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

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Abstract

In this paper, the relevance of R&D loans in Turkey has been investigated by using the example of TTGV. Descriptive analysis has been made with the help of the contemporary R&D funding literature. As a result, among the years between 1992 and 2010, R&D loans provided by TTGV under the "Technology Development Projects" program seem relevant and beneficial even though its effect was small on economic development. Its capacity might have been enlarged bymaking it more attractive and compatible with the needs of firms, particularly SMEs.

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1. Introduction

R&D funding is a crucial mechanism for government policies to boost the innovative and technological performance of an industry, region, country, etc. There are certain types of this mechanism, such as tax incentives, grants, loans, and sharing the financial risk of R&D and innovative actions within a firm.

Recently, two contradictory views have 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. The opposite view argues that loans help foster the R&D performances of an innovative firm.

In Turkey, R&D loans were provided by the Technology Development Foundation of Turkey (TTGV) between the years 1992 and 2010. The core business of TTGV was R&D funding and this foundation supported R&D projects of industrial firms by those loans for about two decades. TTGV, the only soft-loan provider institution in the Turkish National Innovation System, had almost created an R&D volume of 600 million US dollars between the period concerned via providing R&D support with back payment.

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 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 the 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 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 an 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 concludes the last section.

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2. Theoretical Background

In a neo-classical economy, it is expected that government does not intervene in the markets because the "invisible hand" allocates the resources optimally. Optimal resource allocation can only be provided in perfect markets that have a full rivalry. In a market economy, there are three prerequisites of this optimality. Those are excludability, rivalry, and transparency of goods. Excludability and rivalry refer to that good can be consumed only once and once a good is consumed, it cannot be used again. Furthermore, transparency is defined as having full information about the 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. 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 the production of that good". (Nelson 1959)

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 "market failure". The failure of the markets is naturally equal to the failure of the resource allocation optimality and government intervention becomes necessary to generate technological knowledge and innovative technologies for economic development and growth. (Arrow 1962)

Government intervention may be in three kinds aiming at boosting technological activity, research and development (R&D), invention, and innovation 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. (Busom 2000; Hall and Reenen 2000; Hall 2002; Lach 2002; Trajtenberg 2002) 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". (Lach 2002, 369) 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 the 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 the company displaces the subsidized amount with its 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. (Ughetto and Vezzulli 2008) Myers and Majluf (1984) highlighted the 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. (Myers and Majluf 1984) 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 concerning larger firms and incumbents. This case is more evident in developing countries where investment venture capital opportunities and the public equity market are lagging. (Hall 2002) Hence, SMEs require more easy ways to reach the finance to perform R&D. As a result, it is expected that the propensity to innovate in small firms increases relatively more for larger ones as argued by Lach (2002), Özçelik and Taymaz (2008), Busom (2000) and this case is particularly the same for high-tech firms. (Carpenter and Petersen 2002) Further support comes to this argument from Himmelberg and Petersen (2001) and these scholars suggest that "the principal 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 over investment needs". (Himmelberg and Petersen 2001) In conclusion, one can deduce that R&D subsidies are more helpful for small firms, and good support mechanisms enhance and foster their innovative activities. Those mechanisms also target market failures that prevent optimal resource allocation to technological development and scientific research.

3. TTGV as an 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 was the "Technology Development Project" to compensate the financial requirements of Turkish industry concerning R&D. (Göker 2008) 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. (Göker 2008, 55)

World Bank provided 100 million US dollars to the Undersecretariat of Foreign Trade and the 43,3 million US dollars of this amount was given to TTGV as a gratuitous transfer to support every kind of project 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 was a striking point that TTGV was responsible for compensating its 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 the Undersecretariat of Foreign Trade and independent auditors.

The major mission of TTGV is to bring competitiveness in global markets to Turkish industry and it is the forerunner of the 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 that is flexible and in which public and private sector has equal effect in the process of decision-making. The 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. (Göker 2008, 58)

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

TTGV used this resource as an 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 support has become complementary and TUBİTAK provide grants for R&D projects while TTGV provides those support on a loan basis.

