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Are R&D Loans Relevant for Supporting Industrial R&D: The Case of TTGV in Turkey

Serkan Bürken [1], [+]

[1] Technology Development Foundation of Turkey (TTGV)

Abstract. In this paper, the relevance of R&D loans in Turkey has been investigated by using the example of TTGV. A descriptive analysis has been made with the help of the contemporary R&D funding literature**.** As a result, R&D loans provided by TTGV under the program of "Technology Development Projects" seem relevant and beneficial even though its effect is small on economic development. Its capacity should be enlarged by making it more attractive and compatible with the needs of firms, particularly of SMEs.

Keywords: R&D loans, R&D subsidies, SMEs.

1. Introduction

R&D funding is a crucial mechanism for government policies in order to boost innovative and technological performance of an industry, region or country etc. There are certain types of this mechanism such as tax incentives, grants, loans etc. for sharing the financial risk of R&D and innovative actions within a firm. Recently, two contradictory views have been informally emerged about the relevance of the R&D loans (particularly soft loans). One view suggests that loans are irrelevant in an environment in which grants are provided. Opposite view argues that loans are helpful in fostering R&D performances of an innovative firm.

In Turkey, R&D loans are provided by Technology Development Foundation of Turkey (TTGV). The core business of TTGV is R&D funding and this foundation supports R&D projects of industrial firms by those loans for about two decades. TTGV which is the only soft-loan provider institution in Turkish National Innovation System, has almost created a R&D volume of 600 million US dollars until now via providing R&D support with back payment.

[+] Tel.: +903122650272; Fax: +903122650262
E-mail address: sburken@ttgv.org.tr

In this paper, the relevance of R&D loans in Turkey will be investigated by using the example of TTGV. A descriptive analysis will be made with the help of the contemporary R&D funding literature, the results of "The Industrial Technology Report" written by Taymaz (2006) will be used and the results "DID (difference in difference) estimation models" established by Taymaz (2006) and Özçelik and Taymaz (2008) will be utilized in order to quantitatively analyze the effect of R&D support provided by TTGV. As a result, it is expected to put a light on the functionality of R&D loans in Turkish National Innovation System so that further policy recommendations can be made in the future.

For attaining this aim, in the next section, a theoretical framework will be set up in order to analyze R&D loans on a scientific basis. Then, a brief history of TTGV is summarized and the support mechanisms of that foundation will be explained. Therefore, the evaluation of a R&D loan program (namely, Technology Development Projects Support Program) provided by TTGV will be examined qualitatively and quantitatively via using several studies in the literature. Finally, the paper comes to the conclusion in the last section.

2. Theoretical Background

In a neo-classical economy, it is expected that government does not intervene the markets because "invisible hand" allocates the resources optimally. Optimal resource allocation can only be provided in perfect markets that have full rivalry. In a market economy there is three prerequisites of this optimality. Those are excludability, rivalry and transparency of goods. Excludability and rivalry refers that a good is able to be consumed for only once and once a good is consumed, it cannot be used once again. Furthermore, transparency is defined as having full information about production or consumption of goods by economic agents in economic activities. However, Nelson (1959) clearly explained the fault behind this logic (particularly in some cases) as follows;

> "(…) when the marginal value of a "good" to society exceeds the marginal value of the good to the individual who pays for it, the allocation of resources that maximizes private profits will not be optimal. For in these cases, private profit opportunities do not adequately reflect social benefit, and in the absence of positive public policy, the competitive economy will tend to spend less on that good "than it should". Therefore, it is in the interest of society collectively to support production of that good". [1]

Nelson's those arguments and Arrow's (1962) supporting arguments suggested that technological knowledge and technology products do not depict the characteristics of a good in terms of neo-classical economy and thus, points out the term of "market failure". The failure of the markets is naturally equal to the failure of the resource allocation optimality and the government intervention become necessary in order to generate technological knowledge and innovative technologies for economic development and growth. [2]

Government intervention may be in three kinds aiming at boosting technological activity, research and development (R&D), invention and innovation in order to foster economic development and public welfare. Those are made through performing R&D directly (publicly funded R&D); giving R&D subsidies (grants and loans) and providing tax incentives. Governments have been implementing those methods for decades and several studies have been carried on to examine the "additionality effects" of those subsidies and incentives. [3] [4] [5] [6] [7] In evaluating the R&D subsidy, the main question is "what the subsidized firm would have spent on R&D had it not received the subsidy". [8] There are direct and indirect effects of those subsidies on firm performance. The direct effect is the increase of total expenditure of firm on R&D (holding firm financed part of R&D expenditure constant) while indirect effects come from firm response. Firms' response may be in two ways: the first one is that company might augment its R&D expenditure in response to R&D subsidy or company displaces the subsidized amount with its own part. Of course, the former is better for productivity and in the context of what is aimed by giving R&D subsidy; and the latter is not. Furthermore, there are some other benefits of R&D subsidies. Those supports might lower the private cost of R&D and turn an unprofitable project into a profitable one; it may speed up an ongoing project or upgrade research facilities in such a way that further R&D projects can be afforded with lesser costs. Firms also gain know-how and learning capabilities as much as performing R&D activities.

To my knowledge, studies concerning R&D subsidies particularly major on R&D grants and tax incentives; however, R&D loans have taken little attention. Studies concentrated on loans are especially towards credits provided by banks and mutual guarantee consortiums which are very common especially in Europe. [9] Myers and Majluf (1984) highlighted limited capability of banks in sustaining investments in innovation and mutual-guarantee consortiums can assess the R&D activity more suitable and represents easier financial opportunities, particularly for SMEs. [10] Furthermore, it is widely accepted in the literature that SMEs have more financial constraints on performing R&D and their opportunities to reach

capital is more limited with respect to larger firms and incumbents. This case is more evident in developing countries where investment venture capital opportunities and public equity market are lagging. [11] Hence, SMEs require more easy ways to reach the finance in order to perform R&D. As a result, it is expected that the propensity to innovate in small firms increases relatively more with respect to larger ones as argued by Lach (2002), Özçelik and Taymaz (2008), Busom (2000) and this case is particularly the same for high-tech firms. [12] Further support comes to this argument from Himmelberg and Petersen (2001) and these scholars suggest that "the principle determinant of investment for small and high tech firms is internal finance and (…) large firms are unlikely to face significant internal financial constraints because they have better access to external finance and generate cash flows in excess of investment needs". [13] In conclusion, one can deduce that R&D subsidies are more helpful for small firms and good support mechanisms enhance and foster the innovative activities of them. Those mechanisms also targets market failures that prevent optimal resource allocation to technological development and scientific research.

