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The Impact of Direct Payments in Less Favored Areas on Agricultural Land Use and Farm Numbers: An Instrumental Variable Approach with Panel Data

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Abstract:

We examine the effect of direct payments in less favored areas (LFAs) on agricultural land use and farm numbers in Japan, using large panel data at the community level from the Census of Agriculture in 2000 and 2005. These direct payments, which take a unique form in Japan, are made to rural communities with specific natural handicaps and that are designated as "less favored," as compensation for the additional costs of agricultural production in LFAs. This study uses the location of a community (whether a community with specific natural handicaps is located in LFA) as an instrument for the community's receipt of direct payments. Our instrumental variable estimates indicate that from 2000 to 2005, LFA payments fostered continued land use and prevented farmland abandonment through the maintenance of farm households. In other words, LFA payments helped make farming in these areas viable.

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Keywords: less favored area, direct payment; instrumental variable, difference-in-differences, Japan

1. Introduction

Less favored areas (LFAs) are those with natural handicaps (e.g., lack of water, unsuitable climate, short crop season, and depopulation tendencies), or that are mountainous or hilly, as defined by their altitude and slope (Organisation for Economic Co-operation and Development, 2000). LFAs play an important role in maintaining highly valuable landscape based on the history and culture of the country, biodiversity, rural cultural heritage, general living and working space, among others. However, compared to farming in non-LFAs, farming in LFAs is difficult owing to unfavorable natural conditions for agricultural production. As a result, an exodus from farming in LFAs has led to large-scale depopulation of rural areas and the abandonment of agricultural land, especially causing various problems related to rural development. To prevent many people from giving up farming, direct payments for farming are an important tool to support the income of family farm businesses within LFAs. The logic of intervention is to maintain a farming industry in such areas to prevent the process of rural depopulation, to take action against the abandonment of agricultural land or its conversion to alternative land uses (Institute for European Environmental Policy, 2006), and to maintain the environmental benefits of agriculture in LFAs where agriculture is the dominant land use (Organisation for Economic Co-operation and Development, 2010). In addition, chronically low and highly variable incomes of farm households have been among the main reasons for policies that support farm income (Gardner, 1992). As a result of rising farm incomes, abandonment of farming could be mitigated if the viability of farm businesses were maintained. For instance, the European Union (EU) has been long aware of this role of LFAs. The LFA policy of the EU has a long history as part of the Common Agricultural Structural Policy since 1975.

The impact of agricultural support direct payments on agricultural output and factor markets is a key policy issue, as “green-box” payments are exempted from World Trade

Organization restrictions. In spite of these important issues for economists and policymakers, Ahearn et al. (2005) concluded that "our understanding of how government policies have affected the structure of agriculture, or how future policies could be designed to promote specific outcomes remains limited." In particular, there is little empirical research on the impact of direct payments in LFAs compared with the sizeable body of literature on the impact of direct payments in non-LFAs. From the viewpoint of maintaining farming activity and the rural population in LFAs, there is limited quantitative evidence on the positive correction between LFA payments and agricultural land use. Zawalinska, et al. (2013), using a multi-regional computable general equilibrium model, found a positive correlation between direct payments and retention of marginal agricultural land use in Poland, but the size of the effect is small. However, such simulation results are rather sensitive to hypotheses made by modelers, and these hypotheses are essentially represented by an arbitrary (implicit or explicit) factor (Moro and Sckokai, 2013). As noted by the Institute for European Environmental Policy (2006), supporting statistics from national-level data from 1990 to 2003 show that agricultural land use in LFAs has, by and large, been maintained at the EU level and land abandonment does not appear to have occurred to any significant degree based on land-use change. Furthermore, with regard to the absolute rate of change in farm numbers, it appears that the rate of decline in LFAs and non-LFAs within countries does not differ greatly and there is no clear relationship with the level of LFA payments.

