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Human Capital and Innovation Capacity of Firms in Defense and Aviation Industry in Ankara

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Abstract

Elaborating the literature on innovation as the important indicator of industrial competitiveness, this paper suggests that innovation and human capital are related, key issues. In the context of the paper the relationship between human capital and innovation capacity in defense and aviation industry in Ankara which is a special sector among others in many respects is researched. The paper rests on data of field survey realized with SMEs of the sector in Ankara. The results of the study illustrate that defense and aviation industry shows different structure than other sectors in innovation capacity and innovation activities. On the other hand, the paper provides the clues of the positive relationship between innovation activities and human capital in defense and aviation industry.

Keywords: Innovation; human capital; defense and aviation industry; Ankara.

1. Introduction

In recent years innovation became a well-recognized determinant of growth in firms and regions. Recent studies on high-tech industrial districts reveal the significance of local knowledge accumulation and local innovation capacity for development and economic growth. While knowledge and innovation are defined as main factors of growth and competition, SMEs are accepted as main actors of innovation in regional level (Eraydın & Armatlı Köroğlu, 2005).

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In traditional approach innovation was defined as firm based linear process depending on R&D activities for long years (Freeman, 1995). However, in recent years innovativeness has been recognized as a regional process in broad perspective, and with the evolution of the new relational approach the context of innovativeness involved ability to change with changing conditions (Freeman & Soete, 2003). Moreover innovation contains both introduction to new products or processes, and modifications in the existing products and processes.

In recent years human capital is widely believed to be a main source of knowledge and skills in the innovation process. The endogenous growth theory takes human capital as one of the most important inputs in innovation from the macro level (Romer, 1986; Romer, 1990). Romer (1990) emphasized that innovation is produced by combining R&D and human capital together. This macro approach gives the clues to notice the importance of human capital in firm innovation. High capacity human capital means higher ability of learning, and thus, could improve the innovation capacity of firms. Hence, Schneider et al. (2010) argue that a firm level approach is needed to better understand the relation between human capital and innovation. However, the theoretical literature could not offer the clear mechanisms to analyze relationship between skills and innovation at firm level. The number of empirical studies focusing on the relation between human capital and innovation capacity is limited. Yet, Leiponen (2005) and Vinding (2006) examine the impact of education of employees on innovation and find a positive relation (in Finland and Denmark respectively). Schneider et al., (2010) consider the relation between innovation and the educational level of employees and training provided by firms in Germany and found a positive relation. Meanwhile, some of the industrial district and cluster studies use skilled, highly educated employment, including managerial personnel data at the firm level as the proxy of innovative capacity (Lyons, 2000; Armatlı-Körüögu 2005, Eraydn & Körüögu, 2005). In management literature, there are some studies empirically examining the roles of managerial incentives and CEO characteristics in a firm’s innovation activities (Lin et al., 2011). According to the examples, besides the human capital characteristics such as high level of education, a firm could invest in human capital training programs. These training programs through supporting the ability to absorb knowledge might increase human capital capacity and innovation capacity of firms (Cohen & Levinthal, 1990). In addition to training programs receiving from the firms the occupation is also the indicators of human capital. Schneider et al. (2010) show that the actual occupations of employees instead of their schooling are more meaningful at analyzing human capital.

In innovation and human capital studies, the sector might cause differences in the results. In other words, the relationship between innovation capacity and human capital ability could differentiate as regards to the sector. Although Pavitt’s sector approach (1984) does not directly refer to human capital in industries, the sectors introduced by Pavitt express variety in the sources and innovation processes. In other words, sectors have different skill requirements. In the innovation processes science-based industries are characterized by organized R&D. These industries, obviously, require high-level science and engineering skills. Thus, the defense and aviation industry as a science based industry shows high technology level, organized R&D, high share of R&D expenditures and high skilled human capital.