3. TTGV as a R&D loan provider

3.1. A Brief History of TTGV

Efforts for establishing the national innovation system of Turkey had speeded up after the year, 1990, and Technology Development Foundation of Turkey (TTGV, Turkish acronym) was one of the fruits of those newly flourishing efforts. In 1991, World Bank had made a loan agreement with Turkey; and a model executed by the cooperation between South Korea and World was chosen in this context. One of three pillars of this agreement is "Technology Development Project" in order to compensate the financial requirements of Turkish industry concerning R&D. [14] TTGV was established as a result, and the functions of the foundation were stated as follows;

- To increase the competitiveness of Turkey in international markets changing continuously,
- To provide the mechanisms of seed capital required for the improvement of Turkish industrial infrastructure. [15]

World Bank has provided 100 million US dollars to Undersecretariat of Foreign Trade and the 43,3 million US dollars of this amount was given to TTGV as a gratuitous transfer in order to support every kind of projects concerning research, development, technology adoption and to contribute financially to

strategic focus projects for enhancing R&D potential and technological infrastructure inside the country. On the agreement, there is a striking point that TTGV was responsible for compensating its own operating costs and the transferred amount was excluded from the operation. TTGV was obliged to pay at least 20 percent and at least 33 percent of its operating costs on its own from the services it provided. Supports were under the control of Undersecretariat of Foreign Trade and independent auditors.

The major mission of TTGV is to bring in competitiveness in global markets to Turkish industry and it is the forerunner of R&D support mechanism in Turkey. TTGV is a unique example and established in the status of a "foundation". As Göker (2008) stated, the aim is to provide an independent entity which is flexible and in which public and private sector has equal effect in the process of decision-making. Board of directors involves both public and private delegates. As a result, TTGV is mainly under the ownership and supervision of the state and also it is an autonomous and independent institution. [16]

In 1999, "Industrial Technology Project" (ITP) was signed as an extension of the development project between World Bank and Turkish Republic. TTGV was assigned as a partner on R&D funding; and again considerable amount of money (about 60 million USD) was allocated to the foundation and 50 percent of this allocation is with no back payment.

TTGV used this resource as a R&D fund for industrial technology projects. After a grant mechanism established by The Scientific and Technological Research Council of Turkey (TÜBİTAK, Turkish acronym), TÜBİTAK and TTGV supports has become complementary and TUBİTAK provide grants for R&D projects while TTGV provides those support on loan basis.

The ITP finished in the year, 2006, and TTGV has begun to use "Support and Price Stability Fund" provided by Undersecretariat of Foreign Trade. Now, 75 percent of the loan provided by TTGV comes from this mechanism. The other 25 percent part is compensated from TTGV's own resources.

In this period, TTGV has also tried to generate new support mechanisms such as "Joint Technology Development Project" and "Commercialization Project" which are the outcomes of the "An Assessment of the Industrial Technology Project-Final Report" written by Taymaz (2006). [17] Those are the unique mechanisms firstly implemented in Turkey; however, their implementation has not gone further from the pilot application. The explanation of those mechanisms and the evaluation of TTGV's R&D funding performance will be made in the next part.

Not only has TTGV executed R&D funding mechanisms but also it has made some other contributions to the development of national innovation system (NIS)

in Turkey. TTGV has established or partly been a shareholder on the establishment of private service centres such as Esim Co. and Novagenix Co.; the former is a test centre for electromagnetism and vibration and the latter is bioanalytic drug R&D centre for bioavailability and bioequivalence. It also has contributed to the establishment of technoparks such as Arı Teknokent in İstanbul and Bilkent Cyberpark in Ankara.

Proper to its mission determined by the agreements, TTGV has assisted in the development of venture and risk capital funds, namely İş Girişim, Turkven, İstanbul Venture Capital Initiative (iVCi). It also established "Teknoloji Yatırım A. Ş. (Technology Investment Co., synonymous in English) in order to make start-up investments.

TTGV collaborated with Ministry of Environment in "Phase-out of Ozon-Depleting Substance Project" with World Bank funds and the project was completed successfully and has prepared the infrastructure for environmental supports of the foundation towards eco-innovation which are the unique mechanisms in Turkish NIS.

Finally, for encouraging scientific and technological efforts through the country and providing industry and university collaboration, TTGV arranges some honorary awards, namely "Technology Awards" (by collaborating with TÜSİAD and TÜBİTAK) and "Dr. Akın ÇAKMAKCI Thesis Awards for University-Industry Collaboration". TTGV is a member of TAFTIE (The Association for Technology Implementation in Europe) and also represents TÜBİTAK and Small and Medium Enterprises Development Organization (KOSGEB, Turkish acronym) in the association. TTGV became the Chief organisation of TAFTIE in 2007 and was in the board of the association in the former and the latter years.

3.2. Supporting and Funding Mechanisms of TTGV

Ongoing TTGV support mechanisms can be divided into three parts. The first one is "Technology Development Projects Support". It is the major support program which provides R&D loans for industrial R&D within firms. The second one is "The Environmental Projects Support" which is the only support mechanism within the National Innovation System of Turkey aiming at developing eco-innovation. The last one is about the risk capital and entrepreneurship and the mechanisms within this "Technology and Entrepreneurship Program" are sustained by Teknoloji Yatırım A. Ş..

3.2.1. **Technology Development Projects Support**

In this support scheme, R&D loans (soft loans) are provided for industrial R&D projects. 50 percent of the project budget proposed by the applicant firm is supported in the context of this mechanism. The ratio of the support is fixed notwithstanding the technology base, firm size and foresighted effect of the project. The duration of the project is up to 24 months. Firms are obliged to pay back the granted amount of money and payback is started one year later after the project has been completed. The granted amount is repaid in three years period with seven instalments departed by six months. Firms use the soft loan on US dollars basis and back payment of the firm is also on the same currency; thus the applicant firm also undertakes the exchange rate risk which is a problem for especially SMEs as proved by the several crises because of the macro economic instability within the country. The upper limit of the support is one million US dollars and this means that applicant firms are able to offer project budgets up to 2 million US dollars. 75 percent of this fund offered by TTGV is allocated from Undersecretariat of Foreign Trade and 25 percent is compensated from the own resources of the foundation. On the evaluation of applicant projects, several academicians and private sector specialists (namely Field Committee Members) are utilized in order to accept or refuse the project proposal. The acceptance and refusal of the project is determined via using Frascati and Oslo Manuals and by taking into account the current R&D condition of the country. Thus, for being supported, it is not obliged to have radical or high tech innovations. TTGV could support incremental product and process innovations involving industrial R&D on international, national and even firm level. After being accepted, a field committee member is charged as a "project viewer" in order to monitor the development of the project and usually make valuable recommendations about technical aspects of the project; hence university-industry collaboration is generated to some extent. At the end, technological know-how is left for the company that has proposed the project and the commercialization ability of the project is also taken into account because the support is given on the loan basis; hence it is important for the support provider to get the provided money back. For this reason, TTGV demands guarantee from the applicant firm at changing rates. Lastly, it should be mentioned that projects about investing in infrastructure or production are not under the scope of this support.

As an outcome of the report written by Taymaz (2006) for the assessment of Industrial Technology Project; under technology development projects support, it is determined to create a "Commercialization Support" mechanism in order to enable the commercialization of supported R&D projects, to make possible the benefits of economies of scale and to compete in international markets. The upper limit is 1 million US dollars as well the support is a soft loan with no interest but a service fee. In the scope of this mechanism, a pilot application was held and seven projects that completed their R&D were supported to be commercialized. However, this mechanism has not continued even though it is the sole one directed to commercialization of R&D projects within the national innovation system.

