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Use of plant level micro-data for SME innovation policy evaluation in Japan[1]

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[Abstract]

Japan's SME policy has reached a major turning point. That is, traditional 'lifting up SMEs as a whole' type policy has been revised toward pro-competition policy to induce entrepreneurship and innovation in SMEs. In this paper, this policy direction and new innovation promotion schemes initiated by METI are evaluated by using plant-level micro data. Census of Manufacturing base longitudinal micro-data are linked with the list of firms participating in SME innovation policy scheme under the Law on Creative Activities in SMEs and the Law on Supporting Business Innovation in SMEs. Plant level pattern on industrial dynamics suggests both policies for new business start-up and innovation creation in existing firm are important. In addition, positive effects on sale growth by participating in a program of the Creative Activity Laws are observed.

JEL classification: C35, L10, L50
Keywords: firm's growth, SME innovation policy, program evaluation, sample selection model

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1. Introduction

Japan's SME policies have reached a major turning point. They used to be aiming at lifting up SMEs as a whole, focusing on the gap in productivity and wages between SMEs and large corporations, during the 30 years since the end of the Second World War. Now they are in the process of transformation to a policy that sees SMEs as the source of entrepreneurship and innovation which leads to economic dynamism and supports individual high growth SMEs. Based on this fundamental idea, METI is undertaking drastic reform of SME policy by various means, including the amendment of the SME Basic Law that took place in 1999.

As background to this kind of policy direction, analysis at the establishment or firm level of official statistics such as the Census of Establishments and Enterprises and the Census of Manufacturing, has provided important implications on dynamic firm demography and heterogeneity of SMEs. The dualistic structure theory, which concentrates on the gap between large corporations and SMEs, is based on a comparison of an 'average large corporation' and an 'average SME.' However, we have come to realize that, in the areas of R&D, innovation indices, and business performance factors such as employment and productivity, compared to large corporations, SMEs have an amazingly large variation (METI, 1999). Also, as seen in the fact that almost all large corporations began as SMEs, it is important not only to conduct analyses based on the static structure of firm demography, but also to consider dynamic firm-level trends reflecting its expansion, contraction, entry and exit.

The heterogeneity of SMEs implies that there is no average SME, which used to be the target of traditional SME policies in the era of the dualistic structure theory. Instead, we need to create specific policies for a variety of purposes, keeping in mind the SMEs to be targeted, for example, the building up of front-line SMEs such as high-tech ventures, business innovations of existing SMEs, safety net policies to protect SMEs from negative macro-economic shock, etc. To that end, it is necessary to carry out accurate analysis of the actual conditions of economic activity using establishment- or firm-level micro-data rather than aggregate data by industry or firm size.

Since the mid-1990s, METI has been actively compiling establishment and firm-level panel data.[3]

[3] Motohashi (2001) provides an overview of METI's activities in the development of longitudinal micro datasets.

In developing a micro-data base, it is common for OECD countries to use administrative data, such as tax records, business registers and administrative records as a basis for linking statistical survey data, but this does not happen in Japan. On the other hand, large-scale census surveys are conducted by means of visits to each establishment by enumerators, so that it is possible to grasp the entry and exit of the establishment, and to construct clean data for dynamic establishment demography, through statistical surveys. Currently, METI is involved in a project to develop a comprehensive establishment and firm data base, by linking firm-level data from the Basic Survey of Business Structure and Activity, and establishment data from various kinds of census statistics such as the Census of Manufacturing, Census of Commerce, and Census of Selected Service Sectors.

In this paper, establishment level-dynamics of the Japanese manufacturing sector are analyzed by using longitudinal data sets from the Manufacturing Census. In addition, I will present analytical works on the evaluation of METI's policy measures to promote SME innovation. First, I will provide a general description of METI's SME innovation promotional measures, i.e. the Law for the Promotion of Creative Business Activities of Small and Medium Enterprises and the Law on Supporting Business Innovation of Small and Medium Enterprises. This is followed by a section concerning establishment-level dynamics and their implications for SME innovation policy. Then I will provide models and results of analytical works on SME innovation policy evaluation with implications for considering future SME innovation policies.

2. METI's SME Innovation Policy

(1) Reform of METI's SME Innovation Policy

In response to the change in the basic SME policy direction mentioned above, in 1999 METI totally reviewed its SME support policies. Several laws to promote SMEs exist to achieve various specific policy purposes, such as to vitalize regional clusters and to streamline distribution system for SMEs. The most fundamental of these systems is the SME Modernization Promotion Law, a law passed in 1963 which encourages the promotion of investment in SME facilities, in order to abolish the dualistic structure between large corporations and SMEs in terms of productivity and wages.

The SME Modernization Promotion Law contributed to the improvement of productivity, through

the modernization of SME equipment, in the era when for industrial productivity the scale of profits was important, and SMEs was handicapped due to the low level of capital intensity. However, as intangible investments such as investments in human resources and R&D, rather than tangible equipment investments, become increasingly important, assistance schemes based on the SME Modernization Promotion Law have become obsolete and less able to meet the needs of SMEs. Also, the SME Modernization Promotion Law is designed so that the sectors which should be modernized are specified, and all companies belonging to those sectors receive financial assistance. However, as the diversity of SMEs expands, the usefulness of supporting schemes by industry has decreased.