The lack of previous studies providing causal evidence can be attributed largely to complex government programs. First, it is difficult to identify the impact from various policies other than LFA payments. In practice, government programs frequently have different objectives that are difficult to conceptualize, and each program often uses a large set of diverse instruments to accommodate these goals: programs might stimulate demand for agricultural output, regulate output prices directly, or influence production processes (Pufahl

and Weiss, 2009). In the case of the EU, it is complicated to separate the effects of the LFA measure on land use from other policy measures, such as Pillar One support, agri-environment and other rural development measures, or external factors, including market prices (Institute for European Environmental Policy, 2006). Second, econometric studies on direct payments face endogeneity problem, as participation in farm programs is typically voluntary (Moro and Sckokai, 2013). Many studies treat the assignment of direct payments as random (c.f., O'Donoghue and Whitaker, 2010; Weber and Key, 2012). Most types of capital subsidies in the EU and the United States are not assigned randomly, since they have eligibility conditions and selection criteria that can be met only by certain types of firms (Nilsson, 2017). Therefore, in most instances, it is unclear what causes a variation in payments across observationally similar farms, opening the possibility that unobservable factors could be associated with both program participation (or payment levels) and outcomes, such as agricultural production (Weber and Key, 2012). Thus, we should be concerned about omitted variable correlation with both direct payments and agricultural land use. Third, program participation is also often universal, such that national and local governments provide direct payment to all farmers who fulfill the required conditions. As a result, because there is no control group to compare to the treatment group—a prerequisite for standard program evaluation—it is difficult to identify the effect of direct payments.

In this study, we examine the effect of direct payments on agricultural land use and farm numbers in LFAs in Japan. LFAs cover 40.6% of Japan's farmland, and account for 40.3% of gross agricultural output. Direct payments were introduced in fiscal 2000 for the purpose of helping to foster continued land use and prevent land abandonment through maintaining farm production activities, thereby helping to maintain the countryside and the viability of rural communities in these areas. LFA payment measures employed in Japan are advantageous in terms of econometric analyses (see Section 2 for more details). These direct payments, which

take a unique form in Japan, are made to rural communities with specific natural handicaps and that are designated as “less favored,” as compensation for the additional costs of agricultural production in LFAs. Rural communities located in designated “less-favored” areas are eligible for these payments. This study uses the location of community (whether a community with specific natural handicaps is located in this area) as an instrument for the community’s receipt of direct payments. In addition, we employ panel data on rural communities from the Census of Agriculture in 2000 and 2005. Using panel data allows us to control for growth trends and unobservable factors correlated with receipt of direct payment and outcomes (land use and farm numbers) that could bias estimates. Thus, a contribution of this study is that it econometrically analyzes the effects of LFA payments. In addition, fortunately, there are no direct payment measures to the communities in this study other than LFA payments in the analysis target period. Therefore, we do not need to separate the impact of the LFA measure from other policy measures. Finally, previous studies on the impact of LFA payments have been restricted to the EU. The applicability of the conclusions arising to Japan has been debatable owing to important differences in the nature of government support between the EU and Japan. Therefore, it is important to assess the impact of LFA payments in Japan on agricultural land use and farm numbers.

The following Section 2 briefly describes policy background. The estimation method and data used are outlined in Section 3. Section 4 presents the estimation and instrumental variable diagnostics. Section 5 presents the empirical results and robustness checks. Section 6 draws conclusions from the findings.

2. Policy Background

The Japanese government has long recognized the special characteristics of LFAs. Conventionally, the Japanese government has considered an LFA to be a hilly or mountainous

area. Hilly and mountainous areas are formally defined as designated areas under eight less favored area development laws, including the Mountain Villages Development Act, Act for the Promotion of Infrastructure Development for Vitalization of Agriculture and Forestry in Designated Rural Areas, Act on Special Measures for Promotion for Independence for Underpopulated Areas, and Peninsular Areas Development Act, or as other areas with specific natural handicaps designated by prefectural governors. According to the latest available statistics from Japan's Ministry of Agriculture, Forestry and Fisheries, LFAs cover 40.6% of Japan's farmland, and account for 40.3% of gross agricultural output. In particular, the growing area of abandoned farmland is a key problem for LFAs in Japan. In 2010, about 396,000 ha of farmland were abandoned nationwide. As 54% of abandoned farmland is located in LFAs, LFA with natural, economic, and social disadvantages face the problems of increased abandoned farmland, depopulation, and aging. Therefore, from the viewpoint of maintaining the countryside in LFAs, the viability of rural communities in these areas is of particular concern in Japan.

