Crop Choice, Farm Income, and Political Relations in Myanmar*

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Abstract

Myanmar's agricultural economy is in transition from a planned to a market system. However, the economy does not seem to capture the full gains of productivity growth expected from such a transition. Using a micro dataset collected in 2001 and covering more than 500 households in eight villages with diverse agro-ecological environments, this paper shows that policy interventions in land use and agricultural marketing underlie the lack of income growth. Regression analyses focusing on within-village variations in cropping patterns show that the acreage share under non-lucrative paddy crops is higher for farmers who are under tighter control of the local administration.

Keywords: reform, food policy, transitional economies, Asia, Myanmar.

1. Introduction

The agricultural economy of Myanmar (formerly Burma) has been under transition from a planned to a market system since the late 1980s. Historical experience from countries around the world shows that such a transition is often associated with a productivity gain in agriculture. According to a literature survey by Rozelle and Swinnen (2004), such productivity gains were largest in East Asia, where the gain also resulted in higher agricultural output. In contrast, in Eastern Europe and Central Asia, although agricultural productivity improved, output growth was not substantial and in fact negative in a number of countries. Rozelle and Swinnen attribute the contrast to the fact that in East Asia, economic planning kept agricultural produce prices artificially low, while in Eastern Europe and Central Asia, it kept prices artificially high. Within East Asia, agricultural performance has been most impressive in China and Vietnam. High growth in agricultural output and productivity partly accounted for the rapid reduction in rural poverty in these two countries. Although Rozelle and Swinnen do not discuss Myanmar in their text, they include it in their table in the group of successful East Asian countries and their numbers show a substantial increase in agricultural output in Myanmar (Rozelle and Swinnen, 2004: Tables 1 and 2). However, due to a lack of data they do not provide any evidence on the productivity/income gain in Myanmar.

The aim of this paper is to attempt to widen our understanding of the impact of agricultural policies in transitional economies through an examination of the case of Myanmar. Even though the country was the world's largest exporter of rice in the pre-World War II period and remains one of the world's largest producers of rice today, little research on Myanmar's rural economy is available and the effects of agricultural policies on production and rural incomes are not well documented. A few studies, by the International Rice Research Institute (Garcia et al., 2000) and by Japanese economists (Takahashi, 2000; Okamoto, 2004; Fujita and Okamoto, 2000; Fujita, 2003), do exist, but compared with the amount of research conducted on other East Asian countries, the case of Myanmar remains relatively unexamined. This study tries to partly fill the gap by using a primary dataset that is more recent, provides more detailed information, and covers more geographically diverse regions than previous studies.

Using the same dataset as used in this paper, Kurosaki et al. (2004) confirmed that Myanmar has experienced a rapid increase in agricultural production since its transition to a market economy; yet, they also found evidence that the country does not seem to have captured the full potential of productivity growth expected from such a transition. Their study highlighted two paradoxical situations: first, income levels were higher in villages far from the center than in villages located in regions under the tight control of the central authorities; second, farmers and villages that emphasized a paddy-based, irrigated cropping system had lower farming incomes than those that did not. The authors suggested that Myanmar's transition did not lead to a rapid increase in productivity because too much production emphasis was put on paddy crops yielding a lower income per acre than other crops and the government had the wherewithal to force farmers to plant paddy.

To demonstrate that the responsibility for low productivity and low income in Myanmar lies with government policy, this paper focuses on the fact that the level of enforcement of government crop planning varied not only across villages but also within villages across farmers. Concretely, this paper examines the determinants of individual farmers' crop choice by using household data. The estimation results are consistent with the theoretical prediction that the share of non-lucrative paddy is higher for farmers who are under tighter control of the local authorities.

The paper is organized as follows. Section 2 describes the background and the dataset, showing a negative relation between paddy acreage shares and per-acre farm incomes. To explain this situation, Section 3 develops a theoretical model of crop choice where political relations between farmers and the local administration play a key role. A prediction of the theoretical model to be tested empirically is also derived in the section. Section 4 provides the estimation results. Simulation results to quantify the impact of policy distortions on household income are also presented in this section. Section 5 concludes the paper.

