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The impact on growth from public seed financing to new technology projects in small enterprises

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Foreword

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Håkan Gadd
Head of Unit

Innehåll

Abstract

In Sweden, Nutek (the national board for technical and business development at that time) being one of the main actors, supplied conditional loans between 1994 and 2004 to new technical project mainly pursued in small business. In this study we analyze the development of the firms supported 1994 to 1997. We compare the population of supported firms with a population of firms not funded by Nutek but with the same age, size and business sector affiliation.

This study differs from other studies in having longitudinal annual report data for both populations of supported and not supported enterprises between 1990 and 2003. The main result from the analysis of survivors is that the support to new technical project has had no effect when considering all supported firms. Also in sub-populations as only independent firms and independent firms within the manufacturing sector, no positive additionality emerged.

For new and independent firms, established between the years 1994–1997 there are increases in sales, increases in employment, increases in productivity and increases in solidity were all larger for the supported firms than the comparison group of non-supported firms. There is thus evidence that public support for technical projects may have societal positive effects but only for a limited population of firms, the newly started and independent ones.

Introduction

One common policy tool stimulating innovation is the supply of public seed financing support to new technology projects. In for example the USA the SBIR program is targeted to this (Wessner 2000, Lerner 1999, Wallsten 2000) In Sweden authorities like National Board for Technology Development (STU) in the 1970ties and 1980ties and its later incarnation The National Board for Economic and Technologic Development (Nutek) has supplied a similar type of support. The reason for this is the alleged importance of new technology in economic growth and that new technology seems to be more likely to be introduced in new enterprises mainly because these are not affected by sunk costs from earlier technology investments (Oakey 199?). The "valley of death" debate (Wessner ibid) has underlined the need for seed financing support to especially new technical small firms which is the character of the programs mentioned above. This paper is written with the background that in Sweden no comprehensive quantitative evaluation of such programs has taken place. Process evaluations and surveys on participators have been made but no scrutinization of the alleged growth contributions of the seed financing programs has actually been performed. This paper is a start of such an endeavor by making an analyze using only administrative data on annual report. The papers outline is as follows: first we briefly present the Nutek seed financing program. Secondly we define main variables of interests and discuss the dilemma of evaluation and how we in this study try to coop with that. In the third section we present the results and make some conclusions about the limitations of the results and paths for further research.

The Nutek program for seed financing of new technical projects

The National Board for Economic and Technologic Development (Nutek) in Sweden and its predecessor National Board for Technology Development (STU) has since the end of 1960ties supplied conditional loans for product development projects.

The general aim with this support was to finance development of products and processes based on the application of new technology with large commercial growth potentials.

It is to be noted that the support is supplied not to firms but to projects or ideas which can equally be hosted in an already established enterprise as in a newly started one. The support has mainly been in the kind of conditional loans but also grants has been supplied but in a lesser degree and amount (Table 1). A conditional loan in the Nutek form is a loan which must be paid back if the project generates a commercial application which in turn generates sales. In order to receive support the enterprise must finance at least haft of the estimated project budget. The loan might be distributed in sequences in order to insure that the project progress according to plan. The amortization payment of the loan starts if the project generates incomes. The payment of interest can be capitalized and postponed up to five years. According to the Swedish venture capital Association these kinds of loans among venture capitalist are considered more like equity increase than debts. However it must be noted that in contrast to equity which earn its rate of return conditional on performance i.e. profits generated the conditional loans of Nutek must be reimbursed on positive sales although break even is not reached. In this respect the conditional loans put a harder pressure on the company to enforce the commercialization process.

There is a backdoor for enterprises not having enough means to amortize if according to plan and that is to change the loan to a royalty agreement.

Table 1 Nutek Seed financing program 1994–2003

	94–96	1997	1998	1999	2000	2001	2002	2003	Total
Applications	197	216	152	187	185	180	104	81	1302
Approvals	92	142	91	118	114	95	50	46	748
"Denials"	105	74	61	69	71	85	54	35	554
Acc loan number 95–03	92	234	325	443	557	402	452	498	498
Amount of conditional loan SEK million	48.9	45.9	58.3	85.2	51.9	73	13.5	19.8	396.5
Grants, SEK million	3.4	4.6	2.5	5.1	13.7	3.6	9.3	3.5	45.7
Total	52.3	50.5	60.8	90.3	65.6	76.6	22.8	23.3	442.2

Source NUTEK Annual reports

Table 1 depicts number of loans distributed in the period of 1994 to 2003. In total 498 conditional loans amounting to almost SEK 400 million (approx $50 million) was supplied to technical projects. In table 2 the distribution on supplied seed money exhibits that on average this amounted to SEK 340 000 ($50 000).

