Toulouse School of Economics

The heterogeneous effects of Matching Grant program on firm's performances : Evidence from the Republic of Yemen.

Poitrasson Damien

The development of SMEs (Small and Medium Enterprises) is a corporate sector that contributes to economic growth and stability. However, for SMEs it is often difficult to find enough capital to grow. Also, investments in R&D may be too risky compared to the expected performance improvements generated by innovation. Under this condition, Matching Grants become one of the most commonly used tools by governments in developing countries. This paper collects evidence from SMEs in the Republic of Yemen as research objects while using firms' total sales as standard measurement for development. We will justify the heterogeneous impacts of matching grants across SMEs' on their performances by using OLS. We find evidence suggesting that the grant will have a bigger additional impact for firms with more labor force and better previous performances.

Introduction

The development of SMEs has a major role in economic growth in the long run. Compared to large companies, small ones have some advantages in terms of innovation thanks to their management structure (Rothwell, 1989). Indeed there are fewer bureaucracies, which usually slows down the innovation process in large corporations (Scherer, 1988). However it is usually more difficult for SMEs to find financial resources in order to grow because of the uncertainty remaining regarding potential returns for lenders. This can be a major issue for small firms because, although companies have a lot of extensive resources, insufficient capital or no treasury will make them less likely to innovate (Newbert, 2008).

Under this complex situation for SMEs, Matching Grants become one of the most commonly used tools by governments in developing countries in order to help them develop. The counterpart for governments dwells in the macro economic stability brought by innovation through pro-competitiveness, job creation, attracting further investments from abroad, etc. The program provides subsidies to small and medium-sized enterprises to help them increase their investment in commercialization programs, such as expanding product lines, expanding on new markets, providing training programs, etc. The Grant consists in giving a subsidy corresponding up to 50% of the cost of the innovation that companies want to undertake, these innovations can either include a new training process, new accounting system or either integrate a new marketing system. The Matching Grant program is a type of development program first introduced by the World Bank in Europe in the early 1960s and before being spread to Asia in the 1990s. Recently, this feature was launched in South Africa in 2012 but also in Yemen at the end of 2013. (World Bank, 2017).

In 2015, The Republic of Yemen was one of the poorest countries in the Middle-East with a GDP of 1608,74 US$ per capita. Indeed, in 2011 the political context and the wave of insecurity led to a drop of 12.7 points of the GDP, before recovering by 2.4 percent in 2012 then 4,8 in 2013, and finally only slightly increasing by 0,3 % between 2013 and 2014 due to several oil production restrictions. Besides, the SMEs are predominant in terms of Yemeni companies. According to the World Bank, 91,9% of the firms in the republic of Yemen have less than 5 employees and 4,7% of firms have between 5 and 10 employees. In this context, Matching Grants, if well-designed, could be one of the first ever policies used in the country that could majorly help small and medium-firms facing economic and budget constraints. As mentioned previously, the program provides a subsidy of up to 50% of the cost of the innovation undertaken with an amount capped at $10,000. However, this circular program had to be stopped because of political events (Civil War in 2015), thus the second round planned in 2015 was canceled.

Based on the Yemen situation, we would like to question whether the implementation of these Matching Grants has promoted the development of SMEs in the short run (one year after the implementation), using the total sales of the firm as the indicator for growth in their performances. The aim of our paper will be to evaluate how efficient will the Matching Grant be on the performances of SMEs in the Republic of Yemen depending on the characteristics of the company such as its location, its size or the level of workers efficiency. We first collect evidence from the existing literature in order to have an overview of the results we can potentially find. Secondly, we selected a database from a randomized trial testing the effect of Matching Grants in the Republic of Yemen by David McKenzie, Ana Paula Cusolito, and Nabila Assaf, and published in the World Bank in 2015.

Literature Review

Until now, the efficiency of public grants on SMEs performances has been widely studied with ambiguous results highlighted. On one hand Wallsten (2000) showed that SBIR (Small Business Innovation Research) does not affect firm growth according to different programs. Additionally, concerning the Matching Grants program done in South Africa, Campos et al.(2012) justified the lack of efficiency of the policy by the imperfect implementation : selection criteria were too selective or there were important delays in the obtention of grants.