2. Background and Data[1]

2.1 Myanmar's Economy and Agricultural Policies

Myanmar, whose population is close to 50 million, is in transition from a planned to a

market economy. The military government that has been in power since 1988 has deregulated various economic activities (Cook and Minogue, 1993). Industrial development is under process, but currently the agricultural sector still remains dominant in the national economy (Table 1). The estimated income level is among the lowest in the world. Rice is the staple food in Myanmar, accounting for more than 20% of consumption expenditure of the nation (CSO, 2002).

The government has given high priority to the expansion of paddy production, because it believes that a stable supply of rice is a prerequisite for political stability. To achieve this expansion, the government has introduced various reforms in agricultural marketing since the late 1980s. Under the regime that was in force until fiscal year 2003/04, the state procured from farmers only a limited and fixed amount of paddy and allowed them to sell the surplus freely in private markets. Since paddy prices in the market during the late 1980s and early 1990s were usually much higher than the government-fixed procurement price, the reform initially gave a substantial incentive to produce a surplus. Because of this impact, Okamoto (2005) called these reforms "the first phase of marketing liberalization."[2] In addition, the government has been promoting the expansion of paddy areas through irrigation investment. Throughout the 1990s, numerous dams were constructed in some areas, while private investment in small scale diesel pumps was promoted in others, in order to increase paddy cultivation in the dry season.

As a result of these two measures, both the area under cultivation and paddy production in Myanmar rose remarkably in the early 1990s (Garcia et al., 2000; Fujita, 2003). However, as shown in Kurosaki et al.'s (2004) detailed analysis, such policies resulted in low incomes for farmers because the production of paddy was not profitable due to repressed domestic prices for paddy resulting from the government monopoly of rice export. Since the income per acre was lower for paddy than for other crops, the government needed to force farmers to plant paddy rather than other crops, and it did so through its agricultural policies toward paddy marketing and land use.

Under the economic reforms adopted by the current government, the system of state ownership of land established during the period of General Ne Win's ``Burmese Socialism'' remained more or less intact, though unofficial transfers of tillage rights were frequent (Takahashi,

2000). Farmers did not have the official right to exchange, transfer, lease, inherit, or mortgage their land, though children were usually given the right to cultivate their parents' land. To retain their tillage right for paddy fields, farmers were obliged to grow paddy crops and supply a designated amount of paddy to the government procurement system. The procurement quota for paddy was set as a fixed quantity per acre of land designated as paddy field. In the main paddy-growing areas, the quota was approximately 20% of gross produce, while it was lower in other areas. Since the quota was set irrespective of the actual acreage devoted to paddy or the actual output of paddy, this may seem to be a non-distortionary implicit tax. In reality, however, the system adversely affected paddy production in Myanmar because of the incentive effects it created. The first of these was a disincentive effect on the quality of rice that was supplied to the state, which was so low that it was not accepted in foreign markets. The second effect regards the incentives that influenced farmers' crop choice (see next section). Although crop planning by the government was officially abandoned in 1987, farmers continued to face the threat of seeing their tillage rights revoked if they deviated too much from crop plans agreed with local administrators, especially with respect to paddy.

Another important characteristic of Myanmar's rural economy is the existence of a large pool of landless, non-farm households consisting of families that were not allocated any farmland in the land reforms of the 1950s because they did not own means of production such as bullocks. The share of landless, non-farm households in villages typically ranges from 20 to 50%. The majority of landless households depend on income earned as agricultural wages and their wealth level tends to be lower than that of landed households.

2.2 Characteristics of Sample Villages and Households

As a result of the country's isolationist foreign policy, the availability of micro data on Myanmar's rural economy is limited. We therefore conducted a survey of sample households belonging to eight selected villages[3] in June-October 2001 (Kurosaki et al., 2004).