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

In this period, TTGV also tried to generate new support mechanisms such as the "Joint Technology Development Project" and "Commercialization Project" which were the outcomes of the "An Assessment of the Industrial Technology Project-Final Report" written by Taymaz (2006). (Taymaz 2006) Those were the unique mechanisms firstly implemented in Turkey; however, their implementation had 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 the national innovation system (NIS) in Turkey. TTGV established or partly been a shareholder in the establishment of private service centers such as Esim Co. and Novagenix Co.; the former was a test center for electromagnetism and vibration and the latter was a bioanalytic drug R&D center for bioavailability and bioequivalence. It also 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 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) to make start-up investments.

TTGV collaborated with the 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 organization of TAFTIE in 2007 and was on the board of the association in the former and the latter years.

3.2 Supporting and Funding Mechanisms of TTGV

TTGV support mechanisms might be divided into three parts. The first one was "Technology Development Projects Support". It was the major support program that provides R&D loans for industrial R&D within firms. The second one was "The Environmental Projects Support" which was the only support mechanism within the National Innovation System of Turkey aiming at developing eco-innovation. The last one was about the risk capital and entrepreneurship and the mechanisms within this "Technology and Entrepreneurship Program" were 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 installments departed by six months. Firms use the soft loan on a US dollars basis and the 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 can offer project budgets up to 2 million US dollars. 75 percent of this fund offered by TTGV is allocated from the 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 to accept or refuse the project proposal. The acceptance and refusal of the project are 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" 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. In 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 a loan basis; hence the support provider needs to get the provided money back. For this reason, TTGV demands a 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 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 the 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 the upper limit was fixed as 2,5 million US dollars on a loan basis. A pilot project was implemented; however, the mechanism did not work properly because of the property rights problem that emerged during the pilot implementation.

3.2.2 Environmental Projects Support

TTGV is used to implement support programs since its establishment. With the help of this experience, the foundation provides project support concerning the environment. The terms of this support mechanism are 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 the grace period. The project duration is limited to one and a half years. 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 the 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 to encourage entrepreneurship on a 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 their company. This mechanism includes research, consultancy, and office setup 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 to generate technology-based companies that have high growth potential. 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 at least two years. The fund is provided on a loan basis. 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 program. The upper limit is 400.000 US dollars and TTGV provides this money as equity capital. High investment returns are supposed such as a return of 10 times the invested total in 5 or 7 years. Especially the latter two of these mechanisms were implemented and Teknoloji Yatırım A. Ş. provided 3 million €.

In the next section, the paper will investigate particularly the Technology Development Projects Support mechanism of the foundation. Environmental concerns and risk and venture capital are 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 program 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 the completed "Technology Development Project" and "Industrial Technology Project" between the Turkish government and the World Bank as mentioned above. However, TTGV sustained the program, collaborated with the Undersecretariat of Foreign Trade and the details of the program are aforementioned in the previous section.

The quantitative information about this program is stated as follows; (TTGV 2010)

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**
# 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 Table 1, 2187 projects were applied and 891 projects were supported. The ratio of supported projects is 40,7 percent. This number depicts that TTGV seriously investigates the R&D sufficiency of applicant projects.

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

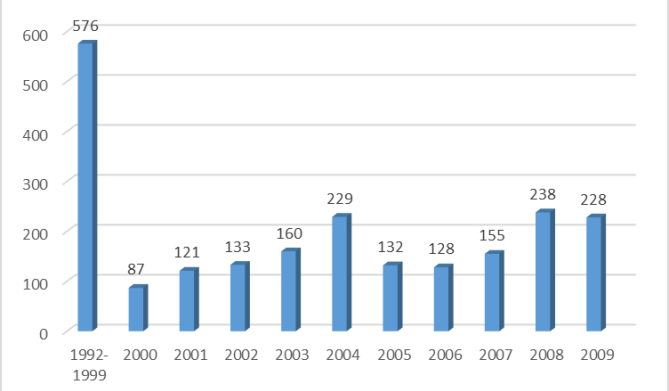
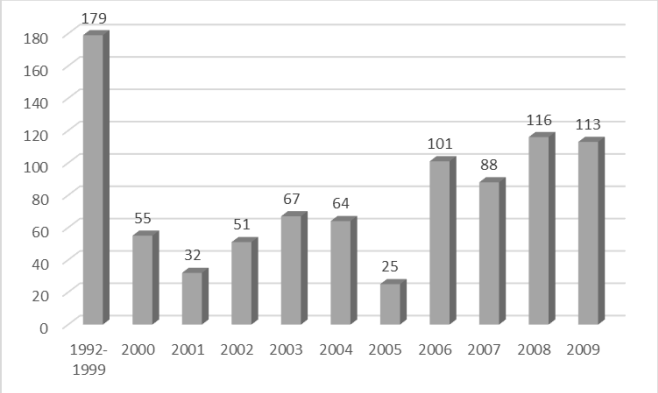