METI decided to abolish the SME Modernization Promotion Law in 1999, and worked to prepare a new scheme to support SME innovation. The Law on Supporting Business Innovation of Small and Medium Enterprises was established, to support a wide range of innovation for SMEs, such as the development of new products and new production methods, rather than investment in equipment. At that time, the Law Concerning Promotion of the Advancement of SMEs into New Fields, which supports the transfer of type of business of SMEs involved in business fields that are not doing well, was combined with new innovation support schemes. Also, the streamlining and integration of the Law for the Promotion of Creative Business Activities of SMEs, which supports the opening of companies and technological development, was considered. However, since this law is effective until 2003 and many SMEs are still making use of the law's assistance policy schemes, it was decided to leave that particular law in place as is. Accordingly, the current METI schemes to promote SME innovation consist of the two pillars of the Law for the Promotion of Creative Business Activities of SMEs established in 1995 and the Law on Supporting Business Innovation of SMEs passed in 1999.

(2) Law for Promotion of Creative Business Activities of SMEs

The schemes based on this law are fundamentally composed of one part to assist new business openings and another part to assist technological development. The former includes systems that recognize measures for taxation-related postponement of investment by individual investors in venture businesses, and direct financial support for venture businesses through local venture organizations.

For the latter, first it is necessary for SMEs to submit proposals related to technological

development projects. If it is judged that the contents of the project in question feature newness, and moreover if the project seems to have a high probability of successful completion in terms of capital and human resource allowances, subsidiaries, low-interest financing and taxation-related support policies can be received. Although it is also possible for proposals to be put forward by groups of several SMEs, in almost all cases applications are from individual SMEs. As of June, 2001, about 7,400 proposals had been approved.

(3) Law on Supporting Business Innovation of SMEs

The schemes based on this law[4] begin with the submission of proposals related to broadly determined "innovation," including both product and process innovation, as is the case for the Law for Promotion of Creative Business Activities of SMEs. However, for the Law on Supporting Business Innovation of SMEs, it is also necessary to indicate the performance target in the proposal by innovation activities supported by this scheme.[5]

In addition, for each approved project, it is necessary to report to the government the state of progress of the project, and the government will conduct follow-ups, including examination of the progress made towards the performance target. Therefore, while the Law for Promotion of Creative Business Activities of SMEs requires strict ex-ante examination process for project approval, the Law on Supporting Business Innovation of SMEs differs in that its focus is more on follow-ups afterwards than on examination at the application stage. For this latter law also, a group of SMEs can submit a proposal, but in almost all cases the applications are made by individual SMEs. As of June, 2001, about 1,400 proposals had been approved.

(4) Objectives of SME innovation policies

In order to conduct evaluative analyses of the programs of each of these two laws, it is important to clarify objectives and firms targeted by these policies. Both laws are schemes to promote SME innovation, which is the top priority of METI's SME policies, since new business openings and

[4] The Law for Promotion of Creative Business Activities of SMEs is composed of the innovation support part and the emergency avoidance safety net part, for business fields in which there has been an extreme worsening of conditions as a result of external shocks, such as dramatic changes in competitive conditions. Here I describe the innovation support part schemes.

[5] The performance target can be made either by value-added growth rate or by labor productivity growth rate. Targeted growth rate should be no less than 9% for three-year plans, 12% for four-year plans, and

active new product development and business field transfer activities in SMEs become a source of strength for the dynamism of the economy as a whole. In fact, a large proportion of the creation of new employment in the past was brought about by high-growth SMEs, which can be observed in many OECD countries (OECD (1996)). At the same time, it is also true that SMEs are handicapped in the aspects of acquisition of capital and human resources. When SMEs start new operations, there are many managers who point out obstacles in the acquisition of capital and personnel (MITI (2000)). Also, we can suppose that the detrimental effect of market failure that occurs in the financial and labor markets as a result of lack of symmetry of information, etc. is more severe for SMEs. Policy for promoting SME innovation can be justified though this way.

Both SME laws have the objective of supporting SME innovation, but the SMEs targeted by each are slightly different. As I mentioned at the beginning of this paper, a firm whose scale is below a certain level is known as an SME, but in reality SMEs show extreme diversity, and we also have to consider the dynamic changes involved, such as expansion and contraction of firm size.

For the Law for Promotion of Creative Business Activities of SMEs, since it is a scheme to basically support high-tech ventures, technological development projects are expected to have a high degree of newness, and the purpose is to mainly support high-risk, high-return projects. For the Law on Supporting Business Innovation of SMEs, in contrast, the chief aim is to promote the revitalization of existing companies through a broad range of innovations. When we consider the promotion of SME innovation, we tend to think of companies that have advanced technology and grow dramatically. However, those kinds of corporations comprise an extremely small percentage of all SMEs, so it is an important policy issue to carry out revitalization of the other kinds of companies that comprise the vast majority of SMEs. Based on this way of thinking, the Law on Supporting Business Innovation of SMEs has as its main goal the promotion of the challenge for as many SMEs as possible to undertake innovations in products and processes.

3. Data

(1) Manufacturing Census Panel Data

The longitudinal dataset used for policy evaluation in this paper is based on plant-level survey data

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15% for five-year plans.

compiled by the Manufacturing Census. The Manufacturing Census used to be an annual survey of all establishments, but recently the complete census survey has been undertaken only in years that end in 0, 3, 5 or 8, while in other years there is a supplementary survey of only establishments with four or more employees. The survey consists of Survey A for establishments with 30 or more employees, and the simpler Survey B, aimed at establishments with 29 or fewer employees. The total number of establishments covered is about 650,000, of which about 60,000 fall into the Survey A category. The Manufacturing Census survey is conducted by survey staff who have been appointed in each geographical district for on-site surveying, so that the opening of new establishments and the closing of existing ones are accurately reflected in the list of establishments in the survey.