The characteristics of the villages are shown in Table 2. The first two villages (DELTA1 and DELTA 2) are located in the delta regions of lower Myanmar and DRY1 is located in the

Mandalay Basin, which is one of Myanmar's centers of commercial crop production due to its long history of canal irrigation dating back to Burma's dynastic period. In contrast, DRY2 and DRY3 represent villages relying on rainfed agriculture. DRY2 is more typical of a dry zone village since only rainfed crops and no paddy crops are grown here. HILL1 and HILL2 represent villages relying on vegetable-based development in hilly regions. Both villages sell their vegetables to major consumption centers such as Yangon and Mandalay, while their paddy cultivation is oriented toward subsistence. The last village of the study, COAST, lies in the coastal region of southern Myanmar, where tropical agro-forestry (rubber, fruits, cashew nuts, etc.) prevails. Peasant farmers run both small-scale rubber estates and paddy farms. Among the eight villages studied, COAST has the most active non-farm sector, which includes general shops, cycle taxis, and fish processing. The eight villages chosen are thus quite representative of the diverse agro-ecosystems found in Myanmar.

The specific villages were carefully chosen to ensure that they would be representative of each region. As far as can be judged by the statistics on cropping patterns and land distribution, this aim was achieved. Sample households were drawn from a complete list of households in each of the villages studied. While these households are not strictly a random sample, we used information obtained from village leaders and local administrations to eliminate discretionary elements, so that the sample households were as representative as possible in terms of the distribution of farmland and primary jobs. A total of 521 households were surveyed in the eight villages (Table 3): the 341 households denoted as "Farm" are households with land tillage rights, while the 180 households denoted as "Non-farm" have no tillage rights.

A structured questionnaire was used for all households to establish household characteristics, household assets, income, consumption, and debt and credit. The sample households include 2,850 persons, implying that the average household size is 5.5 persons. This part of the dataset provides the individual attributes that are used in the analysis of factors that affect crop choice. If households operated farmland, they were asked to fill in an additional questionnaire on farm management. This part of the dataset provides household-level information on agricultural input, output, and disposal/marketing. Household heads or other relevant persons were interviewed

by local research assistants and the information was cross-checked on the spot by the authors to ensure internal consistency and data quality.

2.3 Household Income, Cropping Patterns, and Farm Productivity

Table 4 reports the asset and income status of the sample households. The average land holding size among the sample households was 5.6 acres, which is large by South-East Asian standards. Ownership of modern assets, in contrast, compares poorly: no households owned four-wheel tractors; and though bicycles were common among villagers, motorcycles and four-wheel vehicles for transportation were very rare. Livestock were the most common and important assets.

Overall average incomes were 184,000 Kyats per household and 36,000 Kyats per person per year. If these figures are converted at the market exchange rate of 650 Kyats/US$ prevailing during the study period, they are equivalent to $283 per household and $55 per person per year. Incomes in the sample villages thus were indeed low, but not that different from the average village in rural Myanmar. If these incomes are converted using the price of rice in the Yangon market (56 Kyats/kg) prevailing during the study period, they are equivalent to 3,300 kg of rice per household and 640 kg per person per year.

The composition of income, shown in Table 4, differs across villages. The level of self-employment income from agriculture was highest in villages DRY1 and DRY2 and lowest in DRY3. The share of agricultural self-employment income in total household income was highest in villages HILL2 and DRY1 and lowest in COAST. The table shows that villages with higher agricultural self-employment incomes and higher non-agricultural incomes had higher per capita incomes overall. A probit analysis of the determinants of having household members working in non-agricultural jobs shows that education and local demand derived from farm income are important factors (Kurosaki et al., 2004). Therefore, the disparity in agricultural self-employment income is the key to explaining the disparity in household income.

