Subsidy and networking: The effects of direct and indirect support programs of the cluster policy

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highlights

- We examine effects of support programs of Industrial Cluster Project (ICP) in Japan.
- We distinguish between direct R&D support and indirect networking support programs.
- Cluster firms exploiting support programs expand network after participating in ICP.
- Indirect support programs have more extensive impact on output than direct support.
- We suggest effectiveness of 「soft」 policy intervention by innovation intermediary.

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1.Introduction

- Agglomeration theories :This concept relates to the idea of economies of scale and network effects. As more firms in related fields of business cluster together, their costs of production may decline significantly (firms have competing multiple suppliers; greater specialization and division of labor result).
- Two questions:

1. If the project participants who exploit various support programs are more successful in network formation within the cluster than others?
2. Which kind of support program contributes to improving firm performance?

- Define Industrial Cluster Project (ICP)
  - Direct: heavy (hard) government intervention as direct R&D support, such as the support for R&D consortia, other R&D subsidies, and incubation services
  - Indirect: networking/coordination supports are characterized by light (soft) government intervention.

2.1 Theoretical literature

- The gap between private and public returns to R&D because of knowledge spillovers leads to incomplete appropriability of the R&D results, which gives rise to market failure
- R&D involves three types of uncertainties with regard to technological success, commercial success, and competitor behavior

(1) R&D support generates learning effects that enhance the ability of firms to obtain the latest scientific and technological knowledge (absorptive capacity).

(2) Public funds enable the use of experimental and research facilities and allow private firms to start projects with low additional costs (cost sharing).

(3) Commissioned R&D from the public sector signals future demand for technologies, goods, and services diverted to the private sector (pump-priming effect)

2.2. Empirical literature

- The effectiveness of public R&D support from the viewpoint of the innovation output and subsequent market performance of subsidized firms.
- The public support to NTB is helpful, only if public subsidies are targeted to firms that really need themFs, such as small and/or young ones

(1) Using micro data from original survey, we can precisely estimate the effect of each support program controlling for firm heterogeneity, endogeneity problem, and selection bias.

(2) We explicitly compare the effects of direct and indirect support programs of cluster policies and discuss the relative efficiency of contrasting policy approaches.

3.1. Characteristic of the ICP

- Defines an industrial cluster is not as a mere agglomeration of companies etc. without interactions, but as an innovative business environment where new firms sharing business resources with each other are created one after another through horizontal networks such as industry-academia-government collaboration and inter-firm collaboration, and the resulting state in which industries with comparative advantage play a central role in promoting industrial agglomeration.
- ICP supports autonomous development of existing regional industries without direct intervention in the clustering process.
- The ICP, METI mainly supports network formation among the participants of existing clusters and offers them information on and contacts with the business and academic community as well as funding opportunities.
- The clusters utilize existing regional resources, clusters steadily transform themselves according to their environment,
- The local firms typically regard outside collaborative partners as more important than their neighbors, even in highly advanced clusters, such as Silicon Valley.

3.2. Support programs of the ICP

Table 1
Support programs provided by the ICP and their concrete examples.

Support programs	Examples
Network formation	(1) Establishment of organizations promoting cluster formation, networking with related organizations (2) Dispatch of coordinators to participating companies and universities (3) Information transmission through web sites and e-mail magazines (4) Holding industry-academia collaboration exchange meetings, joint meetings for announcing the results, symposiums, seminars, and workshops (5) Development of database on companies, researchers, and supporters
R&D support	(1) Promotion and collaboration of R&D by public funds based on selective schemes (2) Promotion of utilization of research results (3) Support for protection and strategic use of intellectual property (establishment of local intellectual property strategy headquarters, etc.)
Incubation function	(1) Development of incubation facilities (2) Fostering incubation managers (3) Formation of network between incubation organizations and incubation managers
Marketing support	(1) Holding events for business matching and exhibition of products (including overseas market) (2) Collaboration with specialized trading firms (3) Establishment of distribution system (4) Market cultivation through coordinators (5) Support for cross-industrial collaboration
Financial support	(1) Collaboration with local financial institutions (holding the Industrial Cluster Support Finance Conference) (2) Establishment of local venture capital (3) Holding meetings for announcing business plans
Fostering human resources	Fostering highly specialized human resources (manufacturing personnel, technology management personnel, and judging personnel, etc.)