Every year, the survey is conducted by using the identification number for each establishment, which is called the establishment code, so that the longitudinal data can be compiled based on this code. The data used in this paper are annual panel data from 1986 and 1999, and are unbalanced panel data reflecting a significant number of entries and exits of establishments. It should be noted that a complete census survey is not conducted every year, but only establishments with four or more employees are surveyed in some years. Therefore, the identification code table for all establishments from 1986 to 1999 was compiled first, and each year's data for establishments with four or more employees were linked to this ID code table[6]. The total number of establishments appearing in the table is 1,234,828. The number of establishments with four or more employees was 437,574 in 1988 and 373,713 in 1998, and 236,565 of them appear in datasets throughout the period from 1988 to 1998.[7]

It should be noted that the establishment-level turnover of these datasets not only reflects entries and exits of establishments, but also includes changes in the number of establishments across the survey threshold. The share of 1-3 employee establishments in the total number is 41.9%, but this accounts for 5.4% in employment and 1.8% in value added in 1998. Therefore, it is assumed that biases associated with missing these establishments are small for the employment and productivity analysis provided later in this paper. In addition, it is observed that the attrition rate of very small

[6] Establishments with 1-3 employees are surveyed in complete census years, but individual plant data are not available in a computer-readable format. Therefore, data for '4+ establishments' are used for all years in this paper.

[7] This number of 4+ establishments is measured in census years, such as 1988 and 1998, instead of 1986

firms is very high, and such fragile SMEs are not good control samples for analyzing the impact of SME innovation promotion policy.

The variables covered in this dataset are shipments, material input, number of employees, wages, the four-digit Japanese Industrial Classification (JSIC) code, etc. Information on capital inputs such as investments and the book-value capital stock amount is available only for establishments with 10 or more employees. Real value added for each establishment in each year is calculated by using input and output deflators at the three-digit JISC level.[8]

(2) Linkage with List of Firms Subject to SME Policy

Analysis on the effectiveness of innovation policy was carried out by linking a list of the firms that are receiving policy assistance, such as subsidiaries or low-interest financing systems, with the manufacturing census longitudinal data just mentioned above. Linkage has been conducted by aggregating establishment census data to the firm level by using firm identifiers first, and matching them by the firm's name and address, with the list of firms supported by the two laws on SME innovation promotion. As of June, 2001, there are about 7,400 companies that are subjects of the Law for Promotion of Creative Business Activities of SMEs that began in 1995 (of these, about 2,800 are those whose main business are manufacturing). And the Law on Supporting Business Innovation of SMEs that began in 1999 has about 1,400 companies as subjects (of these, about 800 are those whose main business are manufacturers). We were able to make a linkage for 1,360 companies (3,123 establishments) for the former law and 392 companies (1,004 establishments) for the latter law. Moreover, when a firm is the subject of SME policies, innovation benefits such as new technology and new product development tend to appear in all the establishments owned by the firm in question. Therefore, the analysis in the following sections is conducted at the establishment level.

4. SMEs in Competitive Environment and Implications for Innovation Policy

METI is preparing various kinds of support schemes for the purpose of promoting innovation, taking the view that SMEs are a source for the creation of employment and economic dynamism. In

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and 1999, since the census year survey is more reliable than that in other years.

[8] The deflator at the three-digit JSIC level, with 176 sectors for manufacturing, is compiled by using information from input-output tables in Japan.

this sense, it is important to evaluate this hypothesis, serving as a lynchpin of METI's SME innovation promotion policy, before program evaluation on specific policy scheme is conducted. In this section, using the manufacturing census longitudinal data, I will describe micro-level performance of SMEs and their role in shaping industrial dynamism in competitive environment.

There are some stylized facts on micro-level dynamics are commonly found in many countries. First, concerning the relationship between firm size and speed of growth, in many countries it can be observed that the smaller the size of the firm, the greater the speed of expansion of the firm scale, in terms of number of employees (Caves (1998)). Even in countries such as the U.S. and France, where recently there is a growing trend for large corporations to downsize, a move to expand employment in SMEs can be seen (Motohashi (1998)). At the same time, in contrast to the employment level in large corporations, where changes occur comparatively steadily, in smaller companies changes in employment tend to be dramatic, and frequently lead to business closings. Therefore, we need to be aware of the possibility that if we look only at the trends of surviving companies, there may be a upward sampling bias on the growth rate. That is, the second stylized fact is that the smaller the scale of the firm, the greater the variance in the speed of its growth.

The Passive Learning Model (Javanovic (1982)) can be used as a model to explain such stylized facts related to firm growth. This model is constructed under the assumption that each firm (owner) has its own level of ability, but at the time of establishing the firm, the firm (owner) does not have such information. In this sense, information on managerial ability is passively learned in the course of conducting operations, and decision on the expansion or contraction of the firm is made, based on the posterior of managerial ability, inferred by past information of firm's performance. According to this model, the smaller the scale of the firm, the greater the variance in growth, and moreover, the greater the speed of growth of surviving companies. （Dunne, Roberts and Samuelson (1988)）.

In contrast, there is another model in which the owner is aware of his/her own level of ability and the relevant market conditions, and there is active exploitation by the owner whereby management decisions take place as profitability parameters change stochastically over time (Ericson and Pakes (1995)). A major difference between this model and the passive learning model lies in whether or not the ability parameter changes over time, i.e. time invariant for passive learning model, vs time variant for active exploitation model. An empirical test to distinguish between two models is

provided in Pakes and Ericson (1998). It has been shown that in the U.S., companies involved in the distribution business follow the style of the passive learning model, while those in manufacturing tend to follow a pattern close to the active exploitation model.