Direct payments were introduced in fiscal 2000 for the purpose of helping to foster continued land use and prevent land abandonment through maintaining farm production activities, thereby helping to maintain the countryside and the viability of rural communities in these areas. Direct payment to farmers in hilly and mountainous areas is the oldest direct payment policy in Japan. The LFA direct payment is used as an additional payment, to fill the gap of production costs between hilly/mountainous areas and flat areas to make farming in the former areas sustainable. The LFA direct payment was implemented as a standalone measure until the introduction of a payment for conserving farmland and water in FY 2007. LFA coverage areas are defined as designated areas under eight less favored area development laws or other areas designated by prefectural governors. The target area is farmland consisting of steep slopes (paddy fields over 1/20 slope and dry fields over 15° slope) or moderate slopes

(paddy fields over 1/100 slope and dry fields over 8° slope). Payments depend on the type of farmland and this steepness.

Activities to which the scheme applies are organized around community-based activities. Basically, through an arrangement made with farmers that have maintained farm production activities for at least 5 years in the same rural community, the national and local governments provide direct payments to rural communities with these farmers. This payment system is an important characteristic of LFA payments in Japan, compared with the method used in the EU, where the subsidy is paid for the activities of individual farming households (Shogenji, 2003). The payment agreement must include shared roles for community farm members and the allocation formula for the direct payments among members based on these shared roles. As a result, small-scale farm households are not excluded from the LFA payment allocation, although small-scale farms do not qualify in the EU. This payment system is based on community-based paddy farming with a long history. The main crop grown in Japan is rice, for which common-pool resources (CPRs), such as irrigation and farm roads, are of particular importance and have long been managed by rural community members (Ostrom, 1990). Therefore, because only a few individual farmers cannot manage CPRs for farming, maintaining the numbers of farmers within a community is necessary in the case of rice cropping in paddy fields, which has particular characteristics. In practice, as per agreements with community members, they perform such activities as preventing abandoned farmland and managing farmland, roads, and water facilities, for which they receive LFA payments.

3. Empirical Model and Data

Empirical Model

The objective of this study is to explore the impact of LFA payments on land use and farm numbers. Thus, we estimate the following equation:

$$Outcome_{it} = \alpha DP_{it} + \boldsymbol{x_{it}\beta} + c_i + \lambda_t + \varepsilon_{it}, \quad (1)$$

where $Outocme_{it}$ represents the outcome variables of interest for community i in year t; DP_{it} is an indicator equal to 1 if community i receives LFA payments in year t and 0 otherwise; $\boldsymbol{x_{it}}$ is a vector of covariates; c_i is region fixed effect; λ_t is the year fixed effect; and ε_{it} is the error term. We remove the unobserved effect by taking the difference between periods. Thus, the time-invariant component of omitted variable bias is eliminated in this method of first-difference (FD) estimation:

$$\Delta Outcome_i = \gamma + \alpha \Delta DP_i + \Delta \boldsymbol{x_i \beta} + \Delta \varepsilon_{i,} \quad (2)$$

where Δ denotes the difference between 2000 and 2005, and thereby, the time-invariant component of omitted variable bias is eliminated. Since we employ a binary dummy, DP_{it}, as a receipt of LFA payment, and the data for 2000 used in this analysis were recorded before the introduction of LFA payments, $\Delta DP_{it} = DP_i$. Therefore, the estimation model is

$$\Delta Outocme_i = \gamma + \alpha DP_i + \Delta \boldsymbol{x_i \beta} + \Delta \varepsilon_i \quad (3)$$