In the context of the paper, the relationship between human capital and innovation capacity is researched in defense and aviation industry in Ankara which is a special sector for the economy, hosting 60-70% of all defense and aviation companies in Turkey. 6 out of 11 defense industry companies that are listed among the first 500 biggest industrial enterprises of Turkey are in Ankara. These 6 companies constitute about 62% of the total turnover in the sector. Paper depends on data of field survey realized in Ankara during September 2014 and January 2015. In the field survey 104 organizations that belong to the defense and aviation industry returned with full information interview forms. Innovation activities of firms and the number of patents and the share of R&D expenditures as the main indicators of innovation capacity are analyzed.

In the traditional innovation approach R&D is a central source of innovation. This one-dimensional perspective has been extended; the number of patent and number of quality certificates are considered as indicators of innovation in this study. Moreover, the effects of human capital on innovation activities are core issues of the paper. Occupation, education and training enhance the ability to understand existing processes and to use new knowledge for new product and process (Nelson & Phelps, 1966). Moreover, a workforce with high level of education will
provide firms more innovative outputs. Training programs received from the firm enhances the specific skills and abilities. Subsequently, in this study to define human capital the occupations of employees, the level of schooling of employees and training programs receiving from the firm are analyzed. The article is organized under four sections. Following the discussions on innovation, human capital and the relation between human capital and innovation in the introduction section, the second section introduces methodology of the case study and presents the hypothesis. Section three presents the findings of the empirical research and describes human capital and innovation relation under three sub-headings; “the characteristics of defense and aviation industry in Ankara”; “Technology, R&D and innovation capacity defense and aviation industry in Ankara” and “the relation between human capital and innovation capacity of firms”. Finally, the conclusions are drawn in section four.

2. Human capital and innovation in defense and aviation industry: Methodology

Owing to the lack of systematic firm data, a field study became necessary in order to examine the relationship between innovativeness of firms and human capital in Ankara. The units of analysis are the SMEs as sub-constructors of large leading firms in defense and aviation industry in Ankara. Large firms (such as TAI, ASELSAN, HAVELSAN, ROKETSAN, FNSS, MKEK) in the sector are left outside because of their extremely different structure than the SMEs. In order to define sample firms the lists of sector firms were provided by SSM, SSİ, SASAD, OSSA, TSSK and ESAC in April 2014. These lists were joined in the list that includes about 250 firms. All firms in defense and aviation industry in Ankara were reached in the field survey during September 2014 and January 2015.

A questionnaire form was mailed to each firm on the list. The firm managers were called by telephone in order to explain the aim of the study. Some of the firms, not willing to response by e-mail, were visited and face to face interview has been realized. Moreover, presenting an official permission document from the Undersecretariat for Defense Industries (UDI) made possible to reach firms especially SMEs in the field survey. The number of questionnaire forms returned with full information only reached to 104 (nearly 40% of the total number of SMEs). The high ratio of no-responses (about %60) is due to the high security requirement of the sector, comprehensive and detailed structure of the questionnaire, the lack of sufficient personnel in the firms for systematic data collection. The questionnaire form included questions related to (1) structural characteristics of firms, (2) indicators of innovation, innovative activities of firms, and (3) characteristics of labor and training information. Using collected data it was possible to define the number of innovations and the characteristics of human capital. Although the literature lacks a clear measure of human capital, education and training have long been used as proxies to measure it. R&D personnel can produce innovation directly in the R&D department. On the other hand, non-R&D personnel, mainly engineers and managers, play complementary role in improving process technology and product in the innovation process. In the study the share of managers, the share of engineers in workforce and the share of R&D workers and training programs provided by firms are analyzed as the proxies of human capital. The data on firm level is categorized according to the number of innovations (product, process and organization innovations) and the different characteristics of labor, in order to produce cross tables to verify the relationship between innovation and human capital.