Depending on whether the economy actually follows a passive learning model or an active exploitation model, policy implications change dramatically. That is, in the passive learning model, as a firm grows and gets older, the speed of size growth decreases and becomes stable due to more precision on inferring its managerial ability. Therefore, dynamic economic changes occur only as a result of exit of low-productivity firms out of the market and firm and productivity growth in newly established firms. In this world, it is important to promote new firm openings and to remove obstacles to firms' exits. In contrast, the active exploitation model assumes that managers are facing competitive pressure from other firms, and actively exploiting any possibility to improve its performance. In this world, policy for nursing competitive environment for innovation creation is important, and revitalization of existing SMEs can be also a policy target.

By means of the industrial statistics panel data, we can see the relationship between the entry and exit of establishments and firm scale and productivity. In Table 1, all establishments are classified into groups by looking at and whether or not the establishments in question survived in each year of the complete census, i.e., 1988 (T=1), 1990 (T=2), 1993 (T=3), 1995 (T=4) and 1998 (T=5). For example, Group 123 denotes establishments that existed in 1988, 1990 and 1993, but not in 1995 and 1998. Hence, these establishments must have exited out of the market between 1993 and 1995. In another example, the establishments which survived through all the years are depicted in the diagram as 12345.

Firstly, it is clear that those establishments that survived over all years are comparatively large and have a high level of labor productivity. Further, establishments which opened between 1989 and 1990 and which survived up till 1998 (Group 2345), and establishments which opened between 1996 and 1998 (Group 5) also have comparatively high productivity. On the other hand, establishments which also opened between 1989 and 1990 but closed by 1997 (Groups 2, 23, and 234), were small in size and their productivity level was relatively low from the beginning. If we look at employment and productivity growth, compared to establishments which continue to exist over time, establishments which opened in 1989 or later have a relatively high growth rate. In particular, during the 1995-1998 period, when there was a dramatic decrease in the number of

employees in the manufacturing industry in general, those establishments which opened in 1996 or later showed a growth trend. Since there is also a growth trend in labor productivity for these establishments, rapid expansion in establishment scale is indicated.

The foregoing observations suggest that Japan's manufacturing industry follows a pattern that can be explained by the Passive Learning Model, in which the firm scale is small for comparatively young establishments, while employment and labor productivity has large variance. However, there are some evidences that there are dynamic trends in SMEs with a steady, relatively large scale, as well. For establishments that survived over time, I investigated employment and labor productivity growth by grouping based on whether or not changes in the JSIC three-level industrial classifications between 1988 and 1993 or between 1993 and 1998 occurred. As you can see from Table 2, establishments without a JSIC change tend to have a slightly large scale and higher productivity, but the difference is not all that large. On the other hand, looking at growth in labor productivity, those establishments with a JSIC change show a higher growth rate. Since the labor growth rate is at almost the same level as for those establishments without a JSIC change, this implies that this growth in productivity was brought about by an expansion in added value. Thus, it is true that economic dynamism is brought about not only by establishment entry and exit, but also by business innovation for creating new markets on the part of existing establishments.

As shown in the above observations, SMEs can be a potential spring of economic dynamism leading to expansion of employment and growth in added value during sluggish overall economic conditions in Japan. At the same time, it is also true that SMEs are always in an unstable position in changing economic and managerial conditions. Traditional SME policies are focused on reducing the handicaps of SMEs compared to large corporations in areas such as the lack of economic resources and difficulties in obtaining capital and personnel. However, it has become more important to formulate policies to develop SMEs as sources of growth. From this viewpoint, the concern is how to support SMEs with growth potential, and how to induce innovative activities for transforming potentiality into actual growth. In this case, the promotion of high-growth venture businesses is of course important, but it is also no less important to encourage business innovation in existing corporations, in order to revitalize the whole economy.

5. Evaluation of SME Innovation Policy

Evaluation of METI's SME innovation policy in this section addresses the following two questions. The first is whether or not policy support offered under the two innovation promotion schemes has reached SMEs with the targeted characteristics, i.e., relatively new and high-tech firms for the Law for Promotion of Creative Business Activities of SMEs (Creative Activity Law: CAL) and relatively stable existing firms for the Law on Supporting Business Innovation of SMEs (Business Innovation Law: BIL). Since the selection process of both schemes is initiated by participants, it is important to check whether each firm has applied to the right scheme in line with the policy-makers' intentions.[9] The second question is whether or not policy programs have an impact on a firm's business performance, such as growth in sales, employment and productivity. In this program evaluation, it is important to check the marginal effect of program participation, because participating firms might have performed well even without program participation. It is impossible to conduct an experimental study in the social science field, but this kind of question can be addressed by using datasets with good control samples (Jarmin and Jensen (1997)), as is the case for this study. This performance evaluation study is conducted only for the Creative Activity Law, because the Business Innovation Law just started in 1999, and no data on after-program performance are available.