Since crop income accounted for about 99% of agricultural self-employment income and farm size is pre-determined in the short run, the focus below is on the determinants of *crop income*

per acre. The cropping patterns of the sample farmers are shown in Table 5. Of the major crop groups, paddy occupied more than 60% in DELTA1, DELTA2, and DRY1. Among these villages, DELTA1 had the least diversified cropping pattern: monsoon paddy followed by summer paddy. In contrast, in DELTA2 and DRY1, not all of the paddy fields were cropped with summer paddy but some fields were cropped with pulses (DELTA2) and vegetables (DRY1). The other five villages had a more diversified agriculture. Among these five villages, DRY3 and COAST had higher paddy shares than the other three. There were no paddy fields in DRY2.

Table 6 relates these cropping patterns with per-acre crop income. Crop income per household was highest in DRY2 and lowest in DRY3 and DELTA1. Normalized by farm size, crop income per farm area was highest in DRY1 and HILL2, followed by DRY2, and lowest in DRY3, DELTA2, and DELTA1. A comparison of the first two columns in Table 6 suggests that farm income per acre was lower in villages where paddy cropping was more dominant than in other villages because per-acre income was lowest for paddy and highest for vegetables.

This negative relation between the paddy share and per-acre crop income was observed within villages as well. Table 6 also shows the intra-village correlation coefficients between the crop income per acre of a farm and cropping patterns (the acreage share of each crop group in the gross cropped area). In all villages, the correlation coefficient between the per-acre crop income and the paddy share was negative. It was statistically significant in DELTA2, DRY1, DRY3, HILL2, and COAST. There was no meaningful variation in DELTA1, since most farmers grew monsoon paddy and summer paddy only, while no paddy was grown in DRY2. In DELTA2, the correlation coefficient between the per-acre crop income and the pulses share was 0.448. In DRY1, the correlation coefficient between the per-acre crop income and the vegetables share was 0.555. Therefore, in DELTA2 and DRY1, villages located in the major paddy growing regions, farmers who did not grow much paddy on paddy fields during the summer season but grew more commercial crops instead were better off. This indicates that the policy of maximizing paddy output places a heavy burden on farmers in the major paddy-growing regions. In the other five villages, where agriculture was more diversified, each village had non-paddy crops whose acreage share was

positively correlated with the per-acre crop income. In these villages, it is not always the case that these non-paddy crops directly compete with paddy for land, because these crops are usually grown on farmland not designated as paddy fields. Even then, the allocation of labor and efforts expended on non-paddy crops should be adversely affected when the paddy acreage is increased.

Thus it seems that farmers grew too much paddy in the sense that its cultivation replaced more lucrative crops, resulting in lower crop income than the highest level achievable from the same farmland. Kurosaki et al. (2004) suggested that land and procurement policies were responsible for this situation. A supplemental finding of their study was that there was a regional difference in the enforcement of the government's crop plan: strict enforcement along procedures inherited from the socialist period was attempted in the three villages located in the core regions of paddy-based agriculture (DELTA1, DELTA2, DRY1), with the strictest enforcement in DELTA1; strict enforcement was being extended to the other two villages in the dry zone (DRY2, DRY3) at the time of the survey, while the other three villages (HILL1, HILL2, COAST) were subject to the weakest enforcement of crop plans. This paper formalizes this idea and tests it statistically, focusing on intra-village differences among farmers within villages.

3. Analytical Framework

3.1 A Theoretical Model of Farmers' Crop Choice

To explain the situation described above, a simple model of a farmer's crop choice is presented first. Since paddy is the backbone of Myanmar's economy, it is treated as the numeraire. The farmer has a fixed acreage x_0 of farmland that can be allocated to either a paddy or a non-paddy crop. Let x denote the paddy acreage. The allocation x results in farm income net of production costs, which is denoted by a function $f(x)$. This function reflects the farming technology available to the farmer and the resource constraints he faces. The function is assumed to be continuous, differentiable, and single-peaked. Thus, in the absence of procurement and land policies, a profit-maximizing farmer chooses x^* that maximizes $f(x)$.

