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Public Aids Evaluation: Empirical Evidence for Spanish Industrial Companies

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The implementation of different forms of public aids for industrial companies is standard practice in all countries to promote economic development and job creation. This study presents a comparative analysis of the effectiveness of different instruments for public aid to industrial companies. Using a wide sample of Spanish companies that have received four types of public aid, it has been possible to verify the effect of each of the public aid on the evolution of the companies´ efficiency. The results obtained suggest that the participative loan is the instrument that improves the efficiency of companies significantly.

Keywords: Economic development, Efficiency, Guarantee Loans, Participative Loans

Introduction

Economic and financial aid to companies has traditionally been part of the industrial policies promoted by the governments of all countries.[1] To contribute to economic development and job creation, subsidies, guarantees, equity participation or loans with special payment conditions have been used to help companies improve their financial performance. The previous literature on the evaluation of these public policies has addressed different issues, frequently associated with the activities of the company. For example, the impact of public aid in the area of Research and Development (R&D) has been extensively studied.[2] On the other hand, the previous literature has also addressed the effects of public aid about productivity and business efficiency.[3–5] Finally, other studies have focused on the different instruments of public aid to companies. In this case, those related to the role of loan and guarantee funds[6,7], loss funds[8,9], participative loans[10,11], and public loans[12,13] stand out.

Although the literature on public aid to companies is extensive, the conclusions of the existing studies vary according to the aid instrument, the period time, the geographical area, and the stage of the life cycle of the beneficiary company. Consequently, there are no conclusive results on the economic and social effect generated by the company that benefits from public funds. Nor is it about the effectiveness of the different forms of public aid used by governments.[4,5,14] For this reason, the objective of this study is to provide empirical evidence on the effectiveness of public aid instruments for companies. To this end, a comparative analysis of four common instruments used by governments for public aid (Guarantee loans, Public loans, Participative loans, and Loss funds) has been designed, and measures of the effects on the efficiency of companies have been obtained who have received it.

Materials and Methods

To measure efficiency, we use data envelopment analysis (DEA), which is a methodology designed to evaluate the efficiency of a company concerning for to the best companies in a reference group.[15] In this context, efficiency is the ability to produce the maximum possible output given a mix of inputs. Under the hypothesis of the existence of an optimal production function, an efficient frontier of production possibilities can be constructed for all input mixes. DEA is based on the idea that if a production unit can achieve a certain level of output from a level of inputs, all other units are in a position to do the same or take measures that allow them to improve their efficiency. In this way, the most efficient firms are closer to the border, and the efficiency score is a distance measure of the efficiency of a company concerning for to the border.

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In addition, taking into accountthe theoretical advances on DEA that have allowed explicit incorporation of the continuous temporal structure in the efficiency measurements, the present study uses the dynamic DEA measurement (DSBM), according to the model expressed in Eq. (1).[16]

$$Min \frac{\sum_{t=1}^{T} W^t [\frac{1}{m} \sum_{i=1}^{m} (1 - \frac{s_{io}^{-t}}{x_{io}^t})]}{\sum_{t=1}^{T} W^t [\frac{1}{s} \sum_{r=1}^{s} (1 + \frac{s_{ro}^{+t}}{y_{ro}^t})]}$$

$$s.t. \sum_{j=1}^{n} \lambda_j^t x_{ij}^t + s_i^{-t} = x_{io}^t i = 1,\ldots, = 1,\ldots, (1)$$

$$\sum_{j=1}^{n} \lambda_j^t x_{rj}^t - s_r^{+t} = y_{ro}^t r = 1,\ldots, = 1,\ldots,$$

$$\sum_{j=1}^{n} \lambda_j^t z_{kj}^{(t,t+1)} \geq \sum_{j=1}^{n} \lambda_j^{t+1} z_{kj}^{(t,t+1)} k = 1,\ldots, = 1,\ldots,$$

$$\lambda_j^t, s_i^{-t}, s_r^{+t} \geq 0$$

Where $z_{kj}^{(t,t+1)}$ shows K^{th} output of j^{th} decision making units at time *t* for using and entering to time *t+1*.

Finally, efficiency estimates are obtained by adding $\sum_{j=1}^{n} \lambda_j^t = 1, t = 1, \ldots, T$ in the model (1).