Summarized statistics based on manufacturing census longitudinal data with SME innovation policy participant identifiers are provided in Table 3. It was found that for both schemes, participant firms are relatively large in employment size, and high in labor productivity, average wage and capital/employment ratio. In addition, participating firms show better business performance in the growth rates of sales, employment and labor productivity. It is important to keep in mind the timing of policy support to see whether this comes from original managerial ability or from program participation. The scheme under the Creative Activity Law started in 1995, and the starting year of the project for each participant is distributed from 1995 to 2001, while the Business Innovation Law has just started in 1999. It is observed that participants showed better performance well before program participation for both laws. Table 3 also shows information on the establishment age and changes in industrial classification at the three-digit JSIC level from 1988 to 1998. In this respect, CAL participants and BIL participants show different patterns, that is, the share of younger

[9] It should be noted that this selection process by SMEs is not completely endogenous, because an applicant for some supporting scheme often asks program officers for advice on the scheme best fitting their needs.

establishments and JSIC change are greater than average for CAL participants, but smaller than average for BIL participants.

To control for industry and size effect on the distribution of business performance, I conducted probit analysis for both CAL establishments and BIL establishments. As can be seen in Table 4, labor productivity growth premiums before program participation disappear for both laws after controlling for industry, size and other effects. In contrast, ex-ante premiums on sales growth rate do not disappear for either law, and ex-ante employment growth rates have a positive correlation with BIL participation. Accordingly, a firm with growth intension, instead of improving efficiency, is likely to apply for the innovation promotion schemes. In addition, this firm is presumed to have the managerial ability to expand its business, and to gain a suitable market share.

It should be noted that positive and statistically significant coefficients to dummy variables for firms born after 1994 can be found not only for CAL participants, but also for BIL participants. Therefore, the smaller share of these firms of the BIL participants in Table 3 is biased, presumably due to the size characteristics of BIL large establishments with a larger share. The Business Innovation Law is designed to stimulate product or process innovation for relatively stable existing SMEs, in contrast to the Creative Activity Law, which promotes high-tech ventures. However, it was found that BIL participants and CAL participants have similar characteristics, i.e., they are both relatively new, large in size and growing faster than average. The first look at the manufacturing census longitudinal data suggests an overlapping of policy targets by the two laws.

The performance evaluation study was conducted for the Creative Activity Law. The scheme under the Creative Activity Law started in 1995, and each participating firm is conducting projects on R&D, product development, etc., according to the approved plan lasting from one to five years. The distribution of the timing of the project is presented in Table 5. Out of the 3,123 establishments in this dataset, about 500 establishments start the project each year, and 855 establishments are still active in 2001. Since the project covers the whole process from product development to the marketing of new products, most participants finished the development stage in the first few years. Therefore, in the following analysis, post-project performance evaluation is provided for CAL participants, which started the project before 1997.

OLS estimates of the effect of CAL participation on the sales growth rate from 1996 to 1999 are

presented in Table 6. The value of sales is used for the business performance indicator, since it is relevant in evaluating the short-term effects of the program, as compared to the productivity, which can be achieved over a relatively long term. In addition, by using the growth rate, time-invariant fixed effects, such as managerial ability, can be controlled.[10] As compared to non-participants, participating establishments achieved about 1.3% more sales, after controlling for employment growth rates and other plant characteristics such as industry and size class. When all participants are split up by the timing of the project, starting before 1997 or after 1998, the group before 1997 shows 2.5% more sales growth, while groups after 1998 show no difference compared to non-participants. The same regression was conducted for each size class in 1995. Positive and significant coefficients can be found for more than 10 employee establishments, but not for the category of 10 or fewer employees.

As is shown in Table 4, CAL participants show better performance in sales growth before participation. In addition, there is also an exogenous selection process by the government for approval of CAL projects. Therefore, in order to derive the pure effect of program participation, we need to control for these selection biases. In this paper, Heckman's two-step procedure[11] is used to derive consistent estimates on the effect of CAL participation.

The first model is based on the assumption that coefficients for control variables are identical for participants and non-participants.

$$y_i = b_i X_i + gCAL + u_i \qquad (1)$$

$$p_i^* = d_i Z_i + e_i, \quad \text{CAL=1 iff} \quad p_i^* > 0 \text{ ; otherwise CAL = 0} \qquad (2)$$

The effect of CAL participation is evaluated by the coefficient γ after controlling for X in equation (1). The participation of CAL is determined by equation (2), but we can observe only CAL (participate or not participate), and not p*. If the error terms in the two equations are independent of each other, the OLS estimation of the first equation gives us a consistent estimate of γ, but this may not be the case. By assuming that the error terms of both equations are jointly normally

[10] Using the growth rate as a dependent variable gives fixed effect estimators in panel data analysis. Taking three-year differences gives a better estimate compared to using shorter year differences, such as the first difference model, when there are measurement errors in independent variables. (Griliches and Hausman (1986))

[11] Heckman's two-step method is described in most standard textbooks in econometrics. The econometric technique used in this paper is derived based on Maddala (1983).

distributed with the covariance matrix in (3), the expected values of u_i is determined by (4) or (5), depending on CAL=1 or 0.

$$Cov(u_i, e_i) = \begin{bmatrix} s_u & s_{ue} \\ s_{ue} & 1 \end{bmatrix} \quad (3)$$

$$E(u_i / CAL = 1) = E(u_i / e_i > -d_i Z_i) = s_{ue} \frac{f(d_i Z_i)}{\Phi(d_i Z_i)} \quad (4)$$

$$E(u_i / CAL = 0) = E(u_i / e_i < -d_i Z_i) = -s_{ue} \frac{f(d_i Z_i)}{1 - \Phi(d_i Z_i)} \quad (5)$$

In this situation, Heckman suggested computing $d_i Z_i$ by probit with equation (2) in the first step, and calculating (4) or (5) for each observation, which is used for the OLS estimate of equation (1) in the second step. Table 7 provides the results of this estimate procedure.[12] Here, I compared CAL participants who started the project before 1997 to non-participants. The second step regression is conducted with or without size dummies. The statistically significant coefficient CAL in the second step is found for the regression without size dummies, while it is not found in the regression with size dummies. This result imply that CAL effect on sales growth is undertain at this stage, or the assumption on the same coefficients with control variables for participants and non participants is too strong.