Under the policies prevailing in Myanmar during the survey period, however, the farmer

was required to deliver to the government a fixed quantity of paddy proportional to z (the planned acreage under paddy, which is assumed to be larger than x^*). The total procurement quota is thus bqz, where b is the procurement ratio and q is the average yield of paddy per acre. As explained in Section 2, the government procurement price of paddy was below its market price, resulting in implicit taxation on paddy farmers. The implicit tax amount is denoted by tqz, where t is the taxation rate that is equal to b times the price disparity. The government fixes z, b, and t.

Although the farmer is expected to allocate z acres of his farmland to paddy, this may not be enforceable, i.e., x may deviate from z. However, when the deviation is large and detected by the local administration, the administration may threaten the farmer with revoking the farmland. The expected welfare cost of this threat is assumed to be a quadratic function, $A(z-x)^2$, where A is a non-negative parameter characterizing the political relation of the farmer with the local administration. Given these assumptions, the payoff of the farmer is expressed as

$$y = f(x) - tqz - A(z-x)^2. \quad (1)$$

The first order necessary condition for the optimal solution is given by

$$f'(x) = -2A(z-x). \quad (2)$$

Let x^{**} be the optimal solution for the farmer that satisfies equation (2). When it is an interior solution, by assumption, the following relations hold

$$x^* \leq x^{**} < z, \quad (3)$$

$$\partial x^{**} / \partial A > 0. \quad (4)$$

The last inequality shows the basic relation for the empirical analysis below.

When A=0 (the case where the local administration has no ability to force farmers to follow its directions regarding the planned acreage), $x^* = x^{**}$ holds. In this case, the procurement system does not affect farmers' production decisions at all. When A>0, however, $x^* < x^{**}$ holds, so that the procurement quota becomes a distortionary implicit tax. As A approaches infinity, x^{**} also approaches z. The last case may characterize the situation in Myanmar before the marketing reforms that began in the late 1980s.

Thus the divergence between the actual acreage and the income-maximizing acreage is an

increasing function of parameter *A*. It is expected that *A* is higher for a farmer who has some political reason to please the local administration. Although it is possible that the parameter may be higher for a farmer who derives greater moral satisfaction from following the rule, this possibility is not analyzed since such preferences are not directly observable. Instead, it is assumed that preferences do not systematically differ across individuals within villages. Although parameter *A* is higher for a farmer who lives in a village under tighter control of the central authorities, this aspect is not analyzed directly but controlled indirectly by village fixed effects in the empirical analysis (see below). Although parameter *A* should be treated as endogenous in the long run, since it is determined as a result of strategic interactions of individual farmers with the local administration, it is treated as exogenous in the empirical analysis, because the focus of the analysis is on the short-run determinants of crop choice.

3.2 Empirical Specification

The share of paddy acreage in total farmland under cultivation, x/x_0, is the natural choice for the dependent variable for regression analysis. In the empirical analysis, paddy acreage divided by the acreage of gross cultivated areas is adopted as the dependent variable. To check the robustness of the results, another dependent variable, using the acreage of net cultivated areas as its denominator, is also tried.

As explanatory variables, household/individual characteristics and village dummies are included. Since villages differ with respect to their market conditions, the strictness of enforcement of government crop planning, technologies, and other factors, it is impossible to identify the effects of these factors separately using the dataset adopted in this study. The number of sample villages is too small for such an analysis. Therefore, village fixed effects are included to control for these factors collectively and to enable us to concentrate on the intra-village variations in cropping patterns.

The main prediction of the theoretical model to be tested empirically is the effect of *A*, the political relations between a farmer and the local administration. The focus of the model on the

degree of control exercised by the local administration as a determinant of the amount of paddy a farmer grows makes it possible to examine an important aspect of crop choice that other models fail to address. For example, models emphasizing credit constraints (Feder et al., 1990), risk management (Kurosaki and Fafchamps, 2002), domestic food security (Kurosaki, 2004), and resource constraints (Gotsch et al., 1975) do not address the response of farmers' crop choice to political relations. These models instead predict that human capital and household resource availability affect farmers' crop choice.