This paper aims to evaluate the importance of innovativeness, human capital and their interaction in defense and aviation industry. In order to reach this aim, the following points are defined as the focus of this study;

- The higher the share of managers, engineers and R&D personnel the higher, the firm’s innovation activities.
- The higher the share of employees with university education within a firm, the higher the innovation activities.
- A firm that provides training to the employees has higher innovation activities.
3. Results of the Study

The results of the study are handled under three sub-titles; ‘the characteristics of defense and aviation industry in Ankara’; ‘technology, R&D and innovation capacity in defense and aviation industry in Ankara’; and ‘the relation between human capital and innovation capacity’.

3.1. The Characteristics of Defense and Aviation Industry in Ankara

The characteristics of the industry in Ankara are analyzed under five issues; firm size, annual turnover, age of firm, production organization and exporting (Table 1). The average number of employment in the sector was 90 employees in 2013. This value had been 60 in 2009. Thus, there has been 50% growth realized in the sector in a four years period. In the case study, the size of firms are determined in four categories; 1-10 employees (micro firms), 11-49 employees (small firms), 50-249 employees (medium sized firms) and more than 250 employees (large firms but subcontractors of leading firms of the sector). In the defense and aviation industry as 19 % of firms are micro firms, 52% of the firms are small firms and 22% of firms are medium firms (Table 1). by way of explanation, about half of the sector is made up of small firms.

Table 1. The Characteristics of Defense and Aviation Industry in Ankara

| Number of Employment | Frequency | Valid Percent |
|----------------------|-----------|---------------|
| 1-10                 | 19        | 19,0          |
| 11-49                | 52        | 52,0          |
| 50-249               | 22        | 22,0          |
| 250+                 | 7         | 7,0           |
| Total                | 100       | 100,0         |
| Missing              | 4         |               |
| Total                | 104       |               |

| Turnover (Dollar)   | Frequency | Valid Percent |
|---------------------|-----------|---------------|
| 0-1,000,000         | 34        | 36,5          |
| 1,000,000 - 5,000,000| 39      | 41,9          |
| 5,000,000 - 10,000,000| 9      | 9,6           |
| 10,000,000+         | 11        | 11,8          |
| Total               | 93        | 100,0         |
| Missing             | 11        |               |
| Total               | 104       |               |

| Year of Establishment| Frequency | Valid Percent |
|---------------------|-----------|---------------|
| Before 1980         | 7         | 7,5           |
| Between 1980 - 2000 | 42        | 44,7          |
| After 2000          | 45        | 47,9          |
| Total               | 94        | 100,0         |
| Missing             | 10        |               |
| Total               | 104       |               |

| Production organization | Frequency | Valid Percent |
|-------------------------|-----------|---------------|
| Non subcontracting Firms| 30        | 28,8          |
| Subcontracting Firms    | 74        | 71,2          |
| Total                   | 104       | 100,0         |

| Exporting | Frequency | Valid Percent |
|-----------|-----------|---------------|
| Non-exporting Firms | 55        | 53,4          |
| Exporting Firms      | 48        | 46,6          |
| Total                | 103       | 100,0         |
| Missing              | 1         |               |
| Total                | 104       |               |
Next, the firms are grouped as regards to turnover under four groups; less than 1 million Dollars, 1 million-5 million Dollars, 5 million-10 million Dollars, and more than 10 million Dollars. 41.9% of firms belong to 1 million to 5 million Dollar group in turnover (Table 1). The average turnover in the sector was 12.551.039 Dollar in 2013. As defense and aviation industry have improved after 1980s in Turkey, 92, 5% of firms have established after 1980s and 47, 9% of firms have established after 2000s. Moreover, large amount of firms is comparatively young, having been established in the last 15 years period. Subcontracting relations with leading firms is the main organization process in defense and aviation industry. Thus, 74% of the firms are subcontracting firms. Although export capacity is important for leading firms, the export capacity of subcontracting firms is relatively low. Only 48 % of the firms are exporting firms (Table 1). In other words, more than half of the firms do not have export activities. The average export value in the sector has increased from 10.000 Dollar to 5.000.000 Dollar in the four years period from 2009 to 2013.