Figure 2. Number of supported projects (Source: TTGV, 2010)



There was instability in 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 was also greater than before, particularly in the last four years.

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

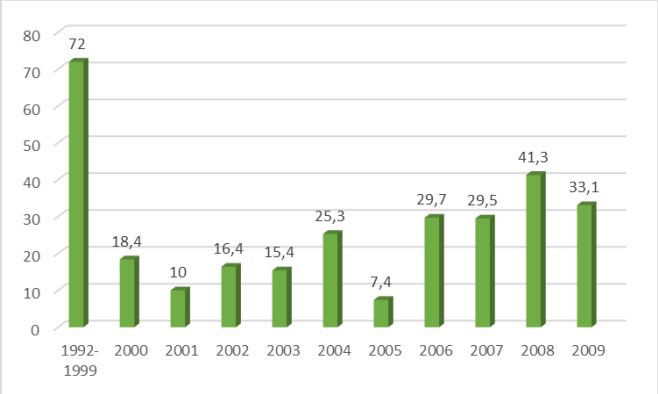
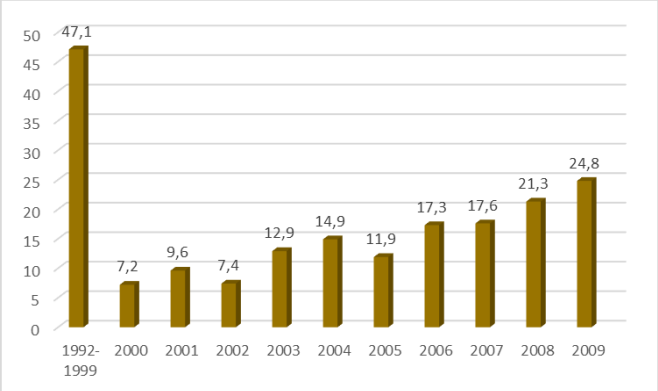


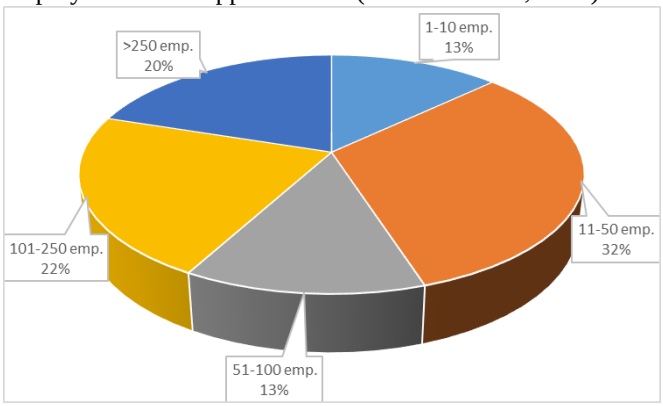
Figure 4. Provided funds (year by year in million US dollars) (Source: TTGV, 2010)



For 891 supported projects, the 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 had been completed and 194 projects were ongoing by the year 2010.123,7 million US dollars of the used amount had been repaid to TTGV. Contracted funds had been at their peak in 2008, and they had been at their larger values in the last four years in which also used funds steadily increased and reached their peak value of 24,8 million US dollars in 2009. It was 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 increased its performance especially in 2008 and 2009 in which a serious economic crisis had 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 was highly directed to the financial requirements of SMEs which had financial constraints and need liquidity in their operations. Here, we should point out that the exchange rates of currencies had been highly stable in Turkey in the given period.