As another outcome of the same report (Taymaz (2006)), "Joint Technology Development Projects Support" was designated. The aim of the support was towards fostering the vertical and horizontal pre-competition and in-competition relationships and R&D between firms and upper limit was fixed as 2,5 million US dollars on a loan basis. A pilot project was implemented; however, the mechanism is not active now because of the property rights problem emerged during the pilot implementation.

3.2.2. **Environmental Projects Support**

TTGV is used to implement support programmes since its establishment. With the help of this experience, the foundation provides project supports concerning environment. The terms of this support mechanism is similar to "Technology Development Supports Project". In this context, R&D loans up to 1 million US dollars are provided for "Renewable Energy", "Energy Efficiency" and "Environmental Technologies" projects back payments are collected in four years containing one year of grace period. The project duration is limited to one and a half year. The ratio of the TTGV support is fixed to 50 percent of the project budget. There is no interest but 6 percent of TTGV funding is required for service fee which could be admitted as an interest or cost for the applicant firm.

3.2.3. Technology and Entrepreneurship Support

One of the objectives of TTGV is to enhance and foster risk capital within the country in order to encourage entrepreneurship on technological basis. For attaining this aim, Teknoloji Yatırım A. Ş. was established and technology and entrepreneurship supports are provided via this company. There are three support

programs. The first one is “Pre-Incubation Support” for entrepreneurs who have innovative ideas and try to establish its company. This mechanism includes research, consultancy and office set up services. The upper limit is 50.000 US dollars and the duration cannot exceed two years. However, this mechanism is at its infantry and has not been implemented yet. The second one is “Risk Sharing Facility Support” aiming at providing capital for technological product and process innovations in order to generate technology-based companies that has high potential for growth. Projects with low-budget and high risk are in the scope of this support. The upper limit is 200.000 US dollars and TTGV funded 50 percent of the project budget for duration of at least two years. The fund is provided on loan base. The last mechanism is “Start-up Support” directed towards talented entrepreneurs that have creative, unique and advanced-technology ideas and vision. Rational business models and leading-edge technologies are prerequisites for this programme. The upper limit is 400.000 US dollars and TTGV provides this money as an equity capital. High returns for investment are supposed such as a return of 10 times of the invested total in 5 or 7 years. Especially the latter two of this mechanisms are implemented until now and Teknoloji Yatırım A. Ş. has provided 3 million € until now.

In the next section, the paper will investigate particularly Technology Development Projects Support mechanism of the foundation. Environmental concerns and risk and venture capital is beyond the scope of this paper. The focus is on R&D loans and their contributions and additionality effect to R&D.

3.3. The Assessment of Technology Development Projects Support

3.3.1. The Structure of the Mechanism

As stated above, Technology Development Project Support is the major programme of TTGV and provides R&D loans for industrial technology development projects. It has been continued since 1992 (the establishment of TTGV). It is the extension of completed “Technology Development Project” and “Industrial Technology Project” between Turkish government and World Bank as mentioned above. However, TTGV sustains the programme since 2006, collaborated with Undersecretariat of Foreign Trade and the details of the programme are aforementioned in the previous section.

The quantitative information about this programme is stated as follows; [18]

Table 1: Information about Technology Development Projects (Source: TTGV, 2010)

Periods	*1992-1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*TOTAL*
# of Applicant Projects (1)	576	87	121	133	160	229	132	128	155	238	228	**2187**
# of Supported Projects (2)	179	55	32	51	67	64	25	101	88	116	113	**891**
SME Ratio in Supported Projects (3)	67%	83%	66%	81%	94%	78%	81%	87%	88%	88%	80%	**76%**
Contracted Fund (in million US dollars) (4)	72	18,4	10	16,4	15,4	25,3	7,4	29,7	29,5	41,3	33.1	**298,5**
Total Project Budget (in million US dollars) (5)	150,9	38,6	19,8	34	30,8	50,9	14,4	59,4	59	82,6	66.2	**606,6**
Provided Funds (in million US dollars) (6)	47,1	7,2	9,6	7,4	12,9	14,9	11,9	17,3	17,6	21,3	24,8	**192,0**
# of Completed Projects (7)	146	17	30	40	44	35	78	73	73	66	95	**697**
Back Payment (in million US dollars) (8)	17,9	7,2	4	4,6	6,6	7,5	9,4	13,3	16,8	19,2	17,2	**123,7**

As seen from the Table 1, 2187 projects applied and 891 projects were supported. The ratio of supported projects 40,7 percent. This number depicts that TTGV seriously investigate the R&D sufficiency of applicant projects.

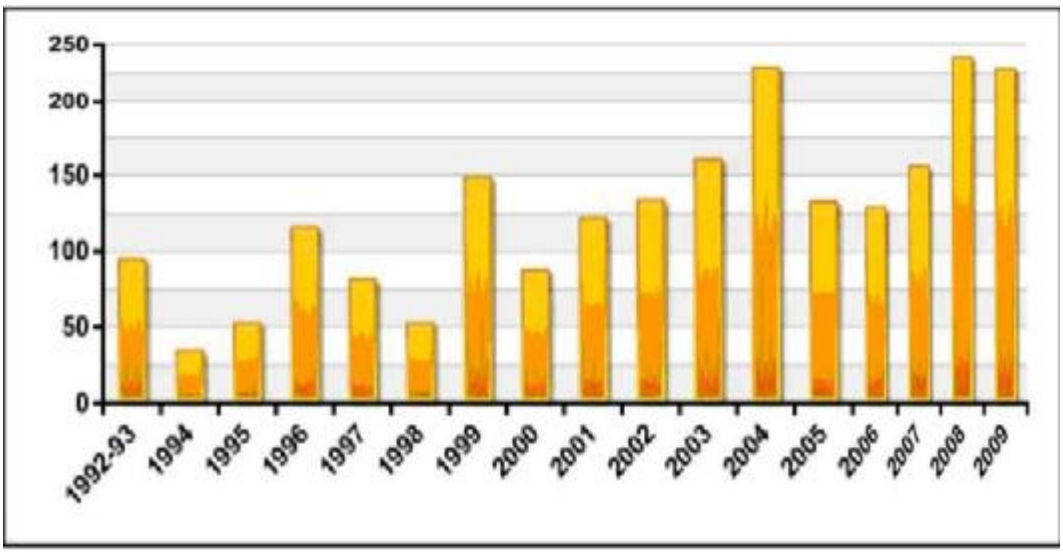

Fig. 1 : Number of applicant projects (Source: TTGV, 2010)