On the other hand, we find evidence of a positive impact of grants on firm performances. Bruhn et al. (2012) evaluated the impact of consulting services subsidies on SMEs in Puebla, Mexico, and showed that their monthly sales increased by 80% due to the program. Furthermore, Enio Elias (2014) exhibited significant instantaneous impact on employment and sales as productivity is increasing only a few years after the program was applied in Finland. His IV regression also shows that 1 unit invested in R&D multiplies by 1.4 the full performance of the firm during the year, while the result continuously increases through time.

We can also observe ambiguous heterogeneous effects depending on the location of the firm. Tingvall & Gutvansson (2020) shows that such policy leads to a more or less important growth of the company depending on its area : firms in areas with more skilled-labor force supply will be more likely to hire sufficient human capital to undertake intensive R&D activity. They have shown that even if the impact of public R&D grants is really low, the latter increases for firms located in areas with strong local supply of skilled labor. The size of the company can also be a feature of interest given the subsidy. A medium size firm will be more likely to undertake a larger innovation, as the amount received from the government will be more important leading in turn to a bigger impact on its performances (Banai & Co, 2020). Conversely, Lööf and Heshmati (2004) have shown that the subsidy has a notable

impact on firm performances only for small firms, arguing that these have more benefits and potential growth to take from these R&D private investments, compared to medium firms. In contrast to these arguments, Herrera and Sanchez-Gonzalez (2013) state that public R&D funding increases sales regardless of the firm size, and the effects depend more on strategies and specific market (sector of activity) than on specific firm's size groups.

Finally, a study made by Cincera & Co (2009) evaluates the efficiency of the R&D public support of SMEs across different countries. They argued the fact that most industrialized countries, and the one with best performance in terms of innovative activities, will experience a stronger effect of the policy whereas the efficiency of the policy on developing countries is less obvious. They made 3 groups of efficiency, including North America countries in the first one while most of the E.U are in the second one. On the contrary, U.S programs are generally less optimistic regarding the impact of R&D subsidies on SME's performances than European programs according to Hall and Van Reenen (2000).

Methodology

Description of the Data

Overall Presentation

The data we used to investigate our research question is a sample survey data composed of a follow-up survey with firms that participated in the public program of Matching Grant. The aim of the program is to encourage SMEs facing financial constraints to undertake innovation and thus grow. The program provided firms with matching grants of up to $10,000 as a half sponsorship towards the expense of business administrations like money and bookkeeping frameworks, site creation, preparing, showcasing, support in displays, and some related products like office and IT gear. Because of the political context in Yemen in 2015, our

performance analysis will only be focused on 2014 performances compared to the baseline in 2012s. As the firm's performances are really heterogeneous, we used logarithm in order to fit our values. To do so, we add +1 to all the sales to keep only positive values. We considered that this would not bias our results as we increased all the performances at the same time.

Randomization

The experiment has been randomized across 400 firms and was supposed to be renewed every year during 2 annual rounds, one at the end of 2013 and the other was supposed to take place at the end of 2014. The only variable used in stratification was the city, with separate drawings happening in the two cities. Because of an insecurity wave due to political context in Yemen, the second has been canceled and we will thus only use the first annual round follow-up survey. Researchers launched a follow-up survey in March 2015, approximately 4 to 10 months after firms had used their matching grants, and right before widespread civil conflict broke out. Among the 400 firms selected, we obtained a 54.3% response rate. We finally obtained a total of 226 companies : 98 in the control group and 128 in the treatment group for our analysis.

Eligibility

To be qualified for the business development matching grant, firms had to be located either in Aden or Sana'a (two main cities of Yemen); should be in business during the last 6 months; should not be in a precluded action (weapons, manufacture), and should have submitted a complete application structure filling the application form survey used as the baseline of the experiment. The application form consists of some basic information such as the number of employees, the location, the sector of activity of the company, utilization of advisors, financing from banks and the award program, and on the organizations' fares and deals. The follow-up survey gives more precise information, including actual sales used as

our variable of interest to evaluate company performances, but also the innovations undertaken.