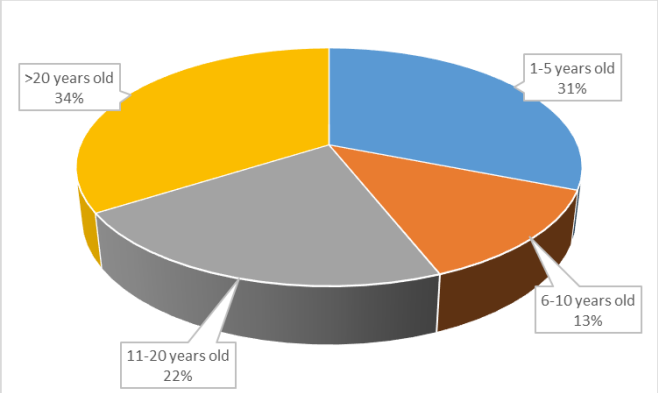
Further conclusions could be made from the below graphs that belong to the statistics related to the years between 2005 and 2009. (TTGV 2010, 15-18)

Figure 5. Share of projects concerning the number of employees of the supported firm (Source: TTGV, 2010)



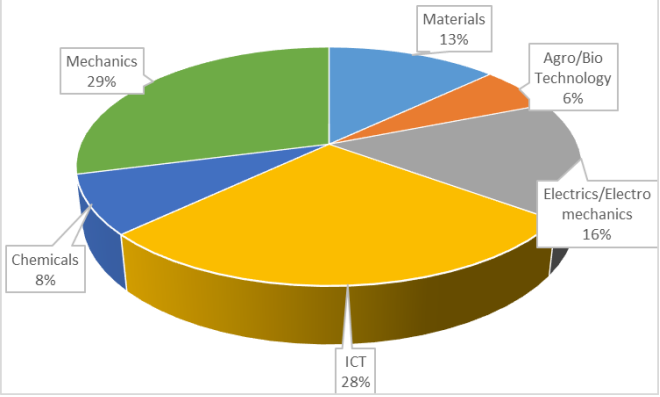
According to Figure 5, 45 percent of the supported projects belong to firms that have 11-100 numbers of workers. Only 22 percent of the projects belong to firms that have more than 250 workers; thus, this finding also supports the argument that generally SMEs benefit from this kind of mechanism.

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



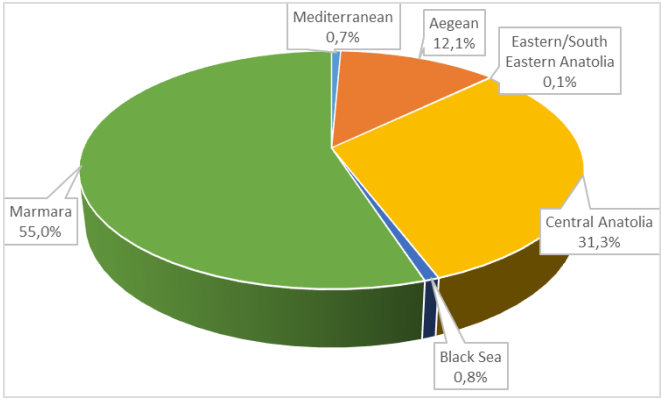
There is nearly an even distribution between the firms' age and support and can be suggested that several firms of several ages apply to the supports of the foundation.

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



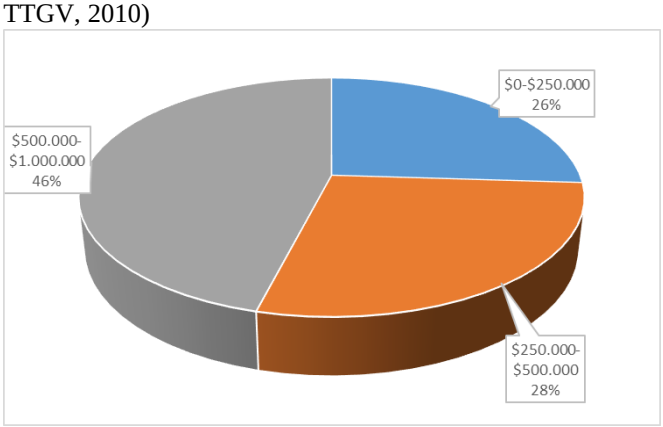
The distribution of TTGV support concerning technological fields is not surprising that the most supported projects have come from the machine industry and are related to the technological field of mechanics. It is a realistic outcome while taking into account the weight of the machine sector in the Turkish industry. The point that deserves attention is that the ICT sector is in second place with its 28 percent and its percentage is nearly equal to the 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.