Source: Based on METI (2005).

- METI created regional networks between 6100 firms and 250 universities by 2005.
- R&D support is one of the most important ICP support measures.
- R&D consortia and the other R&D subsidies are the two major types of R&D support.
- 60% of 1130 R&D consortia formed by 2004 involve the participants of the ICP

4.1. Questionnaire data

- we matched the list of cluster participants (approximately 5000) on the websites, which cover 13 regional projects, with another company database to arrive at a definitive list of these 2668 firms.
- We classified them into the following ten groups:

  (1) provision of information and database via websites, (2) research meetings, (3) business matching events, (4) matching events with financial institutions, (5) technological consultation and advice, (6) management consultation and advice, (7) financial consultation and advice, (8) promotion of R&D consortia, (9) R&D subsidy, and (10) incubation services. Then, we gathered information on the support measures

4.2. Sample characteristics

- Users may be able to grow faster thanks to support programs under the ICP. Another interpretation is that users may be representative firms in the local area and thus become core participants in the ICP.
- Users are more actively engaged in academic societies (significant at the 1% level) and trade associations (significant at the 5% level).

Table 2
Differences in the firm characteristics of *users* and *non-users*.

Items	*Users* 68%(322)	*Non-users* 37%(189)	Comparative test
Participation year	2004 (2.14)	2004 (2.38)	
Firm age (year)	28.57 (18.72)	27.44 (17.76)	
R&D ratios to sale (%)	25.31 (232.20)	9.93 (37.57)	
Number of employees	86.56 (208.08)	43.79 (60.21)	***
Number of patents before ICP	9.62 (23.86)	11.64 (32.76)	
Meeting participation (5-point Likert scale)			
Academic society	2.30 (1.29)	1.89 (1.25)	***
Trade association	3.20 (1.42)	2.87 (1.46)	**
Chamber of commerce	2.57 (1.41)	2.42 (1.39)	
Motivation for the ICP (5-point Likert scale)			
Networking formation	3.62 (1.23)	2.85 (1.31)	***
R&D support	3.76 (1.23)	3.11 (1.40)	***
Incubation	2.50 (1.31)	2.08 (1.20)	***
Market exploitation	3.28 (1.45)	3.09 (1.48)	
Financial support	2.95 (1.54)	2.68 (1.57)	*

Note 1: Average value in columns and standard deviation in parentheses.
Note 2: This table shows the results of two-sample mean comparison tests under unequal variances. Level of significance: *** 1%, ** 5%, * 10%.

4.3. Support programs and the ICP performance

4.3.1. Support programs

- We classified ten support measures into four major types: (1) provision of information on websites, (2) organizing of meetings and events, (3) service of coordinators and advisors, and (4) R&D support

Table 3
Utilization of support programs and outputs of the ICP.

Support programs		Number of responses	Ratios of users	S.D.
Provision of information on websites (*d_web*)	Utilizing websites (*d_web*)	481	0.23 113	0.42
Organizing meetings and events (*d_event*)	Research meetings (*d_meeting*)	494	0.44 219	0.50
	Business matching events (*d_business*)	488	0.35 169	0.48
	Matching events with financial institutions (*d_finance*)	482	0.18	0.38
Service of coordinators and advisors (*d_cord*)	Technological consultation and advice (*d_technology*)	492	0.27	0.45
	Management consultation and advice (*d_evaluation*)	483	0.13	0.33
	Financial consultation and advice (*d_funding*)	482	0.09	0.29
R&D support (*d_rd*)	R&D consortia (*d_consortium*)	487	0.20 96	0.40
	R&D subsidy (*d_rdsubsidy*)	490	0.30 148	0.46
	Incubation services (*d_incubator*)	483	0.14	0.35