Table 2 Distribution of support as conditional loans, current values

Min percentiles, max mean & std	Total per project
Minimum	8000
10 %	50 000
25 % (1:a quartile)	131 031
50 % (median)	340 000
75 % (3:e quartile)	821 650
Maximum	15 000 000
Mean	689 417
Standard deviation	1 090 273
Total number of cases	749

Source ITPS

In this paper we will focus on conditional loans supplied between the years 1994–1997. The reason for this is to have a reasonable time for success to emerge. In public programs notorious references are frequent about success in a distant future. A relevant question posed is: What is the distribution for projects with both new technology relevance and high commercialization potential? In this paper we are inspired by two sources to set a success time frame. The first is the experience of venture capital investments which on average has a time frame between three to seven years. However considering that these projects are in the very early phase where venture capitalists in lesser degree do investments we also consider the results from an earlier evaluation of the repayment of conditional loans. Reitberger (1982) analyzing such repayment in form supplied conditional loans in the 1970 concludes that if a project has not generated income after five years it must be considered a failure. Another interesting factual from Reitberger (1982) as the estimation of success ratio as the proportion project actually realized a reimbursement of loan. For small enterprises this proportion was 5 percent or one company out of twenty.

The general problem to analyze effect of project success is economic data on project level. In Sweden there is no such database, so one has to retort to assumptions regarding the influence the project have on the total of enterprise performance.

For small firms it might be a reasonable assumption and especially for new, small firms the assumption that the project dominates the enterprises economy and performance seems realistic.

Variables of interest, data and method of analysis

Commercial success is undoubtedly to generate profits. However in order to generate profits you have to generate sales. Thus a relevant success criterion must be data on sales. Considering that we actually study project in a early stage sales might not be the first "success". The project success actually lies in pushing the concept to commercialize forward in order to make more reliable for private equity investment. A success indicator in the short perspective might be the change in the solidity measured as the ratio of equity to total capital. Besides these economic measures we also focus on employment and productivity, two concepts referred to indicate societal utility besides private enterprise utility.

In previous research which utilizes sample survey methods it is common to try to collect data on other variables than just economic ones. Table 3 lists some of these. However these studies put forward other questions than we are interested in here. Mainly the investigates if there are certain structural factors which correlates with enterprise success. Storey (1994) concludes that these factors might be appealing but seldom explains much of the observed variance in enterprise economic performance.

Table 3 Other common factors used to explain success

Factors	Referens
Motivation, eagerness to pursue an idea	Utterback & Reitberger (1982)
Education	Storey (1994)
More than one founder, a proxy for the possible representation of larger	Storey (1994)
network and broader skills in top management	Utterback&Reitberger (1982)
Middleage entrepreneur (35–55)	Storey (1994)
Newly established enterprise	Storey (1994)
New products	Storey (1994)
Experience from earlier employment in MNC (spin-off)	Lindholm Dahlstrand (2004)
Family business background	Storey (1994)
Manangement willing to let in external capital	Storey (1994)
Limited corporation	Storey (1994)
The ability to explain (sell) the product versatility	Utterback & Reiberger (1995)

In this study we will focus only on economic performance and have collected annual report data in order to have well defined and well measured variables. These variables have been checked by professional accountants and tax authorities and are probably the best kind of measures available today. The population of enterprises is incorporated companies. The Nutek supported enterprises industrial code classification and age of establishment has been governing the construction of the relevant control group. Thus all enterprises with the same age and industry classification at the most detailed level are included in the database. For both groups supported (treatment group) and not supported (non-treated) we have annual report data from 1990 to 2003 in the case the enterprise has existed for the full period. In this paper we only utilize part of the material.

Hypotheses in this investigation

The main issue for this study was to whether NTSBF, defined as participators in the Nutek seed financing program in a seven years perspective exhibits increased growth in four traditional measures as: sales, productivity, employment and solidity. The general hypothesis is that the "treated firms" are expected to exhibit higher growth than the comparison group.

In estimating these measures it must be underlined the importance to consider extreme values. In ordinary measurement of central tendencies the recommendation is to down weight the effect of outliers and extreme values especially if the distributions measured are not symmetric. However albeit that the general case is skewed distributions in almost all economic phenomena dealing with effects of innovative behaviour one has to change focus and explicit observe and include the extreme values into the analysis. Considering that successful innovations are an infrequent event the advantage of population analyses that is considering the full total population of firms is if not a necessity a distinct advantage.

Thus the estimated growth in the selected economic measures is the population averages.

In brief this analysis differs from others in the same area in the following respects:

- Only administrative data or register data
- Whole population both for the treated group of firms and non-treated included in analyses. No sampling errors and full coverage.