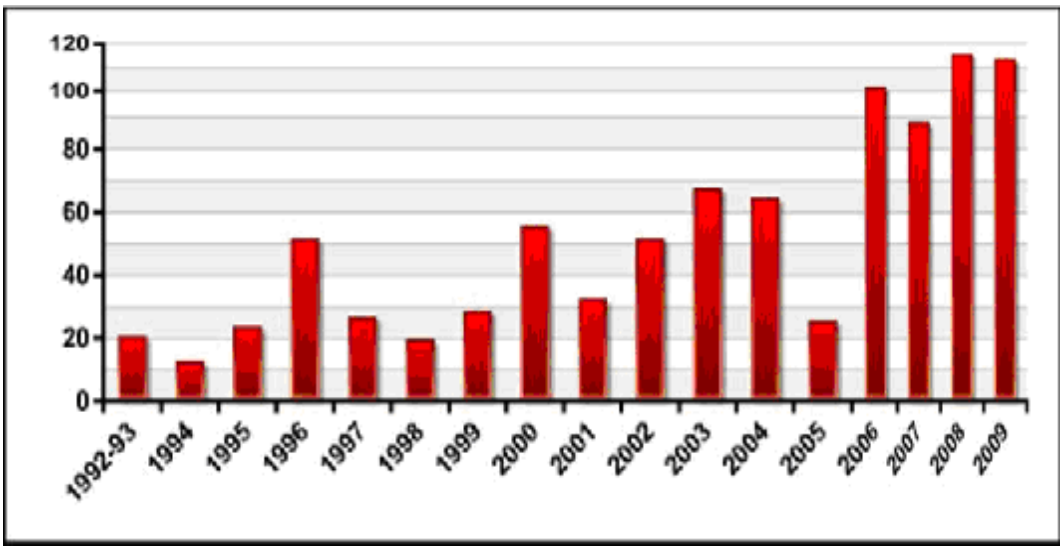

Fig. 2 : Number of supported projects (Source: TTGV, 2010)

There is instability on the number of applicant projects, nevertheless it could be stated that applicants are increased with a peak in those years, 2004, 2008 and 2009. As expected, the number of supported projects has also been greater than before particularly in last four years.

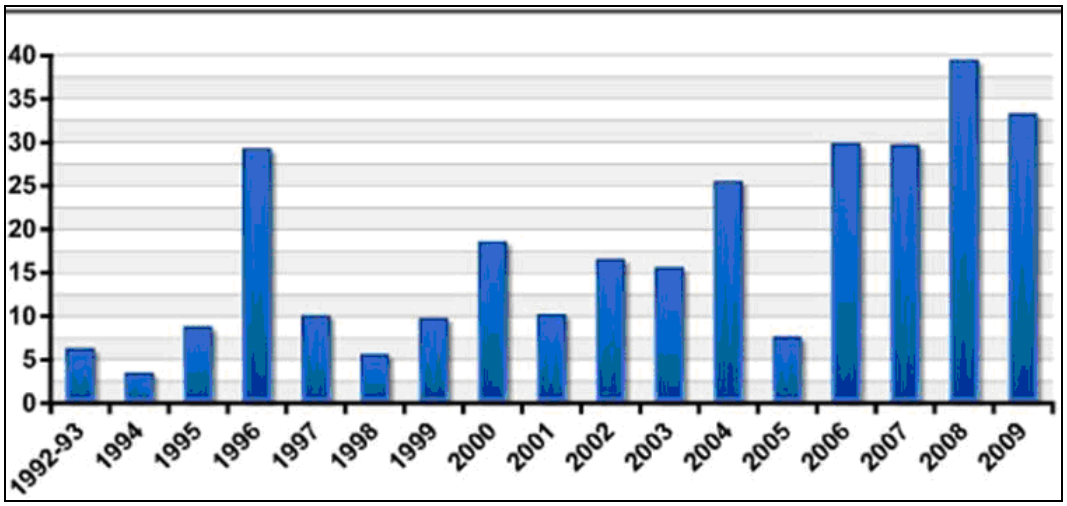

Fig. 3 : Contracted funds (year by year in million US dollars) (Source: TTGV, 2010)

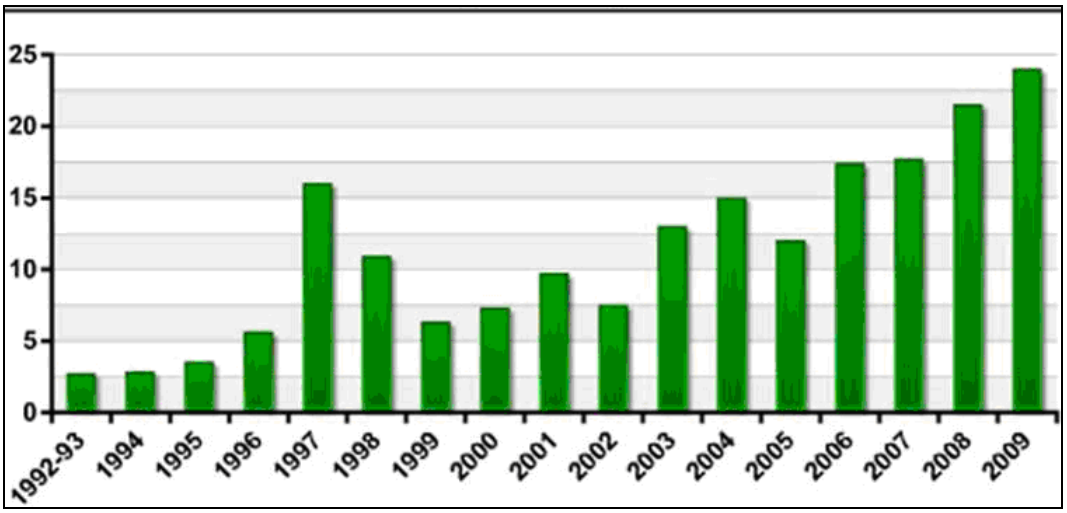

Fig. 4 : Provided funds (year by year in million US dollars) (Source: TTGV, 2010)

For 891 supported projects, total budget of the projects is 602 million US dollars; 298,5 million US dollars has been contracted and 192,0 million of this

amount has been used by the applicant firms. Totally 697 projects has been completed and 194 projects are ongoing.123,7 million US dollars of the used amount has been repaid to TTGV. Contracted funds has been at its peak in 2008, and it has been at its larger values in last four years in which also used funds steadily increased and reached its peak value of 24,8 million US dollars in 2009. It is reasonable that after the highest value of money contracted in 2008, the usage of those funds was also high in the consequent year. It can be concluded that TTGV has increased its performance especially in 2008 and 2009 in which a serious economic crisis has been experienced all over the world. Finally, Table 1 depicts that 80 percent of supported projects belong to SMEs in 2009; and this ratio has been between 67 percent (in 2001 at its lowest) and 94 percent (in 2003 at its highest). It is explicit that this support mechanism of TTGV is highly directed to the financial requirements of SMEs which have financial constraints and needs liquidity in its operations.