Model And Analysis

Proof of Randomization

The assumption we need to analyse our sample relies on the fact that the companies' outcomes at the baseline survey and the follow-up survey are independent of the treatment status of the firm. This shows that the treatment is random. The authors of the previous paper, based on the additional impact of the matching grant, mentioned that this experiment was a randomized control trial. However, because of missing values for our variable of interest (only 118 observations) it is possible that the control and treatment group are unbalanced. We then want to control for the balance of the characteristics of the treated and controlled firms. To do so, we ran a balance test for each of the firm's characteristics within the control and treatment group.

[Table 1: Balancing Test of the Treated and Controlled companies]

Table 3 shows the balance of the mean of firm characteristics depending if they are treated or used as control. We can first see that there is a slight difference from previous performances in 2012, explained by the high heterogeneity in the previous sales. However it is still balanced with a p-value of 0.7. For the other features of companies, it also seems that they are relatively balanced. We can then assume that dropping observations for our analysis doesn't change the random assignment and we can still use an OLS specification to estimate the impact of the policy on firm performances.

Empirical Strategy and Interpretation

According to the existing literature, several papers attested that there is an additional impact of matching grants on SMEs performances depending on the different characteristics of the company. In our analysis, we will focus on the size of the company, the number of total workers, its location and previous sales of the company. We will also look at the heterogeneous effects into subgroups. In the case of our experiment we saw that there were many missing sales values in the follow-up survey. Indeed, some of the firms that were assigned the treatment did not mention their sales. Only 118 companies mentioned it, with 52 firms in the control group and 66 in the treatment group.

Intention to Treat (ITT)

We initially focused on the heterogeneous effects of assigning the treatment on firm performances, thus computing the Intention To Treat effect. To do so, we use a simple OLS regression as we are in a RCT situation. Firstly, we regressed our dependent variable, the logarithm of value of total sales of 2014, on the assignment of treatment, our stratification control, the area, and an intercept.

Regression 1

$$Y_i = \alpha_0 + \alpha_1 * AssignedTreat_i + \alpha_2 * X_i + \epsilon_i$$

With Yi the log of the sales of 2014, α_0 a constant, X_i a vector composed of stratification control (city) and the previous sales of 2012 in thousands, and an error term. We then ran two other regressions, adding control variables in the second one and control variables plus interaction variables in the third one. The control variables are: the size of the company, the number of total workers, past sales (2012). We also added interaction variables between location and assignment, size and assignment and finally previous sales and assignment. We did not use the field of company as the differences in performances between sectors were already captured by the performances at the baseline. Moreover, as the description of the field's companies are not given, it will be meaningless to use them as interpretation.

Regression 2 :

$$Y_i = \alpha_0 + \alpha_1 * AssignedTreat_i + \alpha_2 * X_i + \epsilon_i$$

With Yi the log of the sales of 2014, α_0 a constant, X_i a vector of control variables : location, number of workers, the previous sales of 2012 (in thousands) and an error term.

Regression 3 :

$$Y_i = \alpha_0 + \alpha_1 * AssignedTreat_i + \alpha_2 * X_i + \alpha_3 * Aden_{i*}AssignTreat_i + \alpha_4 * totalworkers_i * AssignTreat_i + \alpha_5 sales2012_i * AssignTreat_i + \epsilon_i$$

With Yi the log of the sales of 2014, α_0 a constant, X_i a vector of control variables : location, number of workers, the previous sales of 2012 in thousands, interaction terms between assigning the treatment with the number of workers and the previous sales of the company, and an error term.