3.2. Technology, R&D and Innovation Capacity in Defense and Aviation Industry in Ankara

Defense and aviation industry as science based industry abstains high level technology and high innovation capacity. In the literature R&D expenditure, taking patent and quality certificate are considered as the main indicators of innovation capacity (Larsson & Malmberg, 1999; Armath Koroğlu, 2004). At the same time these indicators support innovation activities of the firm in the long period. In the case study the level of technology, R&D expenditures, number of patents and number of quality certificates are analyzed as the indicators of innovation capacity. The values in Table 2 illustrate that technology level is high in defense and aviation industry in Ankara. 42.3% has compatible technology in the sector, meanwhile 26% has leading technology. R&D expenditures are grouped under three categories; less than 100.000 Dollar, 100.001 -1.000.000 Dollar and more than 1.000.000 Dollar. Only 8,7 % of firms allocate more than 1.000.000 Dollar for R&D expenditures (Table 2). It is interesting that 40,4% of firms declare that they have no R&D expenditure in their financial plan. This result is also related to the size of firm as regards to their turnover. Moreover, there is a statistically meaningful positive relation between the turnover of firms and R&D expenditure (Chi-Square: 23.834 and p_value:0,001). The relation between technology level of firm and the share of R&D expenditures of firm (Chi-Square:16.443 and p_value: 0,036) show that firms with leading technology in the sector allocate more R&D expenditure.

According to the results of the study, patent application to protect innovation is not widespread in defense and aviation industry. There are different mechanisms such as offset applications. Therefore 86,5 % of firms have no patents (Table 2). Only 13,5% of firms have patent, which is not enough value for statistical evaluation. As a result, the significant relation between patent number and innovation activities could not be observed. It is expected that the new quality certificate processes may force the firms to introduce new production and organization processes (Armat Koroğlu, 2005). Although 79,8% of firms have quality certificate (Table 2), the relation between innovation activities and taking quality certificates is not significant. The innovation activities realized in the last three years are analyzed and according to the number of innovations firms are categorized in three groups as no innovation (0 innovation), low innovation (1-2 number of innovation) and high innovation capacity (more than 2 innovation). 41,3% of firms do not realize any innovation activities Meanwhile, 16,3 % has low innovation capacity and 42,3 % has high level of innovation capacity (Table 2). The result of the analysis reveals that there is a low innovation capacity in SMEs in the defense and aviation industry in Ankara.

On the other hand, the level of innovation shows interesting results. More than half of the firms (54,2%) reveal that their innovations are new for the firm, however they are not new for Ankara, for Turkey or for the sector in the global level (Table 2). Only 4,9% of firms innovate new product or processes first in the World. These results show that the innovations in SMEs in Ankara defense and aviation industry could not compete in the global level. Although these indicators of innovation are highly emphasized in the literature, the reliability of them could not be observed in SMEs in Ankara defense and aviation industry.
| Table 2. Technology, R&D and innovation capacity in defense and aviation industry in Ankara |
|----------------------------------|---------------|-------------|
| Technology level of firms        | Frequency     | Percent     |
| Leading technology in the sector | 27            | 26,0        |
| Compatible technology in the sector | 44           | 42,3        |
| Improvable technology in the sector | 23           | 22,1        |
| Missing                          | 10            | 9,6         |
| Total                            | 104           | 100,0       |
| R&D Expenditures (Dollar)        | Frequency     | Percent     |
| 1 - 100,000                      | 27            | 26,0        |
| 100,001 - 1,000,000              | 26            | 25,0        |
| 1,000,001 +                      | 9             | 8,7         |
| Total                            | 62            | 59,6        |
| No R&D Expenditures              | 42            | 40,4        |
| Total                            | 104           | 100,0       |
| Number of Patent                 | Frequency     | Percent     |
| 1-2                              | 5             | 4,8         |
| 2+                               | 9             | 8,7         |
| Total                            | 14            | 13,5        |
| 0 patent                         | 90            | 86,5        |
| Total                            | 104           | 100,0       |
| Number of Quality Certificate    | Frequency     | Percent     |
| 1                                | 40            | 38,5        |
| 2                                | 21            | 20,2        |
| 3+                               | 22            | 21,2        |
| Total                            | 83            | 79,8        |
| No quality certificate           | 21            | 20,2        |
| Total                            | 104           | 100,0       |
| Number of Innovation             | Frequency     | Percent     |
| 0 (no innovation capacity)       | 43            | 41,3        |
| 1 – 2 (low innovation capacity)  | 17            | 16,3        |
| 2 + (high innovation capacity)   | 44            | 42,3        |
| Total                            | 104           | 100,0       |
| Level of Innovations             | Frequency     | Valid Percent |
| New product/process for the firm | 33            | 54,2        |
| New product/process for Ankara   | 9             | 14,7        |
| New product/process for Turkey   | 16            | 26,2        |
| First in the World               | 3             | 4,9         |
| Total                            | 61            | 100,0       |
| No innovation                    | 43            |              |
| Total                            | 104           |              |