We estimate two outcome equations based on equation (3)—one relating to LFA payments for land use and the other to LFA payments for farm numbers. In equation (3), α is so-called the difference-in-difference estimate of the effect of LFA payment. However, the introduction

of receiving LFA payments was not random. The endogeneity problem of LFA payment receipt in communities means we cannot show whether there would be an impact from LFA payments and if so, whether it would be positive or negative. Therefore, to identify the causal effect of payments on farmland and farm numbers, we instrument for the payment receipt using the location of a rural community. LFA payment receipt depends on whether rural communities with target farmland areas (steep or moderate slopes) are located in areas designated as less favored by the law. Rural communities located in designated areas would have received LFA payments compared to rural communities not located in designated areas. A good instrument is strongly correlated with the endogenous regressor, in this case, DP_i, and is uncorrelated with the error term, $\Delta\varepsilon_{it}$, in equation (3). We show that location of a rural community is a strong predictor of LFA payment receipt. We also perform a diagnostic that sheds light on the extent to which possible correlation with the error term might affect our results.

We instrument for DP_i using the following reduced form equation:

$$DP_i = \gamma Location_i + \Delta \boldsymbol{x_{it}} \boldsymbol{\beta} + \varepsilon_i \,, \tag{4}$$

where $Location_i$ is a dummy variable for whether a community is located in an area designated as less favored by the law. Thus, α is the first-difference instrumental variable (FDIV) estimator in equation (3) (Wooldridge, 2010).

To aid identification, we include in the vector of control variables ($\boldsymbol{x}$) the *ratio of elderly farmers* (ratio of population engaged in farming who are above 65 years' old) and the *ratio of paddy field*. The *ratio of elderly farmers* variable controls for changes in production linked to the life stage of a typical farm operator (Weber and Key, 2012). The *ratio of paddy field* variable captures farmland quality or usage status in a community, because crops

(mainly rice) are harvested in paddy fields or dry fields over the growing season in Japan. Furthermore, the region fixed-effects term, c_i, is included in equation (1) to control for peculiar features of a region, such as landscapes with different agro-climatic conditions and crop mixes. The region fixed-effect term is preferable to a community-level term, since a rural community whose boundaries were created based on the smallest unit of regional society in a rural village can capture the origin, long history, and very distinct types of agriculture.

Data

The data used in this analysis are taken from the *Rural Community Card, World Census of Agriculture and Forestry 2005*. The data are calculated by aggregating farm household-level data from the *Farm Household Survey* for farm households residing in each community. This census has been conducted every 5 years since 1950 for all farm households in order to measure actual agricultural conditions in Japan. This census includes information on agriculture and forestry at the levels of prefecture, municipality, old municipality (area of municipality in 1950), and rural community (smallest unit of regional society in rural villages). These data are the most detailed and comprehensive community-level data available for this study. We concentrate on data in 2000, which include information before the introduction of the LFA payments, and in 2005, which include information on the effect of LFA payments. Because rural communities in Hokkaido and Okinawa prefectures differ from other prefectures in terms of agricultural conditions, we are forced to eliminate these communities from our analysis. Except for community location, we limit communities with farmland of target areas with steep or moderate slopes in order to unify the eligibility conditions for receipt of LFA payments.

The outcomes of interest are land use and farm numbers in order to foster continued land use and prevent land abandonment through maintaining farm production

activities. As the primary indicator of land use and farm numbers, we examine the *ratio of abandoned farmland* and *farmland* (Area of owned farmland (1a)) as indicators of land use. These indicators capture the extent of conservation of farmland. In addition, we focus on *farm numbers* to capture the extent of maintaining the country's population. To reduce the influence of outliers and be able to interpret coefficients as elasticities, we use the natural log to transform *farmland* and *farm households*.

Table 1 presents descriptive statistics of key variables. From 2000 to 2005, community-level data indicate that the *ratio of abandoned farmland* increases by about 0.6 percentage point. At the same time, *farmland* and *farm households* decrease by -9.7% and 14.2%, respectively. This change of indicator means that an exodus from farming has led to large-scale depopulation of rural areas and the abandonment of agricultural land in rural communities whose target farmland area consists of steep or moderate slopes. Community-level data indicate that half of rural communities with target area farmland consisting of steep or moderate slopes received LFA payments between 2000 and 2005 even though 81.8% of rural communities were eligible to receive them.