[Table 2: Results of Regression]

Secondly, we regressed our outcome variables on the same control and interaction variables. However, we now focus on the heterogeneous impact of the grant across subgroups. We first of all choose the companies located either in Sanaa or in Aden as subgroups. Thus, we deleted Aden as a control variable and the interaction between the city and assigning the treatment. This leads to the following fourth regression :

Regression 4 :

$$Y_i = \alpha_0 + \alpha_1 * AssignedTreat_i + \alpha_2 * X_i + \alpha_3 * totalworkers_i * AssignTreat_i + \alpha_4 * sales2012_i * AssignTreat_i + \epsilon_i$$

Regression 5 :

$$Y_i = \alpha_0 + \alpha_1 * AssignedTreat_i + \alpha_2 * X_i + \alpha_3 * Aden_{i*}AssignTreat_i + \alpha_4 * totalworkers_i * AssignTreat_i + \alpha_5 sales2012_i * AssignTreat_i + \epsilon_i$$

With Yi the log of the sales of 2014, α_0 a constant, X_i a vector of the following control variables: location, number of workers, the previous sales of 2012 in thousands (we omitted location for regression 4), interaction terms between assigning the treatment with the number

of workers and the previous sales of the company, and an error term. For this regression, we used the same process as for the third one, but we splitted firms between the one that innovated in the past 3 years and the one that did not. The past innovations taken into account for this regression are training for workers, product line improvements, expenditure of business operations or expenditure on new markets. If a firm did one or several of these previous innovations, the latter is considered as a firm that innovated in the past. We then get the following and the same regression as the third one.

[Table 3: Results of subgroups Regressions]

Interpretation & Results

[Table 2] First of all, it is important to mention that across the firms that participated we only have the value of sales of 118 firms between treatment and control group, almost equally distributed. In the first two regressions, it seems that we don't have a significant impact of assigning the treatment, the location of the city, either Sanaa or Aden and also the interaction effect of assigning the treatment in one city or another. We find more explicit results in the third regression. Indeed, there seems to be no significant impact of the number of total workers in the firms, thus the size of the firm, on firm's performances. However, the estimate of the interaction term between the size of the company and the assignment to treatment seems to be significant at a level 10%. Finally, between two firms that have the same level of workers and assigned for treatment, a firm that will hire an extra worker will have an additional positive impact of 3,44% on its performances, ceteris paribus.

[Table 3] Formerly, we had a look at the impact of the subsidy across cities. We omit the city stratification and the interaction term between assigning treatment and the location. We obtain several significant estimates. In Aden, we obtain an estimate of 0,0296 with a robust standard error of 0,0102 at level 1%, suggesting that a company that is assigned for treatment

which has one more worker in its workforce will see its sales increase by almost 3% compared to another firm also located in Sanaa and did apply for treatment, ceteris paribus. While it seems to have no significant effect for companies located in Sanaa. Secondly, we obtain a significant estimate of the interaction between the previous sales and the assignment to treatment at a 5% level. The estimate of this variable is 0,0363 with a robust standard error of 0,0144, meaning that a company that has the intention to get treated and has 1000 more annual sales than another company also located in Sanaa, will have an additional positive impact of the treatment of 3,6% on the actual sales, ceteris paribus. Finally, we find no evidence of an additional impact of the intention to treat between firms that innovated in the past and those who didn't.

Limitation and improvement

We faced several issues during our research project that could potentially bias our result or limit our analysis of the economical question. First of all, the application form used at the baseline of the experiment is not available on the World Bank Survey, which limited our interpretations. Indeed, the fields of the companies are splitted into 14 different sectors, however, there is no description of the different fields, leading the interpretation to be meaningless. Thus we didn't use the fields as a control for the performances of the company. Also, to control for heterogeneity of firms, we focused on the one of the year 2012 for previous value of sales, since the sales of 2013 were missing. This can be problematic as we are not taking into account the potential differences in firm's performances that occured in 2013. This kind of "Matching Grant " program is usually implemented over several years after the first subsidies. Because of the political context, no more take-up surveys have been made after 2014. Because of this lack of data, we were constrained to focus only on the short-term effect of the program in 2014. Finally, many firms that applied for the Matching

Grant Program dropped it before actually receiving the grant. Among 416 companies that were assigned for treatment only 216 received the subsidy. Moreover, among the firms that assigned and received the subsidy, some didn't correctly fill the take-up survey and many of the performance values are missing. We finally ended up with only 118 observations for our analysis. This problem of attrition and missing datas can lead to a lack of robustness of our datas and thus explain why some of our results differ from the existing literature.