3.3 The Relation between Human Capital and Innovation Capacity of Firms

The relationship between human capital and innovation capacity is studied in SMEs of defense and aviation industry in Ankara. There are three hypotheses monitoring the analysis; the first hypothesis is related to occupations; “The higher the share of managers, engineers and R&D personnel the higher the firm’s innovation activities.” Firstly, the share of managers in firm is determined and as regards to the share of managers, firms are categorized in three groups as low, medium and high share of managers. Also innovation capacity of firms is handled in three groups as no innovation (0 innovation), low innovation (1-2 number of innovation) and high innovation capacity (more than 2 innovation). A total of 47.5% of the firms with high share of managers have no innovation capacity,
while 47.5% of the firms with high share of managers have high innovation capacity. On the other hand, among firms with high innovation capacity, the share of firms with high share of managers (44.2%) is more than the ones with low share of managers (18.6%) (Table 3). As these observations could not give clear relation between the innovation capacity and the share of managers, the relation could not be verified by the chi-square value (Table 3). However, a statistically significant difference is determined between the share of managers and the share of R&D expenditure in total expenditures of the firm (chi-square value: 13.410, p_value:0.009).

As regards to the share of managers firms is categorized in three groups as none, low and high share of engineers. The analytical findings show that 34.3% of firms with high share of engineers have no innovation capacity, while 51.4% of them have high innovation capacity. Among firms with high innovation capacity 31.7% has no engineers in the firm and 43.9% has high share of engineers in the firm. The relation between the share of engineers and innovation capacity could not be confirmed by the chi-square value (Table 4). This finding could not support the conclusions of the studies determining the relationship between share of engineers and innovation (Lyons, 2000; Schneider at al., 2010). However, the relationship between the share of engineers and the share of R&D expenditure as an indicator of innovativeness is statistically significant (chi-square value: 9.695; p_value:0.046).

Table 3. Relation between share of managers and innovation capacity

| The share of managers | Low (0 - 0.05) | Medium (0.05 - 0.10) | High (0.10 +) | Total |
|-----------------------|---------------|----------------------|---------------|-------|
| 0 innovation          | Number        | 7                    | 11            | 19    | 37    |
| No innovation         | %             | 18.9                 | 29.7          | 51.4  | 100.0 |
| 1 – 2 innovations     | Number        | 6                    | 8             | 2     | 16    |
| Low innovation capacity | %            | 37.5                 | 50.0          | 12.5  | 100.0 |
| 2 + innovations       | Number        | 8                    | 16            | 19    | 43    |
| High innovation capacity | %           | 18.6                 | 37.2          | 44.2  | 100.0 |
| Total                 | Number        | 21                   | 35            | 40    | 96    |
| %                     |               | 21.9                 | 36.5          | 41.7  | 100.0 |
| Pearson Chi-Square:   |               | 7.580                |               | 0.108 |