4. Estimation and Instrumental Variable Diagnostics

In model (3), α is the so-called the difference-in-difference estimate of the effect of LFA payments on land use and farm numbers. The key identifying assumption for this interpretation is that the change in land use and farm numbers in a rural community with no LFA payment is an unbiased estimate of the counterfactual. While we cannot directly test this assumption, we can test whether the trends of the dependent variable in communities with or without LFA payments were the same before 2000. If the trends before 2000 are the same, then it is likely that they would have been the same since 2000 if a community qualifying for LFA payments did not receive them. Figure 1 suggests that the levels and trends in land use

and farm numbers in communities with or without LFA payments were the same before the introduction of the payments in 2000.

In addition, we formally test whether the time trends before 2000 for communities with and without LFA payment are different by estimating a modified version of equation (1). We use only the observations of communities with and without LFA payments in the pretreatment period; that is, we use 1990–2000 (every 5 years). We modify equation (1) by excluding the LFA payment dummy variable and including separate year dummies for (eventual) LFA payment communities and no LFA payment communities. We estimate the following model:

$$Outocme_{it} = \alpha DP_community_{it} \times year_dummy + \boldsymbol{x_{it}\beta} + c_i + \lambda_t + \varepsilon_{it,} \qquad (5)$$

where $DP_community_{it}$ is an indicator equal to 1 if community i is an (eventual) LFA payment community and 0 otherwise,

In Table 2, we cannot statistically reject the hypothesis that the interaction coefficients of year dummies with LFA payments are the same for both no LFA payment and (eventual) LFA payment communities at conventional levels of statistical significance. This finding implies that the land use and farm numbers in no LFA payment and (eventual) LFA payment communities have identical time trends (and levels) in the pretreatment period.

Furthermore, receipt of direct payment is based on a community's location (designated areas under eight less favored area development laws or other areas designated by prefectural governors), on condition that the community has farmland consisting of steep or moderate slopes. We use this location ($Location_i$.) as our instrument for the community's receipt of direct payments. When testing for the statistical relevance of an instrument, the F-statistic for the null hypothesis, that the instrument coefficients are jointly equal to 0,

should exceed 16 in the case of one instrument and one endogenous regressor (Stock and Yogo, 2005). As expected, estimating the first stage of equation (4) reveals that community location in areas designated as less-favored is strongly correlated with the receipt of LFA payments between 2000 and 2005 (Table 3). The F-statistic is large enough to reject the null hypothesis in column (1)–(2). Therefore, we dismiss concerns about weak instrument bias. As an instrument for the receipt of LFA payments, the instrumental variable models using community location in areas designated as less favored are implemented using two-stage least squares. Standard errors clustered by prefecture are calculated.

5. Results

For outcome equations (1), (5), and (9) as well as (2), (6), and (10), which include control variables, as shown in Table 4, the FD estimates suggest a strong statistical relationship, significant at the 1% level, between LFA payments and *ratio of abandoned farmland*, *farmland*, and *farm households*. For outcome equations (1) and (2), the coefficients of the *ratio of abandoned farmland* imply that receipt of LFA payments is associated with about a 0.57 percentage point decrease in the ratio of abandoned farmland. For outcome equations (5) and (6), receipt of LFA payments is associated with about a 3.6% increase in farmland. For outcome equations (9) and (10), receipt of LFA payments is associated with about a 2.2% increase in farm households. Similarly, the FDIV estimates indicate these coefficients are significantly in the same direction as the FD estimates at the 1% level. The FDIV estimate with control variables is larger than the FD estimate for the *ratio of abandoned farmland* (-0.904 vs. -0.899); for *farm households*, the difference is smaller (0.038 vs. 0.040) and for *farmland*, the difference is even smaller (0.030 vs. 0.031).

The point estimate implies that receipt of LFA payments leads to a decline in the ratio of abandoned farmland of 0.904 percentage point in outcome equation (4) of Table 4,

compared to ratio of abandoned farmland of 10.13% on average across all communities and years. This is not a small effect on farmland preservation. The effect of LFA payments on preventing abandoned farmland is not surprising insofar as LFA payment participation requires community activities that could be expected to prevent farmland from increasing or being abandoned, ceteris paribus. Therefore, based on the result that receipt of LFA payments increased farmland by 3.01% in outcome equation (4) of Table 4, this effect could partly explain the effect of LFA payments on preventing farmland from decreasing. In addition, this effect of farmland preservation is attributed to community activities (managing farmland, roads, and water facilities) for receipt of LFA payments.