Conclusion

We can conclude that in the Republic of Yemen, the Matching Grants provided by the government seem to have no significant impact on firms' performances in the short run. These results are close to Wallsten's (2000) work, which stated that SBIR subsidy seems to not have any significant impact on firm growth. We are aware that our lack of observations can be the reason for our divergent results from the literature. Also, we found additional results regarding the heterogeneity of impact across firms treated. Indeed, we find evidence that in Aden, having more workforce will make the impact of the subsidy more important. This result can be explained in two different ways. One leading to the results of Banai & Co (2020) who attested that the bigger the firm is, the larger will the innovation undertaken be. However, we also found an additional effect of having a large workforce and assigning the treatment in Aden and not in Sanaa. We can either assume that it is because the labor force is better skilled there and then workers would be more intent to use the innovation properly and in turn boost performances (Tingvall & Gutvansson, 2020). We also find evidence that a company with higher performances in the past applying for treatment will have a larger additional impact of the subsidy compared to one with smaller performances in the past (2012). Finally, we found no evidence that a firm will have a higher additional impact of assigning the treatment depending if it has innovated in the past or not.

Bibliography

- Banai & Co (2020) Waste of money or opportunity growth : The causal effect of EU subsidies on Hungarian SMEs. *Economic Systems*, Elsevier, vol. 44.
- Bruhn, Miriam, Dean Karlan, and Antoinette Schoar (2012) "The impact of consulting services on small and medium enterprises: Evidence from a randomized trial in Mexico" *Journal of Political Economy*, 2018, vol. 126, issue 2, pp. 635 - 687.
- Campos & al. (2012): "Learning from the experiments that never happened: Lessons from trying to conduct randomized evaluations of matching grant programs in Africa." *Policy Research Working Paper Series 6296*, The World Bank.
- Cincera & Co (2009) : Efficiency of public spending in support of R&D activities. *European Economy, Economic Papers*, vol 376, pp. 113.
- Elias Einio (2014) : "R&D subsidies and company performance: evidence from geographical variation in government funding based on the ERDF population-density rule". *The review of Economics and Statistics*, MIT Press, vol.96, pp. 710-728.
- Herrera and Sanchez-Gonzalez (2013) : Firm size and Innovation policies. *International Small Business Journal*, Vol. 31.
- Lööf and Heshmati (2004) : The impact of public funding on private R&D investment : New Evidence from a firm level innovation study. *Working Paper Series in Economics and Institutions of Innovation,* No 6.
- Mansfield, E., 1995, "Academic Research Underlying Industrial Innovations: Sources, Characteristics, and Financing", *The Review of Economics and Statistics* Vol. 77, No. 1, pp. 55-65.
- D. McKenzie & Co (2015), "The additionality impact of a Matching Grant Program for Small Firms : Experimental Evidence from Yemen", *Policy Research Working Pape*r, No. 7462. World Bank.