Outputs		Number of responses	Mean	S.D.
Number of technology, manufacturing, and sales alliance networks formed	Firms (*network_f*)	142	2.71	5.27
	Universities (*network_u*)	152	1.64	1.66
	Public research institutes (*network_p*)	145	1.27	1.28
Number of financial deals, sales transactions, and innovations	Number of financial deals (*finance*)	145	0.36	1.05
	Number of sales transactions (*business*)	147	7.29	58.32
	Number of new products and processes (*innovation*)	160	1.81	2.45
Subjective overall evaluation	Sales (*out_sale*)	316	2.01	1.17
	Profits (*out_profit*)	316	1.92	1.08
	Technology (*out_tec*)	316	2.71	1.32
	Reputation (*out_repu*)	313	2.96	1.39

Note 1: The names of the dependent and independent variables in empirical models (Section 5.3) are in parentheses.

5.1. Estimation strategy

- We should be aware of the difference between the observed values of the supported (treated) firms and the unobservable counterfactual situation, and carefully estimate the average values of performance that the treated firms would have shown if they had not been treated.

1. to examine the determinants of the exploitation of ICP support programs by binary probit regression and calculate the probability of each cluster participant in our sample to use them (propensity score)
2. based on the propensity score, we conduct the difference-in-differences (DID) estimation to compare the extent of engaging in industry-university-government collaboration (IUGC) by the ICP participants before and after participating in the ICP and between users and non-users of support programs (the methodology is explained later in more detail).
3. Heckman's two-step procedure and the negative binomial model. We employ these estimation models according to the characteristics and distribution of the dependent variables that are measured in different ways.

5.2. Network formation: DID estimation and probit regressions

- We regard users as the treatment group and non-users as the control group and compare users with non-users in terms of network formation.

$$Y_{it} = \alpha + \beta_1 users_i + \beta_2 postICP_t + \beta_3 (users \times postICP)_{it} + \varepsilon_{it},$$

- Where i stands for the firm, and t for the two periods (before and after participating in the ICP). The outcome variable Y is the extent of engaging in the IUGC before and after the ICP (5-point Likert scale: 1 = none to 5 = very high).

$$p(user = 1|X) = \phi(\delta X) + \nu.$$

- The probability of cluster participants using support programs as a function of variables X. Our independent variables principally consist of four groups of variables: firm capability, network of top managers, the extent of IUGC before participating in the ICP, and the importance of motivations to participate in the ICP.

5.2. Network formation: DID estimation and probit regressions

1. firm capability is captured by firm age (age),We expect that relatively large and R&D-intensive firms are actively engaged in the ICP for their higher absorptive capacity and because such firms tend to be invited to the ICP as representative participants.
2. They represent top managers' network and information activity. we expect that the firms which have direct connections with academic societies via their top managers are more likely to exploit the ICP support programs.
3. We expect that the participants who have been actively engaged in the IUGC even before participating in the ICP are more likely to use support programs.
4. We expect that highly motivated participants are more likely to use public supports. Especially, motivation for network formation should be emphasized in the ICP.
5. we also control for firms' technological fields and top managers' educational backgrounds.

5.3. The effect of support programs on firm performance: Heckman's two-step procedure and the negative binomial model

$$P_i = \theta \sum Support_i + \gamma_1 age + \gamma_2 rd\_ratio_i + \gamma_3 emp_i$$

$$+\phi \sum tech + fields_i + \delta\lambda(X\beta) + u_i,$$

- where (Xˇ) is the inverse Mill's ratio constructed from the first step estimates, which controls for the selection problem. The dependent variables are the subjective measures of evaluation of the improvement in sales, profits, technology, and reputation (out sale, out profit, out tec, and out repu, respectively).
- le d web is a dummy variable that takes on the value "one" if a cluster participant utilizes websites of the cluster project and "zero" otherwise. Similarly, d event is a dummy variable on event participation, d cord on coordinator services, and d rd on R&D support.

5.3. The effect of support programs on firm performance: Heckman's two-step procedure and the negative binomial model

Table 4
Definition of variables with summary statistics.