In the second model, the assumption of the identical coefficients of control variables is relaxed, as follows:

$y_{1i} = b_{1i} X_i + u_{1i}$ (for participants; CAL=1) (6)

$y_{0i} = b_{0i} X_i + u_{0i}$ (for non participants; CAL=0) (7)

$p_i^* = d_i Z_i + e_i$, CAL=1 iff $p_i^* > 0$; otherwise CAL = 0 (8)

and we assume that u_{0i}, u_{1i} and e are jointly normally distributed with the covariance matrix in equation (9).

[12] Due to the prohibitively large size of the original dataset, the empirical analysis is conducted based on random sampling data with 5000 observations for non participating controlling samples.

$$Cov(u_{0i,}u_{1i},e_i)=\begin{bmatrix} s_0 & s_{01} & s_{0e} \\ s_{01} & s_1 & s_{1e} \\ s_{0e} & s_{1e} & 1 \end{bmatrix} \qquad (9)$$

The methodology of estimation is similar to that of the first model, i.e., estimating $d_i Z_i$ with equation (8) by probit in the first step, and calculating the inverse Mill's ratio[13], then conducting OLS estimation of (6) and (7) separately with the estimated inverse Mill's ratio. In this model, it is possible to calculate the expected gross benefit for CAL establishments through program participation, i.e., to what extent the sales growth rate goes up as compared to the case if the establishment had not participated in CAL program, by the following equation:

$$E(y_{1i}/CAL=1)-E(y_{0i}/CAL=1)=X_i(b_1-b_2)+(s_{1e}-s_{2e})\frac{f(d_iZ_i)}{\Phi(d_iZ_i)} \qquad (10)$$

Fig. 1 gives the plant distribution of the value in equation (10) for participants. More than 80% of plants shows positive value and the peaks is in the category from 5% to 10% more growth rate. Therefore, it is possible to say that CAL participation has positive impact on sales growth, even after controlling for sample selection.

Heckman's two step procedure is a popular approach for program evaluation analysis by data with possible selection bias, but it is based on strong assumption of the normality in the distribution of error terms. There are recent studies showing that the parameter estimates are strongly sensitive to the distributional assumptions. In addition, when most of independent variables for the first step and the second step are overlapped as is the case for this study, regression results may give inconsistent estimates due to identification problem. In this sense, the results presented here should be read with great care, and I will conduct sensitivity analysis by using different kinds of model specification, including semi parametric or non parametric approach proposed by Heckman (1990), in the future research.

[13] $\frac{f(d_iZ_i)}{\Phi(d_iZ_i)}$ for participants and $-\frac{f(d_iZ_i)}{1-\Phi(d_iZ_i)}$ for non participants

6. Conclusion

In this paper, the manufacturing census longitudinal dataset is used for analysis of SME innovation policy. METI's SME policy is in the process of major transformation, which takes into account the greater and greater growth potential of SMEs and treats them as a source of industrial dynamism for the Japanese economy. By establishment-level micro-data, it is confirmed that small and young plants have greater potentiality for growth, but it is also shown that volatility of growth rate is high for small establishments. In this sense, the focus of SME policy should be put on supporting SMEs, so that they do not fall out of the growth path and are able to realize their growth potential.

Analytical work on evaluation of specific policy schemes, namely, the Law for Promotion of Creative Business Activities of SMEs and the Law on Supporting Business Innovation of SMEs is also provided. Participants in these two schemes show higher sales growth rates before program participation, which implies that policy support seems to be provided for SMEs with greater potentiality for further growth. However, it is also observed that similar kinds of firms are applying to these two schemes, and that these two supporting schemes could overlap. Although more detailed study on the characteristics of participating firms is needed, this information should be taken into account for the future reform of METI's SME innovation policy. Performance evaluation of the Creative Activity Law was also conducted. In general, the policy scheme under the Creative Activity Law works well. However, further analysis based on more detail data and semi or non parametric estimation methodology to control for selectivity bias is needed to show more clear view on effects of the innovation policy and to provide more specific recommendations for improvement of the existing policy scheme.

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Table 1. Productivity and Employment by Establishment Type (entry, stay and exit)

Est Type	# of obs.	VAE63	VAE2	VAE5	VAE7	VAE10	EMP63	EMP2	EMP5	EMP7	EMP10
		1988	1990	1993	1995	1998	1998	1990	1993	1995	1998
1	88903	502	.	.	.	.	14	.	.	.	.
12	42845	485	544	.	.	.	13	12	.	.	.
123	30387	484	553	526	.	.	15	15	13	.	.
1234	46358	518	587	572	553	.	17	17	16	14	.
12345	236565	646	739	736	737	723	34	35	35	34	31
2	41624	.	579	.	.	.	.	15	.	.	.
23	10175	.	546	530	.	.	.	12	11	.	.
234	13092	.	573	584	571	.	.	13	13	12	.
2345	49494	.	667	701	710	697	.	20	22	22	21
3	37688	.	.	639	.	.	.	.	16	.	.
34	2928	.	.	467	437	.	.	.	7	6	.
345	5952	.	.	549	543	540	.	.	9	10	10
4	45384	.	.	.	698	.	.	.	.	18	.
45	2791	.	.	.	468	484	.	.	.	8	8
5	83763	.	.	.	.	728	.	.	.	.	18