- X. Li, R.K. Michell (2008) : "The pace and stability of small enterprise innovation in highly dynamic economies: A China-based template", *Journal of Small Business Management*, pp.370-397.
- S.L Newbert (2008) : "Value, rareness, competitive advantage, and performance: A conceptual-level empirical investigation of the resource-based view of the firm", *Strategic management*, Volume 29, Issue7, pp. 745-768.
- Phyra Sok, Aron O'Cass (2011) : "Achieving superior innovation-based performance outcomes in SMEs through innovation resource–capability complementarity, *Industrial Marketing Management Volume 40*, Issue 8, pp. 1285-1293.
- Tingvall & Gutvansson (2020) : Regional differences in effects of publicly sponsored R&D grants on SMEs performances. *Small Business Economics* 54, pp. 951-969.
- B. Von Stamm (2003): "Managing Innovation, Creativity and Design."
- Scott J. Wallsten (2000): "The effects of Government-Industry R&D Programs on Private R&D : The Case of the Small Business Innovation Research Program.", *The RAND Journal of Economics*, Vol.31, No.1, pp. 82-100.
- Y. Wang, J.Jeffrey, L.Furman (2017): " Firm performance and state innovation funding: Evidence from China Innofund Program", *Research Policy*, vol. 46, issue 6, pp. 1142-1161.
- World Bank (2017) : "Matching Grant Impact Evaluation" Yemen.
- F. Zona (2012): Corporate investing as a response to the economic downturn: Prospect theory, the behavioral agency model and the role of financial slack.", *British Journal of Management*, Vol 23, S42-S57.

Table & Figure

Table 1 : Balancing test

	Control	Treatment	p-value
sales2012	6158.982	4240.347	0.709
totalworkers	13.808	15.924	0.741
ISObase	0.000	0.015	0.377
Aden	0.558	0.515	0.649
improvedproductlinelast3	0.096	0.182	0.191
expandedmarketlast3	0.115	0.106	0.874
trainedworkers	0.173	0.288	0.148
expandedlast3	0.192	0.258	0.406
N	52	66	

Table 2: Regression (1)

	(1) only stratification	(2) all controls	(3) all controls and interaction
AssignTreat	0.0825	0.0607	-1.226
	(0.799)	(0.781)	(1.535)
Aden	1.438	1.225	0.491
	(0.834)	(0.786)	(1.191)
totalworkers		0.00960	0.000375
		(0.00891)	(0.00283)
sales2012(in 1000's)		0.0240***	0.0195***
		(0.00693)	(0.00535)
female		-2.871	-2.911
		(1.635)	(1.639)
AdenAssign			1.233
			(1.676)
totalworkersAssign			0.0344*
			(0.0134)
sales2012Assign(in 1000's)			0.0199
			(0.0131)
_cons	14.38***	14.60***	15.17***
	(0.808)	(0.798)	(1.030)
r2	0.0265	0.110	0.133
N	118	118	118

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Standard errors are robust here in order to take into account the heteroskedasticity of the standard errors. Individual controls included: gender of the respondant, location, size of the company, performances at the baseline. We lose observations when adding the logarithm of the sales's value because information on the initial attainment could not be collected in some of the companies.

Table 3 : Subgroups Regression :

	(1) Sanaa	(2) Aden	(3) No past Innovation	(4) Past innovation
AssignTreat	-1.488	0.0493	-4.115	2.374
	(2.106)	(0.998)	(2.541)	(2.953)
totalworkers	0.0532	-0.000944	-0.00235	0.0276
	(0.0282)	(0.00187)	(0.00168)	(0.0344)
totalworkersAssign	0.0294	0.0296**	0.0813	0.0108
	(0.0762)	(0.0102)	(0.0579)	(0.0379)
sales2012(in 1000's)	0.00320	0.0717	0.0146***	0.332
	(0.00764)	(0.0976)	(0.00370)	(0.169)
sales2012Assign(in 1000's)	0.0363*	0.0976	0.0295	-0.258
	(0.0144)	(0.113)	(0.0151)	(0.176)
female	-3.462	-1.577*	-4.717	0.401
	(2.359)	(0.726)	(2.515)	(1.120)
Aden			0.131	2.119
			(0.972)	(2.916)
AdenAssign			3.520	-2.014
			(2.406)	(3.320)
_cons	14.94***	15.57***	16.13***	12.31***
	(1.207)	(0.717)	(0.913)	(2.762)
r2	0.147	0.0772	0.362	0.108
N	55	63	60	58

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Standard errors are robust here in order to take into account the heteroskedasticity of the standard errors. Individual controls included: gender of the respondent, location, size of the company, performances at the baseline. We lose observations when adding the logarithm of

the sales's value because information on the initial attainment could not be collected in some of the companies.