Variable	Definition	*N*	Mean	Median	S.D.	Min	Max
Firm capability							
age	Firm age	510	28.16	24.5	18.40	1	94
rd_ratio	The ratio of R&D expenditure to sales (%)	499	19.52	2	186.22	0	4063
emp	Number of employees	509	70.68	22	170.45	1	1859
d_pat	Dummy variable which takes on the value one if the firm at least applies for a patent	511	0.55	1	0.50	0	1
Meeting participation							
meet_acad	Degree of participation in academic societies	480	2.15	2	1.29	1	5
meet_trade	Degree of participation in trade associations	498	3.08	3	1.45	1	5
meet_chamber	Degree of participation in chamber of commerce	496	2.52	2	1.41	1	5
Industry-university-government collaboration before the ICP (IUGC)							
collabo_ff	Degree of inter-firm collaboration before the ICP	466	2.00	1	1.25	1	5
collabo_fu	Degree of firm-university collaboration before the ICP	477	2.23	2	1.37	1	5
collabo_fg	Degree of firm-government collaboration before the ICP	467	1.95	1	1.24	1	5
Importance of support programs as the motivation for the ICP							
imp_net	Importance of network formation	469	3.36	3	1.32	1	
imp_rd	Importance of R&D support	475	3.54	4	1.33	1	5
imp_inc	Importance of incubation	451	2.36	2	1.29	1	5
imp_sale	Importance of market exploitation	467	3.22	3	1.47	1	
imp_fin	Importance of financial support	455	2.87	3	1.56	1	5

Note 1: The dummy variables of technological fields and top managers' educational backgrounds are omitted from this table.

6. Estimation results

6.1. Characteristics of firms to use support programs

Table 5
Determinants of the exploitation of support programs.

	Coef.	Robust S.E.
Firm capability		
age	−0.003	0.005
rd_ratio	0.000	0.002
emp	0.002**	0.001
d_pat	0.343**	0.161
Meeting participation		
meet_acad	0.126*	0.069
meet_trade	0.062	0.058
meet_chamber	−0.019	0.059
IUGC before the ICP		
collabo_ff	0.072	0.067
collabo_fu	0.001	0.080
collabo_fg	0.052	0.081
Motivation for the ICP		
imp_net	0.183***	0.062
imp_rd	0.155**	0.067
imp_inc	0.126*	0.069
imp_sale	−0.006	0.057
imp_fin	0.009	0.059
Other control variables		
Technology fields	Included	
Educational backgrounds	Included	
Constant	−1.641***	0.387
N	379	

Note 1: Level of significance: *** 1%, ** 5%, * 10%.

- larger firms are more likely to use public supports
- the firms that have applied for patents before participating in the ICP are more likely to use support programs.
- The primary purpose of the ICP is to build up a collaborative network between industry and university

6. Estimation results

- 6.2. Performance on network formation

Table 6
DID estimation on network formation.

	Before		After	DID
Inter-firm				
Users	2.14	→	2.79	0.423 (0.141)
Non-users	1.78		2.04	
Firm-university				
Users	2.44	→	3.32	0.766 (0.212)
Non-users	1.87		2.26	
Firm-government				
Users	2.15	→	3.02	0.528 (0.183)
Non-users	1.60		1.95	

Note 1: Standard errors are in parentheses.

The results strongly support the statement that users (as opposed to non-users) significantly enhance the degree of IUGC after participating in the ICP. In particular, our estimation results suggest that users are more likely to construct collaborative networks with universities than non-users are.

