of this questionnaire was adapted according to Finnish Innovation System Criteria. This questionnaire was revised based on current developments. Moreover, some inappropriate questions for Japan were removed as this study was conducted in Japan, and new questions thought to reflect better today's institutional structure were added.

In the study, 43 company managers, 39 of whom from the manufacturing industry and 4 from other sectors, were surveyed. All of the companies surveyed did R&D practices in the last five years. In the survey, the effect of R&D expenditures and the number of university graduates among employees on the share of the new product in sales were analyzed. The variables and their abbreviations are in Table 10.

Table 10. Variables

Dependent Variable	Syup	The share of new products in sales
Independent Variable	Barap	The budget allocated for R&D in the last 5 years
Independent Variable	Caumo	The rate of university graduates among employees

The model designed for the variables given above is as follows Eq.**(1)**;

$$syup = \alpha + \beta(barap) + \gamma(caumo) + \mu \qquad (1)$$

The basic hypothesis of the model is "The more budget for R&D and number of university graduates in the staff in the last 5 years, the more share of the new product in sales."
Descriptive statistics of variables are given in Table 11.

Table 11. Descriptive Statistics

	R&D	**SYUP**	**UNIV**
Average	6.920930	49.83721	47.16279
Median	6.800000	58.00000	40.00000
Maximum	16.20000	100.0000	100.0000
Minimum	0.000000	0.000000	0.000000
Standard Deviation	3.439031	29.31271	22.43926
Observations	43	43	43

3.2. Methodology and Implementation

Since the variable of the share of the new product in sales used in the study is a continuous variable, the Least Squares (OLS) regression analysis was used under the assumption of normality. In the OLS method, which is frequently used for parameter estimation, it is necessary to check the reliability and the significance of the model's results through diagnostic tests. The existence of a high positive correlation between independent variables is an indicator of multiple linear connections. In case of a multiple linear connection problem, the effectiveness will be lost, and the significance of coefficients will be insecure. To test multiple linear connection problems, VIF (Variance Inflation Factors) test can be used. The distortion caused by multiple linear connection problems is the same as the distortion caused by variance (Mert, 2016). The white test is used to prevent the heteroscedasticity problem in cross-sectional data (Ryan and Doran, 2012). The model needs to be normally distributed with zero mean and constant variance. Testing normal distribution requires testing normal distribution of residues, which can be done with the Shapiro-Wilk W test. Ramsey RESET Test can be used to check if there is a specification error in the model (Mert, 2016: 127-162).

As the variables discussed in the study are expressed in percentages, they were not subjected to any transformation. Model estimation results made in the Stata application are shown in Table 12.

Table12. Model Estimation Results

Dependent Variable syup	**Coefficient**	**Standard Error**	**t**	**P**
Constant	1.16	10.71	0.11	0.915
Barap	3.91	1.07	3.64	0.001
Caumo	0.46	0.16	2.78	0.008
F-Test		R^2		**Corrected**R^2
Prob. Value: 0.0001		0.37		0.34

Note: indicate statistical significance at levels of 1%, 5%, and 10%respectively.

When the coefficients of the variables are examined according to the table above, it was seen that the coefficient of the constant term was insignificant while the variables of share allocated to R&D in the last 5 years and the rate of university graduates among employees was significant. It was found that around 1% increase in the share allocated to R&D in the last 5 years resulted in a 3.91% increase in the share of the new product in sales while a 1% increase in the number of university graduates among employees resulted in a 0.46% increase in the share of the new product in sales. So, it was concluded that both variables had positive contributions. The next section includes the analysis made on whether the results given in Table 12 are reliable.

3.2.1. Statistical and Econometric Analysis

In this section, the statistical and econometric analysis of the model will be given. First, within the scope of statistical analysis, the general significance of the model and the significance of the parameters will be tested, and then the coefficient of significance will be interpreted. Based on the econometric analysis, the tests of deviation from hypothesis will be evaluated to interpret if the model has reliability or not.

3.2.1.1. Statistical Analysis

Whether the model is generally meaningful, in other words, the significance of independent variables in explaining dependent variables can be tested with F test. For F test, "H_0:α = β= γ=0" and "H_1: At least one of the parameters is different from 0".

H_0: Hypothesis is invalid since for F-test (Prob. Value) = 0001<0.05. It can be said that the model is 95% meaningful. Independent variables' explanation level of dependent variables is meaningful. After this point, individual parameter significance can be tested.

For constant variable, H_0:: α=0 ve H_1:: α≠0.

Since probability value is 0.915 > 0.05, H_0 hypothesis is valid. It is concluded that constant parameter is insignificant. The average share allocated for R&D expenses in the last 5 years is "H_0: β=0" ve "H_1: β≠0" to test the significance of the independent variable.

Since the probability value is 0.001<0.05, H_0 hypothesis is invalid, and it is concluded that this variable is significant. The rate of university graduates among employees is "H_0: γ=0" and "H_1: γ≠0" to test the significance of the independent variable. Since the probability value is 0.008<0.05, H_0 hypothesis is invalid, and it is concluded that this variable is significant.