Furthermore, what determines this significant effect on farmland maintenance? The LFA payment impacts maintenance of farm households in rural communities. As a result, this payment allows small farmers to remain in business longer; thus, maintenance of farm households in a rural community might explain continued farmland use within the community. Maintenance of farm households is a major source of farmland preservation in areas with unfavorable agricultural conditions. In particular, land fragmentation peculiar to rice production in disadvantaged areas of Japan, in which one farm operates multiple, separate plots of land, hinder farm size from expanding, as there are reduced advantages of scale economies (Kawasaki, 2010). The reasons this payment type works for continued farming are as follows. First, small-scale farm households are not excluded from LFA payment allocation. Second, communities spend LFA payments on community activities (managing farmland, roads, and water facilities) for community members. Overall, the cost of farming for all farmers within a community is reduced as a result of the LFA payment system.

Robustness checks

We perform further robustness checks to test if our results are sensitive to the use of a more detailed classification of areas designated as less-favored as the instrumental variable. Areas are designated as less-favored by law. We re-estimate the main models using these dummy variables as the instrument for the community's receipt of LFA payments. The FDIV results for the coefficient on receipt of LFA payments are presented in Table 5. Panel B of Table 5 presents the first-stage regression results, which show the difference between receipt of LFA payments and designated areas. Rural communities located in designated areas are more likely to receive LFA payments, and have large F-statistics. Furthermore, from the result of a test of over-identifying restrictions (Hansen J-statistics), we cannot reject the null hypothesis that our instruments are valid. The results using new instruments and control variables indicate an increase in the estimated effect of LFA payments on the *ratio of abandoned farmland* to - 0.974, *farmland* to 0.056, and *farm households* to 0.070, which are statistically distinguishable from 0.

6. Conclusion

This study employs an identification strategy that relies on the location of rural communities to establish whether they are eligible to receive LFA payments. In so doing, we estimate the impact of LFA payments on land use and farm numbers at the rural community level in terms of fostering continued land use and preventing land abandonment through the maintenance of farm production activities, thereby helping to maintain the countryside and the viability of rural communities in these areas. Our findings indicate that during 2000–2005, LFA payments fostered continued land use and prevented land abandonment through the maintenance of farm households, that is, farming was viable in these areas. An important finding of this study is that these impacts are attributed to communities having received LFA

payments, instead of direct payments to individual farmers. This finding has implication for policy design of future instruments from the viewpoint of the selection target.

LFA payments are often justified by the claim that they help to secure not only food supply and but also mainly maintain the countryside and the viability of rural communities in these areas. Our results support these claims. However, our findings do not support the criticism that LFA payment areas have obscure subsidiary effects, policy effectiveness, and validity of criteria for designating LFA areas. However, under current budget constraints in countries that support farming in LFAs (e.g., the EU and Japan), the most likely policy scenario is a decrease in LFA payments. Our findings imply that the effective reduction or removal of LFA payments would result in failure to maintain the countryside and erode the viability of rural communities in these areas.

Finally, our study considers the impact of LFA payments only at the community level. The distributional impact of LFA payments at the farm level is an area for further research.

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Table 1 Descriptive Statistics of Key Variables