6.3. The effect of support programs: subjective evaluation

Table 7A
Estimation results of Heckman's two-step model: effects of four major support programs on firm performance (subjective evaluation).

	out_sale	*out_profit*	*out_tec*	*out_repu*
d_web	0.176	0.118	0.428**	0.360*
	(0.156)	(0.140)	(0.169)	(0.189)
d_event	0.485**	0.361**	0.261	0.663***
	(0.204)	(0.157)	(0.195)	(0.218)
d_cord	0.330**	0.194	0.188	0.389**
	(0.161)	(0.134)	(0.162)	(0.182)
d_rd	0.184	0.218	0.609***	0.516***
	(0.157)	(0.140)	(0.168)	(0.188)
age	−0.007	−0.006	0.000	0.001
	(0.005)	(0.004)	(0.006)	(0.007)
rd_ratio	−0.002	−0.002	−0.002	−0.002
	(0.002)	(0.001)	(0.002)	(0.002)
emp	−0.001***	−0.001**	−0.001	−0.002**
	(0.000)	(0.000)	(0.000)	(0.001)
Constant	2.367***	2.161***	2.739***	2.808***
	(0.344)	(0.305)	(0.387)	(0.437)
inverse Mill's ratio	−0.928***	−0.755***	−1.495***	−1.702***
	(0.312)	(0.279)	(0.354)	(0.401)
Technology fields	Included	Included	Included	Included
N	361	362	362	359

Note 1: Standard errors are in parentheses.
Note 2: Level of significance: *** 1%, ** 5%, * 10%.

Direct R&D support through R&D consortia and R&D subsidies improve the technological capability of cluster participants

This suggests that event participation and coordinator service increase sales. In particular, business matching and consultation services significantly contribute to sales growth.

we find that the coefficients of inverseMill's ratio(Xˇ) are strongly significant in all models, which indicates that significant selection bias is controlled for.

Table 7B
Estimation results of Heckman's two-step model (summary): effects of ten support programs on firm performance (subjective evaluation).

	out_sale	*out_profit*	*out_tec*	*out_repu*
d_web			+*	+*
d_meeting				+**
d_business	+*	+*		+*
d_finance				+*
d_technology	+*			
d_evaluation	+*			
d_funding	+*			
d_consortium			+**	
d_rdsubsidy	+*	+*	+**	+*
d_incubator				

Note 1: Level of significance: ** 1%, * 5%.
Note 2: Other independent variables are included in the model, but omitted in the table.

business matching has a significant effect on the improvement of sales, profits, and reputation.

all support programs lead to an improved reputation for cluster participants. In particular, event participation is the most effective tool to obtain recognition.

Table 8A
Estimation results of the negative binomial model: effects of ten support programs on firm performance (discrete outcomes).

	network_f	*network_u*	*network_p*	*finance*	*business*	*innovation*
d_web	0.105	0.103	0.301*	0.081	−0.222	0.085
	(0.240)	(0.159)	(0.178)	(0.398)	(0.363)	(0.176)
d_meeting	0.700**	0.121	0.269	0.279	0.106	−0.096
	(0.289)	(0.204)	(0.268)	(0.575)	(0.467)	(0.265)
d_business	0.092	0.382**	0.171	0.483	0.769**	0.797***
	(0.2639)	(0.160)	(0.223)	(0.430)	(0.387)	(0.230)
d_finance	0.220	0.021	0.345*	0.625*	1.034***	0.082
	(0.226)	(0.149)	(0.180)	(0.392)	(0.316)	(0.218)
d_technology	0.027	−0.033	−0.095	−0.764	1.014***	−0.052
		(0.165)	(0.211)	(0.507)	(0.382)	(0.204)
		−0.034	0.070	1.457***	0.061	0.463**
		(0.204)	(0.282)	(0.522)	(0.463)	(0.208)
		0.225	−0.02	−0.253	1.280**	0.417*
		(0.230)	(0.337)	(0.580)	(0.585)	(0.252)
		−0.042	0.028	−0.418	0.438	0.333*
		(0.154)	(0.164)	(0.433)	(0.356)	(0.191)
d_rdsubsidy	0.190	0.279*	0.008	0.330	0.987***	0.546***
	(0.205)	(0.164)	(0.183)	(0.471)	(0.362)	(0.196)
d_incubator	0.190	0.085	−0.04	−0.331	−0.036	−0.229
	(0.266)	(0.165)	(0.193)	(0.479)	(0.466)	(0.206)
age			−0.002	−0.005	0.022	0.009
			(0.006)	(0.012)	(0.014)	(0.006)
rd_ratio			0.000	−0.004	−0.008	−0.002
			(0.003)	(0.007)	(0.007)	(0.004)
emp			0.000	−0.002**	−0.004**	−0.001**
	(0.000)	(0.001)	(0.000)	(0.001)	(0.002)	(0.000)
Constant	0.149	−0.422*	−0.227	−1.601*	−2.690***	−0.787**
	(0.389)	(0.240)	(0.330)	(0.864)	(0.630)	(0.322)
Technology fields	Included	Included	Included	Included	Included	Included
N	121	128	123	124	124	135
LL	−227.803	−189.417	−169.417	−88.672	−192.447	−216.664