Figure 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 support 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 concerning İç Anadolu and in this condition, the distance of Izmir (the largest trade and industry center of Aegean Region) to Ankara may be effective. The share of other regions (namely, Akdeniz (Mediterranean), 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.

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



Lastly, the TTGV support in the 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 whether 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 the Undersecretariat of Foreign Trade. These funds are allocated from a public source and the "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 concerning World Trade agreements". (TTGV 2010, 70)

The second question could be asked whether this support offers significant benefits for industrial R&D and thus, for the national economy and growth. There are two important studies made about this subject. (Özçelik and Taymaz 2008; Taymaz 2006)

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 the beginning of the ITP project sustained by TTGV. Firstly, those scholars depict that the share of R&D loans of TTGV reduced, particularly after R&D grants had been provided by TÜBİTAK and its effects on the macroeconomic scale had become limited as shown by Fig. 10.

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

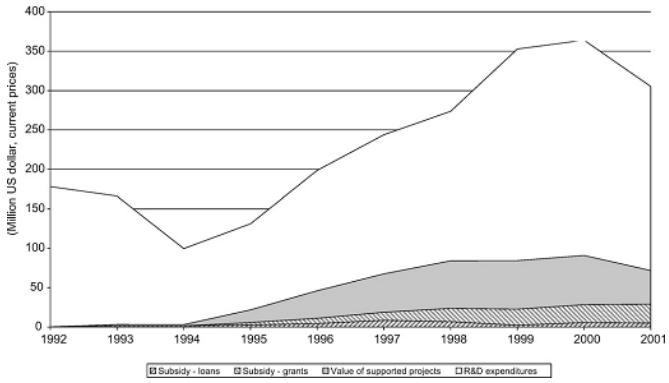


Figure 11. R&D loans, grants, the value of supported projects between 2000 and 2008.

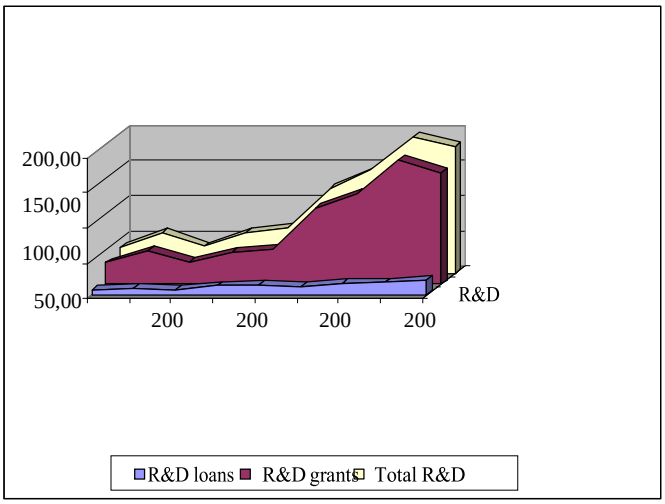
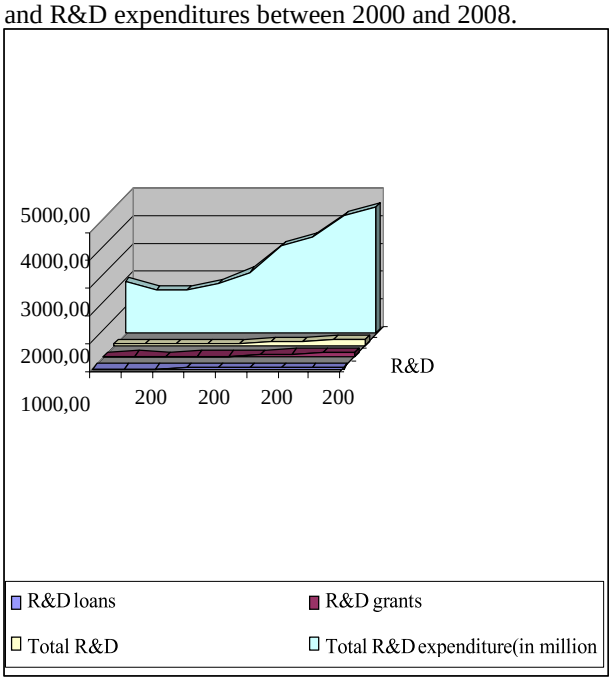