We also have information if firms also been treated in two other similar public financial support schemes

The evaluation dilemma

The evaluation dilemma consists of not having information about the same unit of analysis in two different statuses at the same time. An enterprise can not be supported with public means at the same time as not having been supported. Thus a before-after analysis might be a relevant approach on the individual level if one can make reliable that the surrounding and co-founding factors will be the same before and after or that these can be controlled for. In dynamic processes like technical development a before-after analysis can meet the objections of not being realistic.

The statistical solution to the evaluation dilemma resides in moving from the individual to the level of population (Holland 1986). This consists of the estimation of a characteristic in a population receiving support and then comparing this estimate with an the same characteristic estimated in a relevant group of controls not having support. However, solving one problem turns often into another. Now the problem lies in how to create the relevant control group and convince others about this relevance.

The main problem analyzing program effects is thus the problem of creating a relevant counterfactual. In part we solve this by instead of using a random sample strategy have population data in this respect we do not exclude relevant observations. However the problem of possible self selection bias influencing the estimates of additionality must be addressed. According to Heckman et al (1997) there are four sources of biases in estimation of program effects. First, bias can stem from the use of different definitions in the objectives of interest between treated firm and non-treated firms. Second, bias can emanate from differences in economic environment between the two groups of firms. Third, bias might occur due to different distribution in confounding variables, differences in observables. Finally and fourth, bias can be generated as self-selection bias which is differences

in distribution of un-observable characteristics (for an outside observer) in the two groups of firms. Building upon annual report data regulated by both international standards and legislation and having population coverage on these we find it reasonably to assume that that the first and second sources of bias are reduced to a minimum. Our general strategy in order to minimize bias from the other two sources of bias is to focus on changes in the objective variables. The so called difference in difference estimator (DiD) has been considered as one of the most robust estimators in the literature on matching estimators (Todd & Smith (2001), Meuser, P., R., Troske, K., R., & Gorislavksy, A. (2004)). This estimator compares differences between supported firms and the identified comparison group. Bias generated by static properties in supported firms not present in non-supported firms is differenced away and will thus not influence our estimates of growth. In this paper however we will only report estimates of simple differences in a future more elaborated paper we will also make conditional DID-estimation for matched observations.

Results

In Table 4 for we start the analyses with investigating if there are differences in the survival rate of the enterprises. We only report results for independent enterprises. In our data we also have information if the enterprise has been acquired by another enterprise in the time period of interest; however the incidence of such mergers or acquisitions is very rare and not included in this analysis. We see that there are indication of higher survival rate at the year 1997 for the firms which received support between 1994 and 1997 in comparison to the comparison group of non-supported firms. For the sub-group of only new firms which are defined as being established between the year 1994 and 1997, the survival ratio for 2003 for supported firms are much lower than for the comparison group. This might indicate a problem with relevance of the comparison group in the respect that these in to large extent are dominated by firms without pursuing risky technical projects.

Although these are population means in order to make conclusions one has to relate these two groups to some kind of super population. One reasonable suggestion to such a super population is future enterprises entering the market in these industries. We thus might consider our data as sample from the population of both present and future enterprises. In this case the conventional statistical test becomes relevant. The t-tests for differences in survival rates are not statistically significant neither 1997 nor 2003.

Table 4 Survivors 1997 and 2003, proportions

	All independent enterprises		**Independent and new enterprises**	
	mean	std	mean	std
1997				
Non treated	0.791	0.002	0.774	0.004
Treated	0.813	0.027	0.754	0.054
p>t H(0)diff~=0	0.422		0.703	
2003				
Non treated	0.570	0.003	0.526	0.005
Treated	0.547	0.038	0.429	0.071
p>t H(0)diff~=0	0.555		0.174	

Source: ITPS

Turning to the main results in this paper still focusing on independent enterprises table 5 presents difference-in-difference estimates for the time period of 1997 up to 2003. The principal result is that considering all enterprises and only enterprises in manufacturing sector actually the comparison perform better than the Nutek supported firms. However for new established firms (bottom panel) there are positive "effects" while evaluating the differences. However comparing the levels of 2003 for the measured variables we find that the comparison group lies ahead. This might also be an indication of that the sub comparison group is as stated above dominated by firms not pursuing risky technical projects with innovative implications.