Variables	Definition	2000		2005	
		Mean	S.D.	Mean	S.D.
Ratio of abandoned farmland	Area of abandoned farmland/(Area of owned farmland + area of abandoned farml	9.835	9.836	10.435	10.233
Farmland	Area of owned farmland (1a)	1856.115	2192.636	1675.419	2100.384
Farm households	Total number of farm households	18.143	13.153	15.566	11.555
Ratio of paddy field	Paddy field/Area of owned farmland (%)	78.488	22.863	79.148	23.271
Ratio of elderly farmers	Population engaged in farming above age 65 years/Total population engaged in fa	60.912	15.380	67.216	15.450
LFA Payment	Dummy = 1 if rural community receives LFA payments between 2000 and 2005, 0 otherwise	0.504			
Location	Dummy = 1 if rural community is located in an area designated as "less favoured," 0 otherwise	0.818			
Location1	Dummy = 1 if rural community is located in an area designated as "Mountain Villages Development Act," 0 otherwise	0.422			
Location2	Dummy = 1 if rural community is located in an area designated as "Act for the Promotion of Infrastructure Development for Vitalization of Agriculture and Forestry in Designated Rural Areas," 0 otherwise	0.700			
Location3	Dummy = 1 if rural community is located in an area designated as "Act on Special Measures for Promotion for Independence for Underpopulated Areas," 0 otherwise	0.403			
Location4	Dummy = 1 if Rural community is located in areas designated as "Peninsular Areas Development Act," 0 otherwise	0.109			
Location5	Dummy = 1 if rural community is located in an area designated as "Area defined by the prefectural governor," 0 otherwise	0.617			
Sample Size		29,141			

Sources: *Rural Community Card, World Census of Agriculture and Forestry 2005 (Japan).*

Table 2 Placebo Test

	Ratio of abandoned farmland	Farmland	Farm households
	(1)	(2)	(3)
Payment Community			
× Year dummy in 2000	0.1784	-0.0001	0.0147
	(0.1637)	(0.0103)	(0.0074)
× Year dummy in 1995	0.1876	-0.0007	0.0053
	(0.1112)	(0.0063)	(0.0037)
Year dummy in 2000	3.5151 ***	-0.2317 ***	-0.2662 ***
	(0.3748)	(0.0100)	(0.0069)
Year dummy in 1995	0.6819 ***	-0.1110 ***	-0.1227 ***
	(0.2522)	(0.0054)	(0.0036)
Controls	Yes	Yes	Yes
Observations	87,380	87,380	87,380

Note: *** is significant at 1%. Standard errors clustered by prefecture are reported in parentheses.

Table 3 Community Location and Receipt of LFA Payment

Variables	Receipt of LFA Payment	
	(1)	(2)
Location	0.6157***	0.6155***
	(0.0137)	(0.0137)
Control	No	Yes
F-statistic	2031.83	2026.36
Observations	29,141	29,141

Note: *** is significant at 1%. Standard errors clustered by prefecture are reported in parentheses.

Table 4 Impact of LFA Payment on Land Use and Farm Numbers

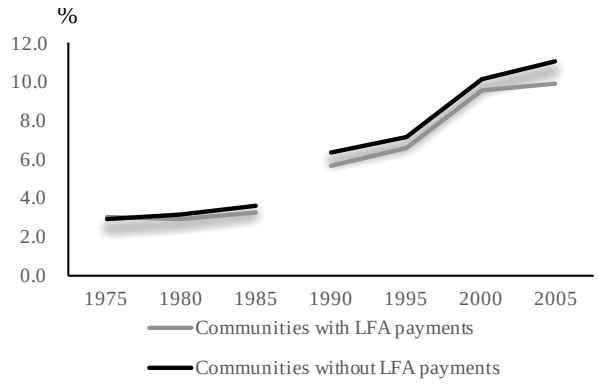
	Ratio of abandoned farmland				Farmland				Farm households			
	First Difference	First Difference	First Difference IV	First Difference IV	First Difference	First Difference	First Difference IV	First Difference IV	First Difference	First Difference	First Difference IV	First Difference IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
LFA payments	-0.5655 ***	-0.5705 ***	-0.8995 ***	-0.9040 ***	0.0359 ***	0.0357 ***	0.0314 ***	0.0301 ***	0.0231 ***	0.0224 ***	0.0403 ***	0.0383 ***
	(0.1151)	(0.1166)	(0.3092)	(0.3097)	(0.0037)	(0.0036)	(0.0094)	(0.0092)	(0.0040)	(0.0040)	(0.0090)	(0.0091)
Control	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	29,141	29,141	29,141	29,141	29,141	29,141	29,141	29,141	29,141	29,141	29,141	29,141

Note: *** is significant at 1%. Standard errors clustered by prefecture are reported in parentheses.