Note 1: Robust standard errors are in parentheses.
Note 2: Level of significance: *** 1%, ** 5%, * 10%.

that the former have greater influence on commercial success and innovation activity, despite a much smaller budget than the latter (2 billion compared to 55 billion yen from 2001 to 2004).

We find that the exploitation of indirect networking/coordination support programs is positively related with the

the number of financial deals is also affected by the utilization of indirect public supports. The participation in the events for matching with financial institutions and consultation with management advisers has positive effects on the success of financial deals

most of the indirect networking/coordination support and direct R&D support measures significantly increase the number of sales transactions and new products and processes.

7. Conclusions

- It distinguishes among various support programs and explores different effects of different support programs. Moreover, using micro data from original survey
- Indirect support programs have an extensive and strong impact on discrete outcomes, especially on innovation outcomes, whereas direct R&D support has a rather weak effect.
- Indirect networking/coordination support contributes to building up new collaborative networks within clusters.
- Indirect support is significantly higher than that of direct R&D support
- Indirect support programs can be effective as policy measures to overcome these knowledge-specific failures.
- 63% of the cluster participants have utilized any support programs
- In meetings and events and using coordination and advisory services enhance firm performance such as network/alliance formation, financial and sales transactions, and innovation activity, while R&D subsidy leads to increase of sales transactions and innovation activity.

8.Limiation

1. We do not control for the quality of outcomes, and therefore cannot conduct an accurate cost-benefit analysis
2. The time frame of the evaluation may be too short. By evaluating the effects of support programs within a few years in the middle of the ICP, we may underestimate their effects
3. We used firm level data for the analyses, and this is our contribution to the literature. However, by using individual data on personal relationships especially with university researchers, we might be able to enrich and deepen our analysis

9.Supplement information

Schøtt, T., & Jensen, K. W. (2016). Firms' innovation benefiting from networking and institutional support: A global analysis of national and firm effects. *Research Policy*, *45*(6), 1233-1246.

- Innovation of a firm is embedded in the network around the firm, and firm networking is embedded in institutions in society.
- Global generalizability from sample of 18,880 firms in 68 countries; measuring networking and innovation, and also support.
- Firm networking is seen to benefit process innovation and especially product innovation.
- Institutional support for networking appears to hard promote quantity of networking.
- Institutional support moderates quality of networking, by enhancing the benefits for process and product innovation.

9.Supplement information

Acs, Z. J., Anselin, L., & Varga, A. (2002). Patents and innovation counts as measures of regional production of new knowledge. Research policy, 31(7), 1069-1085.

- The empirical evidence suggests that patents provide a fairly reliable measure of innovative activity. With respect to regression fit, sensitivity of estimated parameters to changes in the variable structure or the type of spatial dependence the two measures provide very similar results in the KPF context. Also, the signs and significances of those variables representing knowledge sources in the MSA follow similar patterns for both of the measures. However, when patents are applied to measure innovation in the regression context some caution is suggested while interpreting the results: for all the local knowledge-related variables the KPF with patents over-emphasizes the effects of localized interactions. Also, the influence of local university research spillovers is under-represented as compared to the effects of R&D spillovers. In sum, we have found in this paper that the measure of patented inventions provides a fairly good, although not perfect, representation of innovative activity. This supports the use of patent counts in studies examining technological change.