		EMPG632	EMPG25	EMPG57	EMPG710	VAEG632	VAEG25	VAEG57	VAEG710
		1988-90	1990-93	1993-95	1995-98	1988-90	1990-93	1993-95	1995-98
1	88903	.	.	.	.	.	.	.	.
12	42845	-1.55%	.	.	.	8.27%	.	.	.
123	30387	-0.79%	-3.54%	.	.	8.65%	-0.41%	.	.
1234	46358	-0.26%	-2.17%	-2.93%	.	9.08%	0.55%	1.69%	.
12345	236565	1.04%	-0.68%	-0.60%	-1.62%	9.62%	1.49%	2.64%	0.46%
2	41624	.	.	.	.	.	.	.	.
23	10175	.	-2.10%	.	.	.	2.55%	.	.
234	13092	.	-0.70%	-1.77%	.	.	3.68%	2.98%	.
2345	49494	.	1.00%	0.66%	-0.36%	.	4.73%	4.53%	0.90%
3	37688	.	.	.	.	.	.	.	.
34	2928	.	.	0.11%	.	.	.	3.81%	.
345	5952	.	.	2.24%	0.59%	.	.	4.70%	1.04%
4	45384	.	.	.	.	.	.	.	.
45	2791	.	.	.	1.26%	.	.	.	1.62%
5	83763	.	.	.	.	.	.	.	.

Table 2. Productivity and Employment by JSIC Change

	# of obs.	Labor Productivity Level					Employment Level				
		1988	1990	1993	1995	1998	1998	1990	1993	1995	1998
All	236620	682	758	719	737	800	34	35	35	34	31
JSIC no change	170734	719	788	747	762	823	36	37	37	36	33
JSIC change 88-93	17871	616	715	685	704	796	32	33	31	30	29
JSIC change 93-98	10791	617	702	651	686	774	30	31	29	28	27
JSIC change 88-93-98	37224	559	652	619	645	704	26	27	27	26	23

	# of obs.	Labor Productivity Growth				Employment Growth			
		1988-90	1990-93	1993-95	1995-98	1988-90	1990-93	1993-95	1995-98
All	236620	9.45%	-0.09%	0.47%	3.16%	1.04%	-0.68%	-0.60%	-1.62%
JSIC no change	170734	8.36%	-0.14%	0.36%	2.75%	1.02%	-0.48%	-0.61%	-1.67%
JSIC change 88-93	17871	13.33%	0.56%	0.75%	4.63%	1.89%	-0.99%	-0.17%	-1.37%
JSIC change 93-98	10791	11.15%	-0.68%	0.88%	4.60%	1.20%	-1.34%	-0.70%	-1.47%
JSIC change 88-93-98	37224	12.23%	-0.01%	0.79%	4.04%	0.64%	-1.34%	-0.79%	-1.55%

Table3 . Summary Statistics of Policy Evaluation Dataset

	Creative Activity	Business Innovation	All
Number of Establishment	3123	1004	375133
Employment			
1988	48.0	50.4	23.7
1999	39.5	42.5	20.1
Labor Producrivity			
1988	803.0	845.9	633.2
1999	901.0	963.2	700.0
Average Wage			
1988	321.4	325.8	277.5
1999	390.9	386.3	338.8
Capital/Employment Ratio (*)			
1988	321.7	384.6	296.9
1999	552.2	649.1	505.5
Sales Growth (annaul)			
1988-90	10.01%	7.40%	7.11%
1990-93	-0.85%	-0.03%	-0.77%
1993-96	4.02%	3.30%	1.35%
1996-99	0.03%	0.68%	-2.68%
Employment Growth (annaul)			
1988-90	2.35%	1.79%	1.01%
1990-93	0.12%	0.76%	-0.42%
1993-96	0.07%	-0.01%	-0.49%
1996-99	-1.10%	-0.69%	-1.61%
LP Growth (annaul)			
1988-90	11.96%	8.57%	9.35%
1990-93	1.08%	1.34%	0.52%
1993-96	5.18%	3.93%	3.34%
1996-99	0.28%	-0.04%	-0.98%
Share of est. open after 1996	27.1%	24.3%	24.8%
Share of est. open after 1991	13.0%	11.7%	12.9%
Share of est. open before 1988	59.9%	64.0%	62.3%
Share of est. JSIC change	32.5%	26.0%	27.9%
Share of est. no JSIC change	67.5%	74.0%	72.1%

* Capital Stock data is available only for establishment with 10 and more employments

Table 4a. Probit Analysis (Creative Activity Establishment=1)
(t-value in parenthses, statistical significance at 1% level for *, 5% level for **, 1(

Sales Growth, 93-96	-	0.15* (7.67)			
Value Added Growth, 93-96	-		0.03 (0.89)		
Employment Growth, 93-96	-			-0.10 (1.00)	
Labor Prod. Growth, 93-96	-				0.04 (1.74)
Firm Born After 1994(+)	0.15* (72.20)	-0.05 (0.57)	-0.06 (0.72)	-0.04 (0.31)	-0.06 (0.71)
Firm Born After 1989(+)	0.02 (0.89)	0.02 (1.03)	0.03 (2.51)	0.03 (2.42)	0.04 (2.59)
Single Plant Firm(++)	-0.23** (189.75)	-0.16** (58.75)	-0.16** (59.06)	-0.15** (58.26)	-0.16** (58.76)
Single Plant+Single HQ Firm(++)	-0.10 (20.90)	-0.07** (5.83)	-0.08 (7.13)	-0.07** (6.18)	-0.08 (7.10)
Industry Dummy	yes	yes	yes	yes	yes
Size Dummy	yes	yes	yes	yes	yes
N	375133	259508	268374	271242	268374
LogL	-16540.7	-11361.6	-11654.3	-11781.1	-11653.9