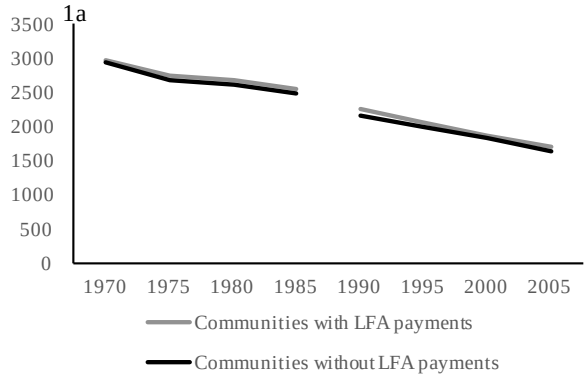
Table 5 Impact of LFA Payment on Land Use and Farm Numbers (Robustness Checks)

	Ratio of abandoned farmland		Farmland		Farm households	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Instrumental variable regressions						
LFA payments	-0.9487 ***	-0.9740 ***	0.0556 ***	0.0560 ***	0.0719 ***	0.0699 ***
	(0.3131)	(0.3124)	(0.0140)	(0.0137)	(0.0133)	(0.0130)
Contorls	No	Yes	No	Yes	No	Yes
Panel B. First-stage regressions: dependent variable = receipt of LFA payments						
Location1	0.0718 ***	0.0719 ***	0.0718 ***	0.0719 ***	0.0718 ***	0.0719 ***
	(0.0265)	(0.0265)	(0.0265)	(0.0265)	(0.0265)	(0.0265)
Location2	0.1404 ***	0.1402 ***	0.1404 ***	0.1402 ***	0.1404 ***	0.1402 ***
	(0.0229)	(0.0229)	(0.0229)	(0.0229)	(0.0229)	(0.0229)
Location3	0.0300	0.0300	0.0300	0.0300	0.0300	0.0300
	(0.0229)	(0.0229)	(0.0229)	(0.0229)	(0.0229)	(0.0229)
Location4	0.0349	0.0348	0.0349	0.0348	0.0349	0.0348
	(0.0369)	(0.0369)	(0.0369)	(0.0369)	(0.0369)	(0.0369)
Location5	0.3782 ***	0.3781 ***	0.3782 ***	0.3781 ***	0.3782 ***	0.3781 ***
	(0.0204)	(0.0204)	(0.0204)	(0.0204)	(0.0204)	(0.0204)
Control	No	Yes	No	Yes	No	Yes
F-statistic	144.82	144.381	144.815	144.381	144.815	144.381
Hansen - J statistics	4.595	5.03	6.791	9.17	7.56	8.608
Observations	29,141	29,141	29,141	29,141	29,141	29,141

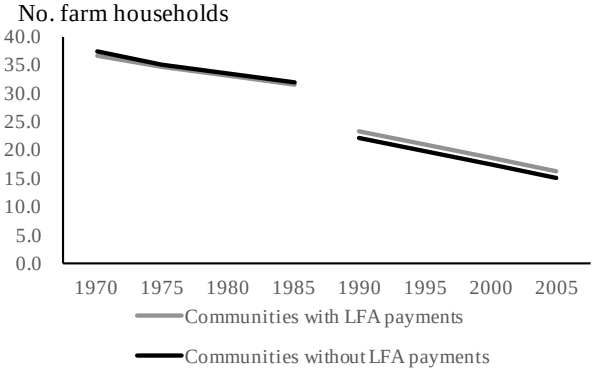
Note: *** is significant at 1%. Standard errors clustered by prefecture are reported in parentheses.



(a) Ratio of abandoned farmland



(b) Farmland



(d) Farm Numbers

Figure 1 Evolution of Outcomes for Communities Receiving vs. Not Receiving LFA Payments

Sources: *Rural Community Card, World Census of Agriculture and Forestry 2005 (Japan).*

Note: We cannot connect the data between 1985 and 1990, since the definition of variables changed.