

**Effects of multilevel policy mix of public R&D subsidies:
Empirical evidence from Japanese local SMEs**

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1. Background and aims of this study

Regional innovation policies have been implemented in several countries. In Japan, for example, under the “Science and Technology Basic Plan”, the promotion of regional innovation has been recognized as an essential policy issue since the beginning of this century, when the Ministries of Economy, Trade and Industry (METI) and of Education, Culture, Sport, Science and Technology (MEXT) started their cluster policies (Okamuro and Nishimura 2018a). In parallel, most prefectures announced their “Science and Technology Vision” based on the national government’s requests and started their own R&D support policies for local SMEs independently. In addition, the Japanese government is currently promoting a regional revitalization policy, requiring local authorities (the municipality level) to plan and design their own strategies.

However, despite increasing attention to regional innovation policies, information about such policies is quite limited thus far. Even internationally, although there are numerous studies on the national government’s policies, empirical studies on local government’s policies are scarce. Thus, we do not know much about the effects of regional

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innovation policies and the relationship among them. Therefore, our study aims at empirically investigating how such R&D subsidies from different levels of governments may interact and increase recipient's productivity.

2. Literature review

Regional innovation systems comprising local firms, research institutes, and local authorities have attracted increasing attention worldwide since the late 1990s, whereas there have been few studies on the innovation policies by local authorities. An OECD report addresses the multilevel governance (or multilevel mix) of innovation policies at different administrative levels (sub-national, national, and supra-national) and refers to some different patterns of governance among member and non-member countries (OECD 2011). There are some conceptual papers on the multilevel policy mix on innovation (Flanagan et al. 2011, Laranja et al. 2008), while Fernandez-Ribas (2009) compares the effects of innovation programs in EU regions among different levels of governments (regional, national, and EU levels), without considering municipality level.

Previous empirical studies on “regional” innovation policies focus on the regional impact of national cluster policies. For example, Cantner et al. (2015), Martin et al. (2011), and Nishimura and Okamuro (2011) empirically examine the effects of cluster policies in Germany, France, and Japan, respectively.

To date, no empirical studies have been carried out on the effects of regional innovation policies by local authorities considering its variety, except for a recent study (Lanahan 2016) that targets state SBIR programs in the USA: It examines the effects of states' additional support for the recipients of federal SBIR program support. For Japan, Okamuro and Nishimura (2018b) explore the variety of R&D subsidy programs for local firms by local authorities and the determinants of program implementation and design, but do not address the effects of these policies.

Thus, this study investigates the effects of these programs at the firm level using original survey data, considering a multilevel policy mix. It shows a distinct originality in that it targets R&D support policies not only by national government but also by local

governments and the interaction of these policies, considering the endogeneity of receiving these R&D subsidies by fixed-effect panel analysis.

3. Empirical methodology

In order to investigate multilevel R&D subsidy effect, we employ econometric analysis (fixed-effect panel estimation) using original survey data and financial data from manufacturing SMEs in Japan. By estimating fixed-effect models, we cope with endogeneity issue, in that we control for the effects of any time-invariant firm characteristics. Online survey for 12,000 firms in the manufacturing sector was conducted from February to May 2017. Target firms were randomly selected from Teikoku Databank (TDB) company database COSMOS 2, equally stratified in three firm size groups (with 10-49, 50-99, and 100-300 employees). 1,030 effective responses were obtained from these firms, among which 624 firms could be matched with TDB COSMOS 1 financial database. We constructed an unbalanced panel dataset with approximately 5,000 observations for 14 years from 2004 to 2017. Due to missing values, our final sample comprises approximately 3,500 observations with 500 firms for 7 years in average.

In the first step, from COSMOS 1 database, we estimate both Cobb-Douglas and Levinsohn-Petrin production functions, from which we calculate total factor productivity (TFP) as a performance measure. Our online survey contains questions about various company information including R&D subsidies they received from city, prefecture and national governments. Using these data, we examine the effects of R&D support from different levels of governments and its interaction on firm's productivity. Other independent variables cover firm size (number of employees), R&D expenditures, advertising, intangible assets, debt ratio, and industry and year dummies.

4. Findings and implications

Estimation results suggest that, after controlling for firm fixed-effect, time-variant firm characteristics, and year and industry effects, prefecture subsidy has positive and significant effect on recipient's productivity, only when we consider the years (specifically three years)

after subsidy period. This implies lagged or persistent effect of R&D subsidy for local SMEs. Moreover, whereas city and national government subsidies show no significant effects, we find that the interaction term of city, prefecture, and national level subsidies has a positive and significant coefficient, which suggests complementarity of multilevel policies.

Major implications from our study for researchers and policymakers are that 1) we should pay more attention to the role of local (prefectural) R&D support, which may be more effective than national support, that 2) a combination of local and national subsidies is important because of complementarity, and that 3) we should consider lagged and persistent effect of public subsidies. Further step of research would be to explore why prefecture programs show larger effects than national and city programs and why a combination of multilevel policies enhances individual effects. A practical implication is that local SMEs should make advantage of public subsidies from different levels in order to increase productivity. Public subsidy programs should consider other levels of programs that are available to the same local firms and better coordinate with other programs.

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