Table 5 Results Population means Did estimation (values in SEK $1=SEK7)

All independent enterprises	**Nutek firm**	**Comparison group**	**DID-estimate**
Differences			
Sales	2 465 613	3 446 162	-980 549
Employees	2	1	1
Productivity	192 823	152 444	40 379
Solidity	14	10	3
Levels 2003			
Sales	6 059 379	7 719 665	-1 660 286
Number of employees	6	5	1
Productivity	521 613	551 129	-29 516
Solidity	38	50	-12
N	100	21 700	
Independent manufacturing firms			
Differences			
Sales	3 485 791	7 104 164	-3 618 373
Employees	3	3	0
Productivity	62 403	90 488	-28 085
Solidity	3	10	-7
Levels 2003			
Sales	5 644 464	12 300 000	-6 655 536
Number of employees	6	9	0
Productivity	394 892	470 397	-3
Solidity	29	47	-75 505
N	23	3000	
Independent older firms (more than 3 years of age)			
Differences			
Sales	983 248	2 997 920	-2 014 672
Employees	1	1	0
Productivity	169 528	152 357	17 171
Solidity	11	11	0
Levels 2003			
Sales	5 713 040	7 468 802	-1 755 762
Number of employees	6	5	1
Productivity	547 642	542 320	5 322
Solidity	36	50	-14
N	75	16 700	
New firms (up to three years of age)			
Differences			
Sales	6 912 708	5 045 938	1 866 770
Employees	6	2	4
Productivity	259 214	152 773	106 441
Solidity	23	10	13
Levels 2003			
Sales	7 554 547	8 537 776	-983 229
Number of employees	7	5	2
Productivity	447 431	580 073	-132 642
Solidity	43	49	-6
N	25	5 000	

Now an indication of risk might be that only few enterprises succeed and most of them fail albeit generate some income. In the distributions of Sales this could be indicated by highly skewed distribution in the non-treated group with high kurtosis. In table 6 we present the full statistical distribution for the levels of Sales 1997 and 2003. These indicate that the comparison group characterized by larger skewness and kurtosis.

Table 6 Character of the Distribution of sales estimates (values in SEK)

All independent	**non-treated**		**treated**	
	1997	2003	1997	2003
min	0	1000	0	6000
1 %	0	5000	0	6000
5 %	49960	36000	37171	28000
10 %	159138	101000	245631	80000
25 %	512721	418000	758000	562000
50 %	1229611	1257000	2311422	2187000
75 %	3466263	4197000	7040000	8091000
90 %	9726324	13400000	15300000	17900000
95 %	18700000	26700000	24000000	25800000
99 %	59700000	92700000	44400000	34300000
max	9.61E+08	1.86E+09	4.44E+07	3.43E+07
n	17100		75	
mean	5161754	7586492	5544631	5713040
std	2.38E+07	4.30E+07	8411816	7961854
skewness	22.78	24.23	2.74	1.97
kurtosis	719.58	783.12	11.35	6.43

New and independent	**non-treated**		**treated**	
	1997	2003	1997	2003
min	0	1000	19000	2000
1%	0	4000	19000	2000
5 %	41250	28000	33471	8000
10 %	129653	91000	159341	11000
25 %	427026	411000	226785	432000
50 %	1025628	1290000	845000	1735000
75 %	2584603	4645000	2802960	5660000
90 %	7515906	14800000	4359929	18500000
95 %	14500000	31900000	4874460	28000000
99 %	61300000	108000000	5072000	81900000
max	3.89E+08	1.89E+09	5.07E+06	8.19E+07
n	5285		25	
mean	4124465	8621975	1627211	7554547
std	1.58E+07	4.68E+07	1.68E+06	1.69E+07
skewness	13.35	22.67	0.83	3.68
kurtosis	242.68	705.52	2.36	16.46

Note $1=SEK7

Source: ITPS

One speculative conclusion is that administrative selection process at Nutek might not have been that adventurous as daring to select the project prone to be most innovative and contiguous, this might be a support for the argument put forward by Wallsten (1997).

Conclusions

The preceding analysis strength lies primarily in the availability of population data. The main weaknesses are two. The alleged control group might not consist of enterprises pursuing technical projects similar to the group of supported firms. Only more expensive surveys will have an opportunity to handle this problem succinctly. A possible way to go is to merge paten data records on our data. Thus patents as an indicator of on-going project would probably single out a more relevant control group. The second problem lies in the small number in the treatment group. Although the treatment group it the grand total of firms supported in the time period the must be considered as a sample of a super population of future supported firms. Such a small sample considered here can only be looked upon as a first indicator on problems in the analysis however this sample grows for each year and in another year or so we will have at least twice the number permitting to more elaborated analysis and perhaps conclusions.

Making conclusions on such indicators might be premature, however the indicators seems to align to other empirical results showing that new ideas in new firms is a more sensible approach for a innovation policy than spreading out public means to all “new” project. Established firms do have a record of performance and should attract the necessary means by this merit without the need for public finance. A final comment deserves the time for evaluation. To evaluate a program at a certain time like 2003 as in this paper is most certainly not adequate as the sole judgment of the program. Contingencies typical for economic development might play a role. A program should at least be evaluated for different time frames. For example one could consider 3-years moving averages in order to sort contingencies out.

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