Table 4. Relation between the share of engineers and innovation capacity

| The share of engineers | 0         | 0 - 0.10  | 0.10 +    | Total |
|-----------------------|-----------|-----------|-----------|-------|
| 0 innovation          | Number    | 18        | 9         | 12    | 39    |
| No innovation         | %         | 46.2%     | 23.1%     | 30.8% | 100.0%|
| 1 – 2 innovations     | Number    | 9         | 3         | 5     | 17    |
| Low innovation capacity | %         | 52.9%     | 17.6%     | 29.4% | 100.0%|
| 2 + innovations       | Number    | 13        | 10        | 18    | 41    |
| High innovation capacity | %         | 31.7%     | 24.4%     | 43.9% | 100.0%|
| Total                 | Number    | 40        | 22        | 35    | 97    |
| %                     |           | 41.2%     | 22.7%     | 36.1% | 100.0%|
| Pearson Chi-Square:   |           | 3.151     |           | 0.533 |
The share of R&D personnel in firms is categorized in three groups as none, low, and high share of R&D personnel. Among firms with no innovation 62.2% has also no R&D personnel in the firm and only 21.6% has high share of R&D personnel in the firm (Table 5). Oppositely, among firms with high innovation capacity, only 32.6% has no R&D personnel in the firm, while the share of firms with high R&D personnel is 61.1%. These observations are verified by statistical analysis. The chi-square value indicates that the innovativeness of firms with no R&D personnel is significantly different than the ones with high share of R&D personnel. Moreover, the relationship between the share of R&D personnel and the technology level of firms is statistically significant (chi-square value: 16.443; p_value:0.036).

| The share of R&D personnel | 0 | 0 - 0.10 | 0.10 + | Total |
|----------------------------|---|----------|--------|-------|
| 0 innovation Number       | 23 | 6 | 8 | 37 |
| %                          | 62.2 | 16.2 | 21.6 | 100.0 |
| No innovation %            | 53.5 | 35.3 | 22.2 | 38.5 |
| 1 – 2 innovations Number   | 6 | 4 | 6 | 16 |
| % Low innovation capacity  | 37.5% | 25.0% | 37.5% | 100.0% |
| % High innovation capacity | 14.0% | 23.5% | 16.7% | 16.7% |
| 2 + innovations Number     | 14 | 7 | 22 | 43 |
| % Low innovation capacity  | 32.6% | 16.3% | 51.2% | 100.0% |
| % High innovation capacity | 32.6% | 41.2% | 61.1% | 44.8% |
| Total Number               | 43 | 17 | 36 | 96 |
| % 0 innovation             | 44.8% | 17.7% | 37.5% | 100.0% |
| % No innovation            | 100.0% | 100.0% | 100.0% | 100.0% |

Pearson Chi-Square 9.894; p value: 0.049

The second hypothesis is related to schooling; “The higher the share of employees with university education within a firm, the higher the innovation activities.” The share of personnel with a university degree in firms is categorized in three groups as none, low and high share.

| The share of university degree personnel | 0 | 0 - 0.20 | 0.20 + | Total |
|-----------------------------------------|---|----------|--------|-------|
| 0 innovation Number                     | 19 | 7 | 4 | 30 |
| % No innovation                         | 63.3% | 23.3% | 13.3% | 100.0% |
| % 1 – 2 innovations Number              | 51.4% | 25.9% | 26.7% | 38.0% |
| % Low innovation capacity               | 7 | 5 | 1 | 13 |
| % High innovation capacity              | 53.8% | 38.5% | 7.7% | 100.0% |
| % 2 + innovations Number                | 18.9% | 18.5% | 6.7% | 16.5% |
| % High innovation capacity              | 30.6% | 41.7% | 27.8% | 100.0% |
| % Total                                 | 37 | 27 | 15 | 79 |
| % 0 innovation                          | 100.0% | 100.0% | 100.0% | 100.0% |