Figure 12. R&D loans, grants, the value of supported projects, and R&D expenditures between 2000 and 2008.



Further support for the above argument comes from Fig. 10 and Fig. 11 in which it is displayed that the share of R&D loans has been decreased steadily.[1] Also they show that the amount of R&D subsidy in the 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 too low in scale for making macroeconomic effects fostering economic growth and development.

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

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 has 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. The total subsidized amount of R&D is no more than 20 percent of total R&D spending. (Özçelik and Taymaz 2008)

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 financing 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 concerning incumbents.
- Thanks to R&D subsidies, an "acceleration effect" 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 concerning R&D tax incentives to create a "crowd in" effect in industrial R&D spending. (Özçelik and Taymaz 2008, 16)

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] to statistically analyze the effect of the 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 concerning TDP and one-third of those projects had been supported. The share of SMEs remained about 80 percent and those findings are following 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". (Taymaz 2006) According to this study, TTGV program is the least known concerning TÜBİTAK and KOSGEB among the industrial firms; and software firms are more knowledgeable about TTGV support because of the information externalities related to being 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 for TTGV support as high loan costs, sufficient own resources, and inconvenience of getting TTGV support almost at equal proportions. (Taymaz 2006, 20) Firms also complained about 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". (Taymaz 2006, 22)

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 not terminated had been scaled down. Thus, R&D expenditures have been reduced by 50 percent. (Taymaz 2006, 24)

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 favor 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 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. (Taymaz 2006, 26)

[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.

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". (Taymaz 2006, 29) Also, firms stated that the evaluation and monitoring of TTGV on the project were 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 proposals, R&D budget, R&D plans, and managing R&D projects. Taymaz also furthered his study to measure the impact of R&D support on productivity, competitiveness, employment, and performance dynamics. Taymaz (2006) concluded that TTGV clients are more productive concerning non-clients, particularly in low-tech industries. He suggested that TTGV clients especially on services are 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 researchers after they had been supported. (Üçdoğruk 2005) 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. (Taymaz 2006, 29-34)

4. Conclusion

This paper has descriptively examined the relevance of R&D loans provided by TTGV to generate technological advancement in the Turkish National Innovation System. From this examination, it is found that a major part of the number of accepted projects was owned by SMEs. This argument is following 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 that are easier to take. SMEs reach finance via using TTGV's support mechanism and as stated above one of the most beneficial aspects of this support is its capability to provide stable liquidity for supported projects. This benefit seems lesser for small firms on a microscale and 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 the industry. It can also be suggested that TTGV support mechanism is significantly beneficial for SMEs in fostering their competitiveness and productivity.

Despite those benefits, TTGV's R&D loan program can be criticized for its financial requirements concerning back payment and those requirements can inhibit R&D since the supported firms take the responsibility of exchange rate risk and give a service fee to the program. 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 the economy is too small when taking into consideration the amount that is contracted and funded. Its macroeconomic effect seems very limited in terms of provided amount. R&D loans cannot increase their scale in line with R&D grants and overall R&D expenditures. However, to provide access to finance for innovative SMEs, R&D loans might be considered as an option by policymakers even though the final support in the form of R&D loans had been given a decade ago. This might be perceived as further research by taking into consideration the current needs and bottlenecks of the Turkish Innovation Ecosystem.

To conclude, R&D loans provided by TTGV under the "Technology Development Projects" program seem relevant and beneficial even though their effect is small on economic development. Its capacity might be enlarged by making it more attractive and compatible with the needs of firms, particularly 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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