We use model (1) to evaluate efficiency in a 3-year window, that is, between the year before the transaction (year of injection of public financing) T-1, and 2 years after the transaction, T+2. Besides, it has also been taken into account that efficiency patterns can be specific to each industry, and therefore, we have estimated the efficiency for each industrial sector (2-digit level).[17]

To evaluate the implications of the different types of public aid on efficiency, a regression model has been developed considering the efficiency scores, the variables of interest, and a group of control variables about age, return on assets (ROA), leverage, Herfindahl index, and industry dummies. This regression model uses the Wooldridge-Papke estimator for coined fractional bound response variables, which has no difficulty in recovering the regression function for the fractional variable, and no need to use ad hoc transformations to handle data at the extreme values. This estimator is suitable for modeling DEA scores.[18,19]

Sample and data

Our sample includes a random selection of 400 Spanish companies that have received different types of public aid in 2016, excluding companies in the financial sector. The information on the aid received by the companies has been provided by ENISA, public innovation company dependent on the Government of Spain. The annual financial statements of the companies in the sample, the dates of creation, and the codes of the industrial sector were obtained from the Bureau Van Dijk SABI database. All monetary data were adjusted for inflation (the base year 2016). The distribution of the sample by industry is presented in Table 1. Overall, companies are heavily concentrated in the Manufacturing, Building, and Chemistry industries (over 48%).

Results & Discussion

The results of dynamic efficiency estimations is reported in Table 2. The table reports a summary of the dynamic DEA estimations of efficiency; The overall score is the measure of global efficiency from T−1 to T+2, with T being the year of companies receive public support. Period 0 corresponds to years T−1 to T; Periods 1 and 2 are defined accordingly; Standard errors are given in brackets. The average level of efficiency of the companies in the sample during the study period is approximately 0.5152 (51.52%). The pattern of these improvements seems

Table 1 — Number of firms per industry in the sample

	All firms		Guarantee		Ordinary loan		Particip.loan		Loss fund	
Industry	N	%	N	%	N	%	N	%	N	%
Farming	18	4.50	8	8.00	2	2.00	2	2.00	6	6.00
Chemistry	44	11.00	8	8.00	23	23.00	5	5.00	8	8.00
Manufacturing	81	20.25	11	11.00	40	40.00	18	18.00	12	12.00
Energy	38	9.50	10	10.00	7	7.00	8	8.00	13	13.00
Building	68	17.00	16	16.00	11	11.00	19	19.00	22	22.00
Communications	28	7.00	8	8.00	3	3.00	9	9.00	8	8.00
Computing	37	9.25	10	10.00	4	4.00	17	17.00	6	6.00
Consultancy	35	8.75	9	9.00	3	3.00	11	11.00	12	12.00
Education	26	6.50	11	11.00	3	3.00	6	6.00	6	6.00
Sport	25	6.25	9	9.00	4	4.00	5	5.00	7	7.00

Table 2 — Summary of dynamic efficiency scores

	All firms	Guarantee	Public loans	Part. loans	Loss fund
Overall score	0.5152	0.4945	0.5167	0.5436	0.5061
	(0.3536)	(0.3660)	(0.3319)	(0.3570)	(0.3596)
Period 0	0.4931	0.4807	0.5060	0.4865	0.4994
	(0.3569)	(0.3716)	(0.3781)	(0.3302)	(0.3479)
Period 1	0.5142	0.4926	0.5198	0.5372	0.5073
	(0.3490)	(0.3432)	(0.3025)	(0.3392)	(0.4114)
Period 2	0.5384	0.5102	0.5244	0.6072	0.5118
	(0.3549)	(0.3834)	(0.3153)	(0.4016)	(0.3195)
Observations	400	100	100	100	100