Note: +: as compared to firm born before 1988
++: as compare to multiple plant firm

Table 4b. Probit Analysis (Business Innovation Establishment=1)
(t-value in parenthses, statistical significance at 1% level for *, 5% level for **, 1(

Sales Growth, 96-99	-	0.20* (17.37)			
Value Added Growth, 96-99	-		0.06 (1.90)		
Employment Growth, 96-99	-			0.49* (14.65)	
Labor Prod. Growth, 96-99	-				0.00 (0.00)
Firm Born After 1994(+)	0.08* (9.04)	0.02 (0.31)	0.03 (0.74)	0.03 (0.77)	0.03 (0.95)
Firm Born After 1989(+)	-0.03 (0.60)	-0.04 (1.18)	-0.04 (1.26)	-0.04 (1.20)	-0.04 (1.20)
Single Plant Firm(++)	-0.31* (146.64)	-0.25* (69.63)	-0.27* (87.73)	-0.27* (89.56)	-0.27* (87.94)
Single Plant+Single HQ Firm(++)	-0.12* (13.52)	-0.08** (4.63)	-0.11* (8.38)	-0.11* (7.69)	-0.11* (8.41)
Industry Dummy	yes	yes	yes	yes	yes
Size Dummy	yes	yes	yes	yes	yes
N	375133	276711	285621	289715	285621
LogL	-6362.53	-4951.86	-5119.97	-5230.55	-5120.77

Note: +: as compared to firm born before 1988
++: as compare to multiple plant firm

Table 5. Number of CAL participating establishments

	1995	1996	1997	1998	1999	2000	2001
# of est. started	220	729	570	511	597	426	70
# of est. active	220	916	1264	1329	1403	1303	855
# of est. finished	0	33	222	446	523	526	-

Table 6. OLS Estimate : Impact of Creative Activity Law
(Dependent Variable= Sales Growth, 1996-99)
(t-value in parenthses, statistical significance at 1% level for *, 5% level for **, 10%

	All establishments		EMP=<10	10<EMP EMP=<50	50<EMP
Creative Activity Est.	0.013* (4.58)	-	-	-	-
Creative Activity Est. (started project before 1997)	-	0.025* (6.03)	0.007 (0.79)	0.030* (5.15)	0.029* (4.21)
Creative Activity Est. (started project after 1998)	-	0.002 (0.55)	0.006 (0.74)	0.001 (0.20)	-0.003 (0.04)
Employment Growth, 96-99	0.646* (208.60)	0.646* (208.61)	0.608* (132.47)	0.674* (142.13)	0.698* (79.88)
Firm Born After 1994(+)	0.036* (46.87)	0.036* (46.87)	0.032* (30.35)	0.042* (32.50)	0.042* (16.72)
Firm Born After 1989(+)	0.011* (13.75)	0.011* (13.76)	0.010* (9.26)	0.011* (8.52)	0.014* (5.95)
Single Plant Firm(++)	-0.006* (7.33)	-0.006* (7.32)	-0.010* (6.40)	-0.006* (5.83)	0.000 (0.43)
Single Plant+Single HQ Firm(+	-0.005* (4.52)	-0.005* (4.52)	-0.008* (4.24)	-0.006* (3.75)	0.000 (0.18)
Industry Dummy	yes	yes	yes	yes	yes
Size Dummy	yes	yes	-	-	-
N	289715	289715	229204	116759	29170
R-square	0.142	0.143	0.115	0.167	0.199

Note: +: as compared to firm born before 1988
++: as compare to multiple plant firm

Table 7 OLS and 2 Step Estimate : Impact of Creative Activity
(Dependent Variable= Sales Growth, 1996-99)
(t-value in parenthses)
(statistical significance at 1% level for *, 5% level for **, 10%

	First Step (Probit)	Second Step(1)	Second Step(2)
Creative Activity Est. (started project before 1997)	-	0.041 (0.94)	0.068* (4.09)
Inverse Mills Ratio	-	-0.023 (0.61)	-0.039* (4.78)
Employment Growth, 93-96	0.085 (0.30)	-	-
Employment Growth, 96-99	- -	0.602* (22.80)	0.600* (22.78)
Firm Born After 1994(+)	- -	0.014 (0.80)	0.012 (0.69)
Firm Born After 1989(+)	-0.132 (0.51)	0.020* (3.44)	0.020* (3.44)
Single Plant Firm(++)	-0.236* (11.40)	-0.005 (0.58)	-0.002 (0.36)
Single Plant+Single HQ Firm(++)	0.075 (0.91)	0.002 (0.18)	0.003 (0.40)
Industry Dummy	yes	yes	yes
Size Dummy	yes	yes	no
N	3787	3502	3502
LogL	-2029	-	-
R-square	-	0.138	0.137

Note: +: as compared to firm born before 1988
++: as compare to multiple plant firm

Fig. 1 : Sales Growth Effect of Creative Activity Law
(Annaul Sales Growth 1996-99, N=1519, Mean=+4.12%)