Further conclusions could be made from the below graphs that belong to the statistics related to the years between 2005 and 2009. [19]

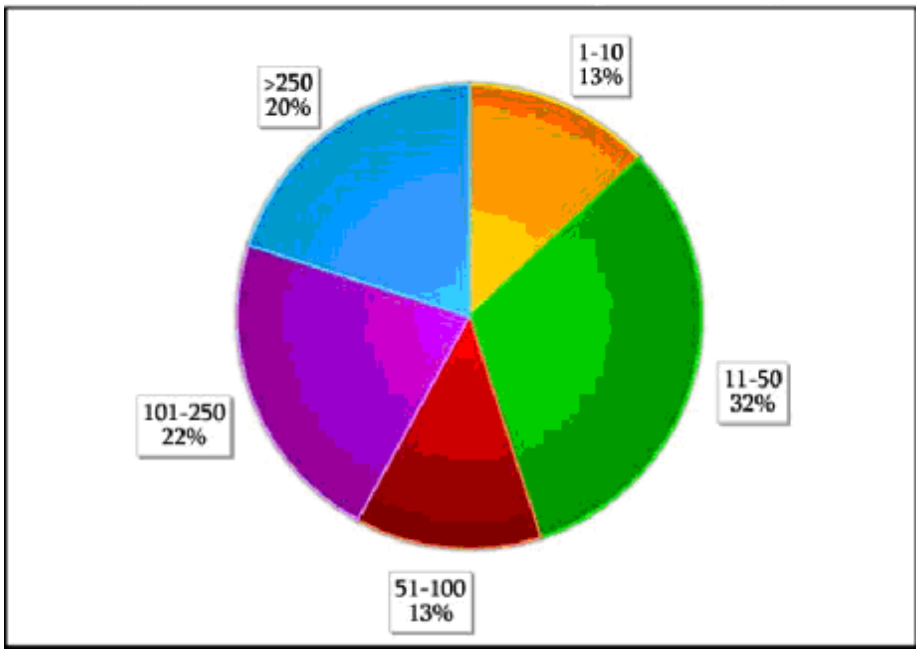

Fig. 5 : Share of projects with respect to number of employees of the supported firm (Source: TTGV, 2010)

According to the Figure 5, 45 percent of the supported projects belong to the firms that have 11-100 numbers of workers. Only 22 percent of the projects belong to firms that have more than 250 workers; thus this finding also supports the argument that generally SMEs benefit this kind of mechanism.

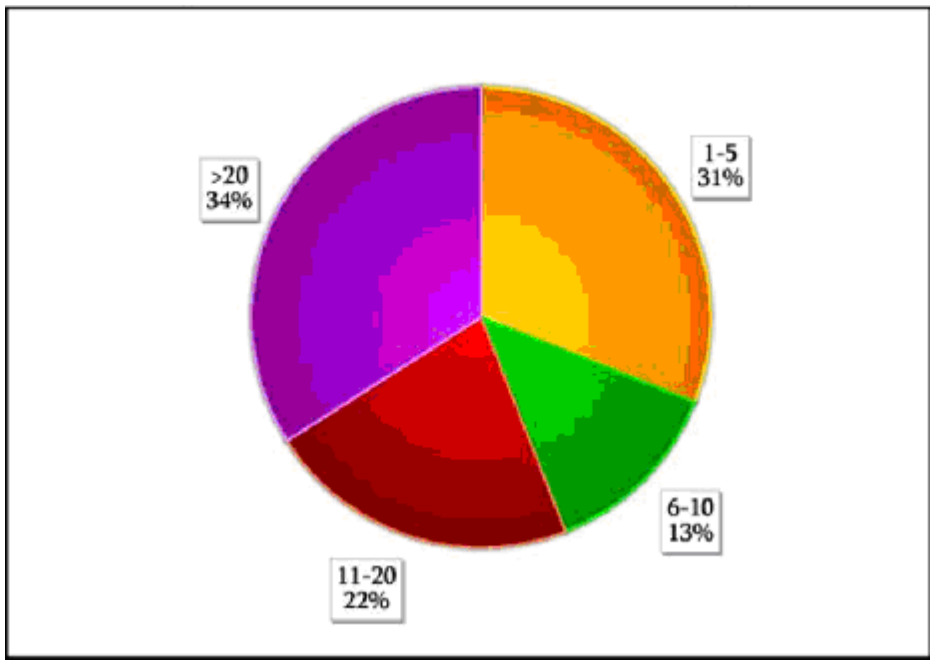

Fig. 6 : Share of supported firms according to firms' age (Source: TTGV, 2010)

There is nearly and even distribution between the firms' age and support and can be suggested that several firms from several ages apply to the supports of the foundation.

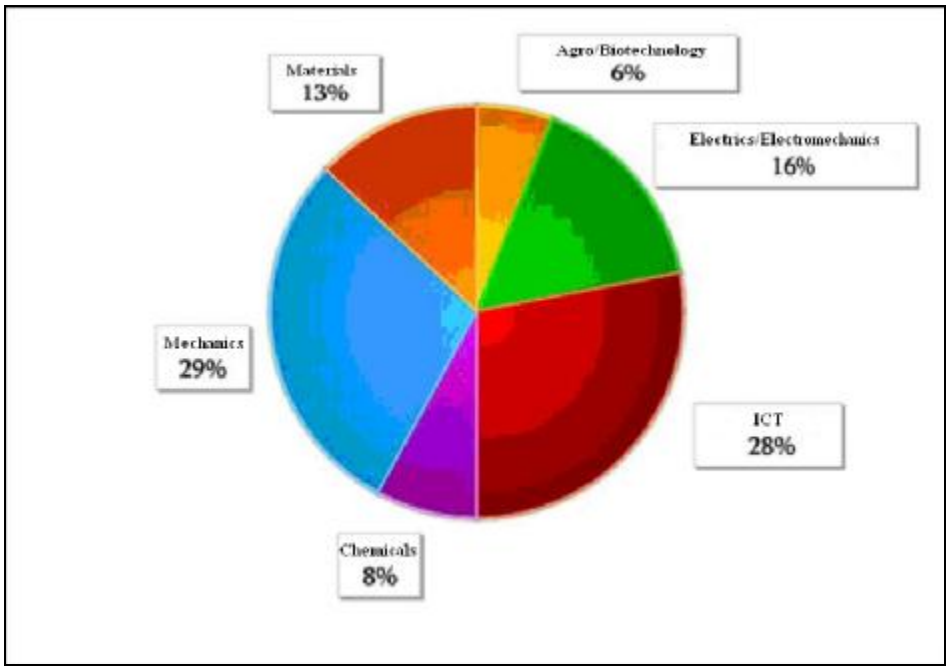

Fig. 7 : Share of supported projects according to related technological fields and sectors (Source: TTGV, 2010)

The distribution of TTGV support with respect to technological fields is not surprising that the most supported projects have come from machine industry and related to the technological field of mechanics. It is a realistic outcome while taking into account the weight of machine sector in Turkish industry. The point that deserves attention is that ICT sector is in the second place with its 28 percent and its percentage is nearly equal to machine industry. This can be highly related to the support mechanism and software projects that have generally project budgets weighted on personnel costs can perceive this mechanism as highly attractive and suitable.