Table 3 — Efficiency regressions

	(0)	(1)	(2)	(3)	(4)	(5)
Constant	8.8091**	2.8809**	4.1624**	2.4023**	4.0370**	2.9327**
Age, T − 1	−0.0003	0.0002	−0.0004	−0.0012	0.0031	−0.0006
ROA, T − 1	−0.0247**	−0.0212**	−0.0348**	−0.0340**	−0.0581**	−0.0602**
Leverage, T − 1	−0.1237*	−0.3841*	−0.4107*	−0.2440*	−0.3821*	−0.4299*
Herfindahl index, T − 1	0.7039*	0.6834*	0.5902**	0.5998*	0.7455	0.4337*
Industry dummies	0.0104*	0.0187*	0.0294*	0.0187*	0.0214*	0.0388*
Guarantee dummy		−0.0380				−0.0389
Public loan dummy			0.0487			0.0463
Part Loan dummy				0.3163*		0.2669*
Loss fund dummy					0.0398	0.0451
R^2	0.1695	0.1695	0.1695	0.2058	0.1767	0.2249
Observations	400	400	400	400	400	400
F-test	1.7960	1.4599	1.9002	1.3726	1.6339	1.4783
Significance	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Durbin W.	1.9472	1.8422	1.9780	1.8938	1.9776	1.9404
ANOVA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mean VIF	1.0833	1.3367	1.2047	1.3066	1.4711	1.2508
J-B p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Heteroskedasticity test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Average partial effects						
	−0.0031			−0.0022		
		0.0153			0.1276	
			0.1974*		0.1740*	
				0.0166	0.0115	

The table reports regressions of efficiency scores; Coefficients are estimated with robust standard errors; ** and * indicate 1% and 5% significance, respectively; DW: Durbin Watson test; J-B: Jarque-Bera test

to be volatile and somewhat convex (Fig. 1), indicating that there are significant differences in the impact of each public aid instrument on the efficiency of companies, and that this impact is greater initially and at the end of the analyzed period. The companies backed by participative loans are the ones that grow the most in efficiency, with an overall increase of over 24%. For their part, the companies that have received guarantee, public loans, and the loss fund increase their efficiency by 6.25%, 4.00%, and 2.20%, respectively. This efficiency evolution patterns with time of the sample firms between the first pre- and second post-transaction years are shown in Fig. 1.

The regressions estimated using the sample of 400 companies supported by public aids is presentes in Table 3. Model (0) provides results using control variables only. Models (1) to (4) test the impact of each type of public aid instrument concerning for to the general efficiency in the study period. Model (3) suggests that the presence of participative loans has a positive and statistically significant effect on the future efficiency of a company. The corresponding partial effect (0.1974) implies that the participative loans in the capital of the company improve efficiency by almost 20% (on average) during the 2 years after the transaction. Models (1), (2) and (4)

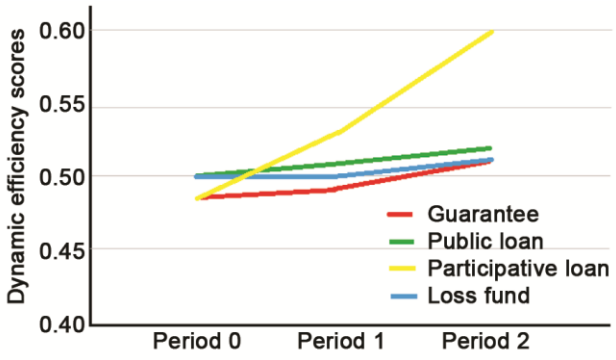

Fig. 1 — Efficiency evolution with time

show that the presence of guarantee, public loan, and loss fund are not significant to explain the increase in efficiency of the companies in the sample. Finally, model (6) combines all public aid instruments. As expected, participative loans have a statistically significant effect on efficiency, although in the combined model the effect is at the 17.40% level. All regression tests (p-values) reject errors in the specification or functional form.

Conclusions

The present study analyzes the implications of public aids on the efficiency of industrial companies. In general, the results suggest that in the sample of Spanish companies supported by public aids, the participative loan is the only instrument that improves the efficiency of companies significantly. Comparing the support of participative loans to other public aid instruments suggests a statistically weak or no effect of Guarantee loans, Public loans, and Loss funds on the efficiency of companies.

Our explicit analysis of the public aid instruments on business efficiency contributes to the ongoing discussions on the effects of public aids on efficiency. Rather than focusing on just one instrument, our study looks at the causality of common public aid instruments in a homogeneous context of time and space.

The results obtained are important for entrepreneurs and industrial policymakers. Entrepreneurs must understand that public aids provide not only financing but also an impact on the economic performance of companies. For industrial policymakers, our evidence suggests that investments in the form of participatory loans are contributing most to the industry's economic development goal and that a re-evaluation of public aid programs seems necessary.

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