In the model, even if the significance coefficient (R^2 value) %37.3 which shows to what extent dependent variables can be explained by independent variables can be considered low as an econometric study, it is regarded as sufficient in applied studies that could include cross-sectional data. In cross-sectional data, the level of explanation of dependent variables by independent variables is expected to be low based on panel data and T series analysis. Since it was thought that the variables added to the model will increase the significance coefficient, corrected significance coefficient is (corrected R^2) %34.17. It can be concluded that 34.17% of dependent variable can be explained by the independent variables in the model.

3.2.1.2. Econometric Analysis

Under econometric analysis, the test results conducted to check the significance and reliability of the model's results will be evaluated. Whether there are multiple linear connections, variable variance problems or specification errors in the model and normality test results are given in Table 13 below.

Table 13. Tests for Deviation from Hypothesis

Multiple Linear Connection	VIF	Max VIF=1.02
	Correlation Coefficient	0.1223
Variable Variance	White Test	P=0.53≥0.05
	Breusch-Pagan/Cook-Weisberg Test	P=0.39≥0.05
Normality	Shapiro-Wilk W Test	P=0.24≥0.05
Specification Error Test	Ramsey Reset Test	P=0.91≥0.05
	Link Test	P=0.71≥0.05

Note: Indicate statistical significance at levels of 1%, 5%, and 10%respectively.

One of the most critical conditions of regression analysis is the normality assumption. If the normality assumption is violated, it is thought an incorrect functional form is considered. Normality assumption is the normal distribution of residues with zero mean and constant variation. In normal distribution;

H_0: The sample is compatible with normal distribution.

H_1: The sample is not compatible with normal distribution.

As shown in Table 13, since the probability value of the Shapiro Wilk W Test conducted to test normality is $0.24 \geq 0.05$, H_0 hypothesis is valid. It can be said that the error terms are normally distributed, and the normality assumption is achieved.

Whether there is multiple linear connection problem or variance inflation factors (VIF) were tested with VIF test. VIF value can minimum be 1 and the values should be from 1 to 5 to reveal if there are any multiple linear connection problems. As shown in Table 13, this value was found as 1.02 and it showed that there is no multiple linear connections problem. Moreover, the correlation coefficient also gives information about multiple linear connections. That correlation coefficient value is something small like 0.1223 also shows that there is no multiple linear connection.

Lots of tests can be done to check if there is a variable variation problem. In the study, variable variation was tested by White Test and Breusch-Pagan/Cook-Weisberg Test. For variable variation;

$\boldsymbol{H_0}$: There is no variable variation

$\boldsymbol{H_1}$: There is variable variation

In Table 13, it is seen that prob value of both tests is bigger than 0.05 and H_0 hypothesis is invalid. In this context, it can be said that there is no variable variation problem and constant variation has been achieved.

Ramsey Rest Test and Link Test were used to reveal if there was a specification error in the model, in other words, if an independent variable that had to be added to the model was missed or added unnecessarily. For specification error;

$\boldsymbol{H_0}$**:** There is no specification error in the model.

$\boldsymbol{H_1}$: There is specification error in the model.

As seen in Table 13 the prob value is bigger than 0.05 for both tests and H_0 hypothesis is valid. These results indicate that there is no specification error in the model.

The econometric analysis conducted revealed that the results of the model are significant and reliable.

4. Results

In this study, the innovation performance of the manufacturing industry in Osaka, Kyoto, Kobe and Sakai cities inKeihanshin Region was analyzed. In this context, essential innovation factors such as patent rights, in-house R&D, external R&D, know-how, cooperation between university and industry, business size, method variety and organizational structure were used to determine this performance.

It has been concluded that the most critical condition for gaining a competitive advantage is know-how. Method variety, reduction in costs, organizational structures, and product innovation also significantly influence this performance. The experience of the enterprises and in-house R&D has great importance with a 86% rate on the innovations made. In the study done in this region, it is seen that patent comes after these two factors. Another vital factor is a cooperation between industry and university.

On the other hand, external R&D does not seem a very influential an innovation factor as expected. Moreover, as the size of the enterprise increases, the share of the new product increases as well. It is very crucial for the firms to innovate against the innovations made.
In this aspect, it has been seen that the firms increase the welfare in the market in the long run. That 28% of the firms go for a reduction in the prices is considered positive for the customers. The absence of a withdrawal from the market indicates that there is no radical innovation or creative destruction effect of innovation. Moreover, it has been understood that 7% of firms did not make alterations in their strategies against innovations made. Finally, the innovations made have enabled 39% of firms to increase their market share, 34% to decrease their costs and 23% to enter new markets. In this study, the share of new products in sales has been taken as the most critical innovation output (Leiponen, 2005; Love et al., 2011; Leiponen and Helfat, 2010; Roper et al., 2016: used it as the dependent variable in their studies). This subject studied under the title of new product improvement performance is based on the innovation definitions given in the literature and refers directly to the innovation. In this aspect, this study contributes to the literature. It is believed that the share of the new product in sales, which is used as innovation output in Japan, also gives accurate results in the evaluation of innovation input. Finally, it is concluded that human capital and R&D expenses in this region have a positive and meaningful effect on innovation output.

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