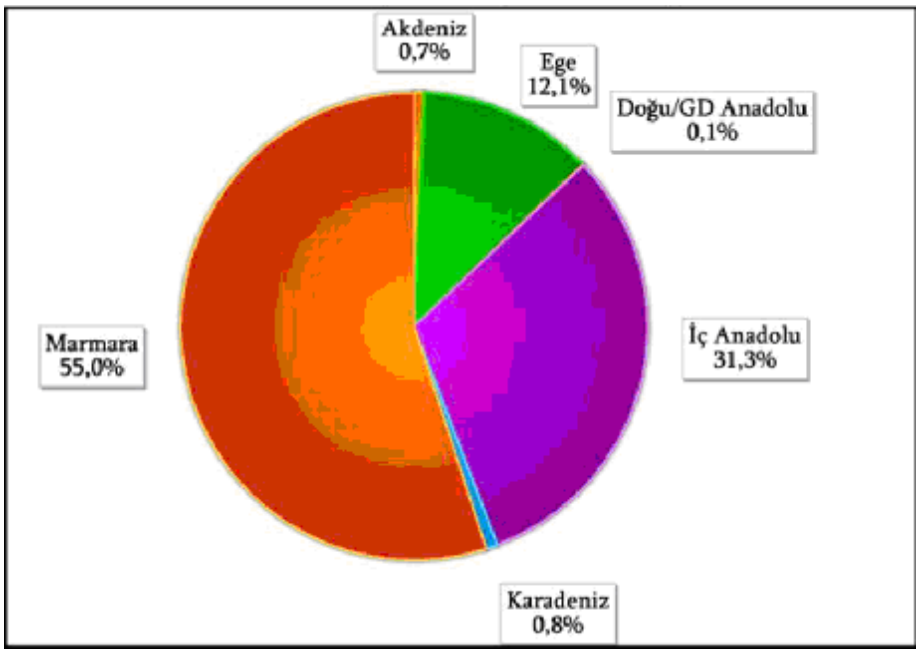

Fig. 8 : The share of geographical regions according to the project (Source: TTGV, 2010)

The distribution of TTGV support according to geographical regions is also unsurprising and Marmara Region has more than one half of the supports with its value of 55 percent. İç Anadolu (Middle Anatolia) is the second with 31,3 percent and Ege (Aegean) Region is the third with 12,1 percent. However, when taking into account the industrial intensification of the regions, it is expected that Ege Region would not have fallen behind so seriously with respect to İç Anadolu and in this condition, the distance of Izmir (the largest trade and industry centre of Aegean Region) to Ankara may be effective. The share of other regions (namely, Akdeniz (Mediterrenean), Doğu Anadolu (East Anatolia), GüneyDoğu Anadolu (South Eastern Anatolia) and Karadeniz (Black Sea) is unfortunately negligible due to the lack of homogeny distribution of industrial facilities in Turkey.

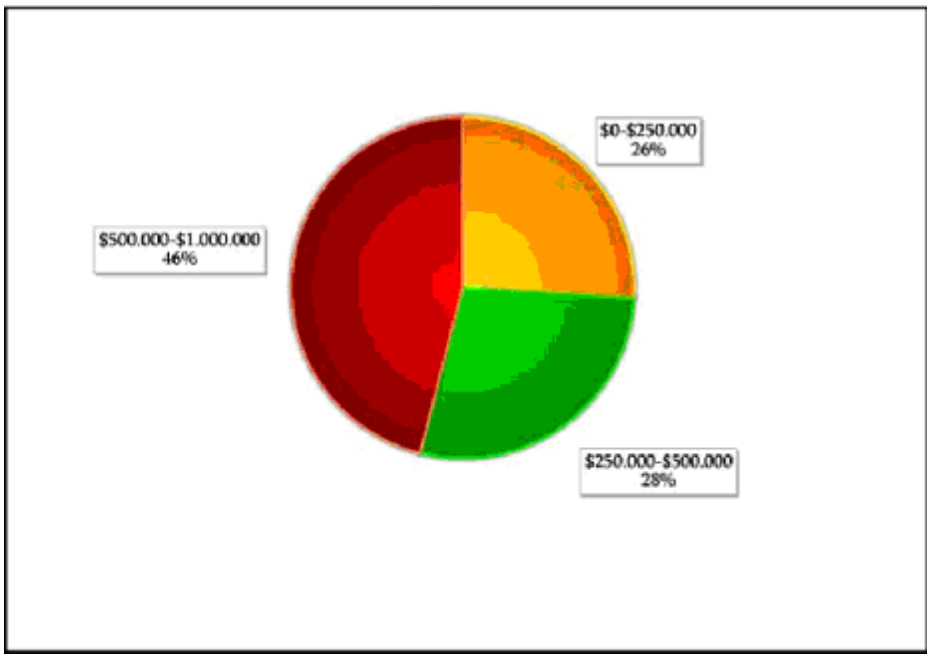

Fig. 9 : Contracted TTGV support per project (Source: TTGV, 2010)

Lastly, the TTGV support in project budget is evenly distributed and TTGV compensates an amount of 0-500.000 US dollars to 54 percent of the supported projects where this compensation is above 500.000 US dollars in 46 percent of the projects.

3.3.2. Benefits of the mechanism

The above findings could be sufficient to summarize the structure of TTGV support; nevertheless the additionality effect or the provided benefits of this support mechanism should be further explained scientifically. First of all, it can be posed that if this mechanism is a subsidy or not? TTGV funds are generated from World Bank subsidies and provided to TTGV as summarized above and this money was not taken back from TTGV. In addition, 75 percent of the ongoing support fund is taken from Undersecretariat of Foreign Trade. This funds are allocated from public source and "government makes use of the fund in hand and thus, abandons its possible earnings and undertake its opportunity cost. In both cases, this can be defined as subsidy with respect to World Trade agreements". [20]

The second question could be asked whether this support offers significant benefit for industrial R&D and thus, for the national economy and growth. There are two important studies made about this subject. [21] [22]

In their study, Özçelik and Taymaz (2008) tried to find the "crowding in" or "crowding out" effects of R&D subsidies (both of subsidies; R&D grants by TÜBİTAK and R&D loans by TTGV) and for this reason they establish five models based on DID (difference-in-difference estimators). The dataset involves the years between 1992 and 2001. In the scope of this paper, I solely focus on the findings related to TTGV. Please note that those data years belong to the first TDP project and to the beginning of ITP project sustained by TTGV. Firstly, those scholars clearly depicts that the share of R&D loans of TTGV reduced, particularly after R&D grants had been provided by TÜBİTAK and its effects on macroeconomic scale had become limited as shown by Fig. 10.