Pearson Chi-Square 8.454; p value: .076
A total of 14.3% of the firms with high share of university degree personnel have no innovation capacity, while 57.1% of the firms with high share of university degree personnel have high innovation capacity. On the other hand, among firms with high innovation capacity, the share of firms with high university degree personnel (33.3%) is more than the ones with no university degree personnel (29.2%) (Table 6). However the relation between the innovation capacity of the firm and the share of personnel with a university degree is statistically insufficient (chi-square value: 8.454; p_value:0.076).

| The share of personnel taking training from the firm and innovation capacity | Low | Medium | High | Total |
|--------------------------------|-----|--------|------|-------|
| 0 innovation                  | 5   | 9      | 2    | 16    |
| No innovation                 | %   | 31.2%  | 56.2%| 12.5% | 100.0%|
| 1 – 2 innovations             | 3   | 3      | 4    | 10    |
| Low innovation capacity       | %   | 20.0%  | 14.3%| 28.6% | 20.0%|
| 2 + innovations               | 7   | 9      | 8    | 24    |
| High innovation capacity      | %   | 46.7%  | 42.9%| 57.1% | 48.0%|
| Total                         | 15  | 21     | 14   | 50    |
| %                             | 100.0% | 100.0% | 100.0%| 100.0%|

Pearson Chi-Square 3.377 p value: 0.497

The third hypothesis is related to training programs in firms; “A firm that provides training to the employees has higher innovation activities.” The share of personnel taking training within firm is categorized in three groups as low, medium and high share of personnel taking training. Among firms with no innovation 31.2% has no personnel training within the firm and only 14.3% has high share of personnel taking training within the firm (Table 7). However, the relation between the innovation capacity of the firm and the share of personnel taking training within the firm is statistically not sufficient (chi-square value: 8.454; p_value:0.076).

4. Conclusion

Turkey has invested in defense and aviation industry in order to decrease the dependence on foreign products within the sector. Since 2003, Turkey has supported ‘local design/local production’ policies and ‘local content/offset’ applications. Due to these policies, Turkish companies are encouraged to develop their own indigenous products, enrich their product portfolio, and are expected to increase their international market share. Advanced technology and investments are supported. To benefit from international know-how, co-operation with international companies in terms of joint production, joint marketing, production under license, participation in joint development programs, multinational partnerships is also being promoted. However, the results of the case study show that these policies directly affect only the leading firms, among which 6 companies of Ankara constitute 62% of the total turnover of the sector. SMEs as subcontractors of these leading firms in Ankara show an extremely different structure as regards to technology level, global linkages and innovation capacity. The results of the case study also show that about half of the firms could not export, and around 40% of firms have not innovation activities in the last three years. Furthermore, about 40% of firms have not any special R&D expenditures allocated in their budget. These observations display that opposite to expectations SMEs of the sector are not well organized to innovate and they have relatively low innovation capacity. The aim of the paper is to analyze the relationship between human capital and innovation capacity in defense and aviation industry in Ankara. Human capital in SMEs are analyzed under three headings; occupation, schooling and training in firm. About 40% of firms could not occupy
engineers in the firm, while around 45% of firms don’t have specialized R&D personnel. Moreover, within the 47% of the firms there is not any university degree personnel employed. These findings give clues about the structure of human capital in SMEs of Ankara defense and aviation industry. Consequently, the hypothesis of the study could not be verified by statistical analysis. Only the relationship between the share of R&D personnel and innovation capacity of firms are statistically sufficient. These results of the study depend on SMEs in defense and aviation industry, however in leading firms of the sector, the relation between human capital and innovation capacity is expected to be more strong and significant. The study on leading firms of the sector is a forthcoming study of the research project.

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