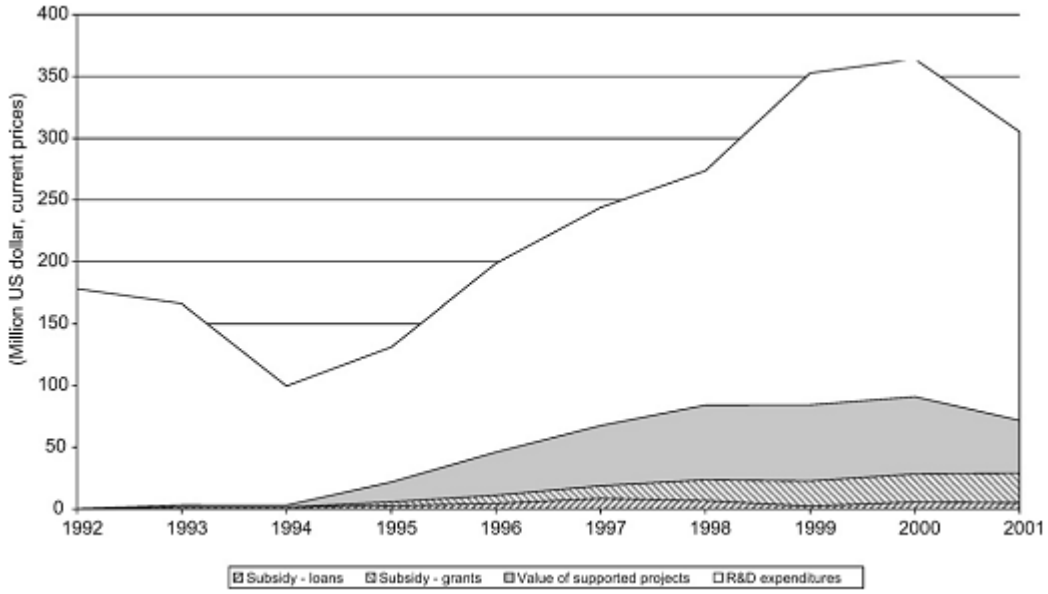

Fig. 10 : R&D loans, grants, value of supported projects and R&D expenditures between 1992 and 2001. (Source: Özçelik and Taymaz (2008))

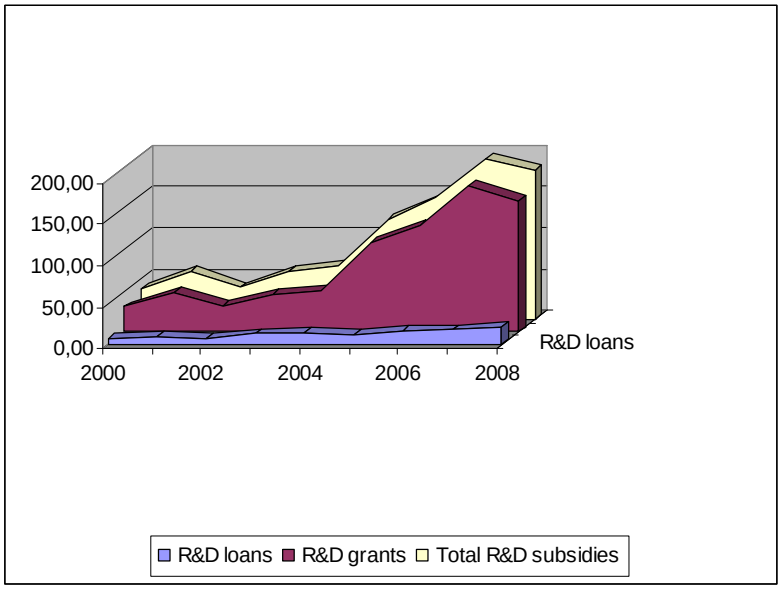

Fig. 11 : R&D loans, grants, value of supported projects between 2000 and 2008.

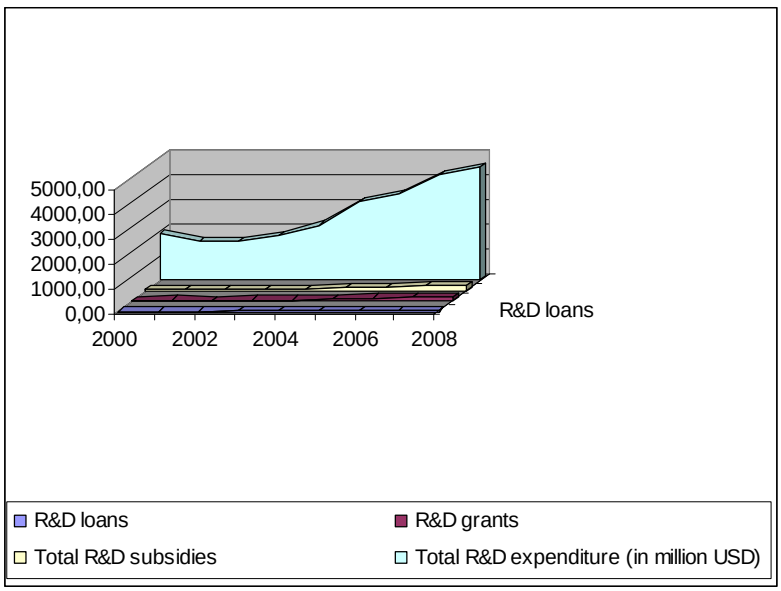

Fig 12 : R&D loans, grants, value of supported projects and R&D expenditures between 2000 and 2008.

Further support for the above argument comes from Fig. 10 and Fig. 11 in which it is clearly displayed that the share of R&D loans has been decreased steadily.[1] Also they show that the amount of R&D subsidy in total amount of the R&D expenditure is considerably low even if the amount of R&D grants provided by TTGV has speeded up recently. To sum up, TTGV support seems as too low in scale for making macroeconomic effect fostering economic growth and development.

In their study, Özçelik and Taymaz (2008) have also found that R&D intensity (the ratio of R&D expenditure to output) of R&D performers increased from 1,45 percent in 1993 to 3,62 percent in 2001 (for loan receiving firms; 5,95% in 1993 to 10,58% in 2001 and for grants receiving 3,13% in 1995(the year program started) to 4,88% in 2001). They also provide the information that "support-receiving firms, on average, exhibit much higher R&D intensities than the non-supported ones". Also, an average R&D performer have an R&D intensity of 2,27 percent in those years between 1993 and 2001 (5,98% for loan recipients and 3,41 for grants recipients). Subsidized R&D intensity is 1,55 percent and 0,82 percent for loan and grants recipients respectively. Total subsidized amount of R&D is no more than 20 percent of total R&D spending. [23]

This paper will not examine the methodology Özçelik and Taymaz (2008) used in their econometric models; however, some related outputs of the models should be mentioned. Those outputs can be summarized as follows;

- Public R&D support does not crowd out private R&D activity. Especially, R&D grants enhanced the firm financed part of R&D activity.
- The results show that incumbent firms spend more on R&D and this confirms the well-known Schumpeterian hypothesis; however, small R&D performers tend to benefit more from R&D subsidies with respect to incumbents.
- Thanks to R&D subsidies, an "acceleration affect" on R&D activities is present notwithstanding the type of subsidy provided since an average firm has increased its R&D intensity when subsidized.
- R&D grants and loans are more effective policy tools with respect to R&D tax incentives in order to create a "crowd in" effect in industrial R&D spending. [24]

[1] Data in Fig. 11 and 12 has been taken from TÜBİTAK, TÜİK (Turkish Statistical Institute) and TTGV statistics.

Complementary to this study, Taymaz evaluated more broadly the effect of TTGV support in another study. Taymaz (2006) used a wide set of data[2] in order to statistically analyze the effect of ITP project. As I analyze that study, I choose subsequent findings related to the subject of this paper. Taymaz (2006) firstly stated that the number of applicants has doubled in ITP with respect to TDP and one-third of those projects had been supported. The share of SMEs was remained about 80 percent and those findings are clearly in accordance with the general structure stated above. Taymaz (2006) also found that the repayment ratio was above 80 percent for TDP and 94 percent for ITP and "the repayment ratio is extremely high for such a risky activity". [25] According to this study, TTGV program is the least known with respect to TÜBİTAK and KOSGEB among the industrial firms; and software firms are more knowledgeable about TTGV support because of the information externalities related to be located in technoparks. Also this study found that the share of R&D loans in business expenditures on R&D is about 2 percent. In the interview, TTGV clients determined the main reasons for not applying TTGV support as high loan costs, sufficient own resources and inconvenience of getting TTGV support almost at equal proportions. [26] Firms also complained the paperwork for applying and carrying on the project and the length of the response time. Nevertheless, "the great majority of firms were pleased that the quality of evaluation and monitoring improved over time". [27]

Since ITP was aimed at generating additional R&D, Taymaz (2006) measured this additionality effect via using interviews and econometric analysis. In interviews, it was asked whether supported firms afford the R&D activity unless their applications were accepted and whether rejected firms made R&D activity notwithstanding their rejection. In this context, the interviews were implemented in 211 firms of which at least one R&D project was supported by TTGV. 12 percent of large corporations and 27 percent of SMEs responded that they would not carry on the project. Half of the firms with rejection stated that they would reduce the project budget by 40 percent. As a result, firms totally would spend 34 percent less on R&D without R&D support. These findings suggest that "TTGV's R&D support program has a substantial additionality effect, especially on SMEs". Further support for this argument comes from the rejected projects. More than 40 percent of those projects had been terminated and in addition to this, the projects

[2] This data set involves The Annual Survey of Manufacturing Statistics, The R&D Survey, The Innovation Surveys (1998, 2002, 2005), The Industrial Technology Services Survey, a database of TTGV clients and a large number of interviews.

not terminated had been scaled down. Thus, R&D expenditures have been reduced by 50 percent. [28]

Taymaz (2006) also tested this suggestion via using econometric analysis. A DID (difference-in-difference) estimation model was used for attaining this aim. As a result, Taymaz (2006) stated that the R&D intensity and own R&D intensity of TTGV clients had increased 5,22 percent and 3,79 percent respectively and the difference between those values in favour of R&D intensity could be attributed to supported projects. Furthermore, there is almost no rise in the R&D intensity of non participants. With the help of another model, the increase for only R&D performers was measured and the result is the same. As Taymaz (2006) noted, "TTGV clients experienced 3.67 percentage points increase in R&D intensity and 2.35 percentage points increase in own R&D intensity, whereas the matched control group raised R&D intensity only by 0.06 percentage points. These results indicate that there could be an "acceleration effect" because an average firm increases its own R&D spending if it receives any R&D support". As a result, TTGV support was determined as statistically and economically significant on R&D activities. [29]

Taymaz (2006) also provided "qualitative evidence" for TTGV support. Accordingly, the main benefits of TTGV support were argued as "the time discipline and tight R&D process management introduced by TTGV, the advice provided by the supervisors (academic and industrial) and the prestige attached to winning TTGV projects". [30] Also, firms stated that the evaluation and monitoring of TTGV on the project was also beneficial and they saved a lot of money and could sustain a positive relationship with universities which they could not establish unless they gained the support. Taymaz (2006) also noticed that firms have gained technology culture and the capability of preparing R&D project proposal, R&D budget, R&D plans and of managing R&D projects. Taymaz also furthered his study in order to measure the impact of R&D support on productivity, competitiveness, employment and performance dynamics. Taymaz (2006) came to the conclusion that TTGV clients are more productive with respect to non-clients, particularly in low-tech industries. He suggested that TTGV clients especially on services is more competitive (has significant export intensity). On employment, the emphasis on making R&D and the considerable increase in TTGV clients are mainly related to the increase in R&D spending, not on TTGV support; since non-supported R&D performers also increase their employment almost as large as TTGV clients. Nevertheless, TTGV clients need more of researchers after they had been supported. [31] Finally, it is found that as in low- and high-technology

manufacturing, TTGV clients in services had the highest growth rate in wages. The innovative performance of small TTGV clients in services is outstanding. [32]

4. Conclusion

This paper has descriptively examined the relevance of R&D loans provided by TTGV in order to generate technological advancement in Turkish National Innovation System. From this examination, it is found that major part of the number of accepted projects was owned by SMEs. This argument is in accordance with the suggestions about SMEs in Section 2. The constraints in internal finance and difficult entry to credit markets are problems for SMEs and TTGV seems to be helpful in this way by providing R&D loans which are easier to take. SMEs reach finance via using TTGV's support mechanism and as stated above one of the most beneficial aspect of this support is its capability to provide stable liquidity for supported projects. This benefit seems lesser for small firms on micro scale and for large firms. Among supported SMEs, smaller ones with less than 10 employees have fewer propensities to be subsidized. Particularly, those firms struggle to present a guarantee which is required by TTGV and those kinds of projects are terminated before the contract is signed up. Also, this support of TTGV maintains the industry and university relationship with its field committee members and project viewers generally stimulate the project positively as interviews suggested. Furthermore, the monitoring mechanism generates a management culture concerning R&D projects and provides tight discipline for the firm. Therefore, those direct and indirect effects provide additionality effects on R&D expenditures and trigger further R&D expenditure in industry. It can also be suggested that TTGV support mechanism is significantly beneficial for SMEs in fostering its competitiveness and productivity.

In spite of those benefits, TTGV's R&D loan program can be criticised for its financial requirements concerning back payment and those requirements can inhibit R&D since the supported firms takes the responsibility of exchange rate risk and give a service fee to the programme. In this manner, a feasibility study should be performed before applying and sometimes firms withdraw their application for these reasons.

It can also be suggested that the overall impact of the program on economy is too small when taking into consideration its amount that is contracted and funded. Its macroeconomic effect seems very limited in terms of provided amount. R&D loans cannot increase its scale in line with R&D grants and overall R&D expenditures.

To conclude, R&D loans provided by TTGV under the program of "Technology Development Projects" seems relevant and beneficial even though its effect is small on economic development. Its capacity should be enlarged by making it more attractive and compatible with the needs of firms, particularly of SMEs. Further research should focus on these issues and this tool should be more effectively used for abandoning the market failures that prevent technological advance, industrial development and optimal resource allocation to R&D.

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