However, it is possible that, in a rural setting like Myanmar, farmers with a higher A are those with superior access to technology, resources, or markets. Therefore, even if it is found that a proxy variable for A is associated with a higher paddy share, this association could be the result of these indirect effects and not of the political mechanism modeled above. Furthermore, there are other endogenous variables that are chosen simultaneously with x/x_0, which were assumed away in the theoretical model for simplicity. As shown in Section 2, household income is composed of agricultural self-employment income, agricultural wage income, and non-agricultural income. The empirical specification should take into consideration that households simultaneously choose several variables (including x/x_0) to determine the level of each income source. Therefore, the following four strategies are adopted in this paper to identify the effect of parameter A.

First, a completely reduced-form approach is adopted. Although it is of interest to quantify the effects on crop choice of the level of non-agricultural self-employment income or agricultural wage income, valid instrumental variables were not found in the dataset to identify these effects. A more structural estimation is left for future study.

Second, to control for other factors that affect crop choice, human capital and household resource availability are included as explanatory variables. Human capital and household resource availability, such as education, household demography, land size, and other assets, may be important determinants of crop choice because they influence farmers' access to markets, technology, credit, and subsistence food. Although these variables may include information on farmers' political relations, this aspect is ignored to set a higher hurdle for the theoretical model to pass the empirical

test.

Third, an attempt is made to search for variables to represent *A* that are not directly related to households' access to markets and technologies. Candidates are variables representing expectations regarding future land inheritance from parents and the early adoption of new agricultural technology during the pre-transition period. During the pre-transition period, the local administration designated several villagers as "contact farmers" and implemented policies through them. Sample farmers satisfying one of the above two characteristics are likely to belong to the families that were designated as contact farmers. In addition, as explained in Section 2, the land tillage right is not officially inheritable, but children are usually given the right to cultivate their parents' land if the local administrator finds no reason to deny such a transaction. This implies that a farmer who has parents with farmland and expects them to transfer the tillage right to him/her in the near future may have an additional incentive to follow the directions of the local administration today so that the administration will not object to the transfer of the cultivation right. The early adoption of new technology during the planned economy period is a more direct indicator for the status of a contact farmer because such adoption of new technology was not chosen by the farmer but ordered by the administration.

However, it is still possible to argue that both of these variables capture not only political relations but also reflect unobservable characteristics of the farmer that enhance the efficiency of paddy production. A farmers' expectation to inherit the parents' paddy field[4] or having been directed in the past to try out a new technology may be linked to her/his unobservable ability to produce paddy more efficiently. If this is the case, these variables should not only be associated with a larger paddy acreage share but also greater paddy productivity, even after controlling for other observable characteristics that affect productivity. The fourth strategy of this paper is, therefore, to regress variables representing paddy productivity on the same set of variables adopted for the paddy acreage share. If it is found that the two variables proxying for *A* are associated with a higher paddy acreage share but with no increase in paddy productivity, the argument in favor of the unobservable productivity superiority is not supported. Instead, such a puzzling situation could be explained in a

consistent way by the theoretical model described above. As a second set of dependent variables, paddy output per acre and paddy value-added per acre are adopted.

4 Estimation Results

4.1 Determinants of Farmers' Crop Choice

In order to examine the effect of individual and household characteristics on crop choice, the following variables were tried initially: (1) proxies for political relations (the size of parents' landholding, a dummy representing the expectation of inheriting land, and an indicator variable for the early adoption of a new technology in the period before 1990[5]); (2) farmland size (the size of lowland fields managed by the household, the size of upland fields managed by the household, the irrigation status of the land); (3) demographic variables (the size and composition of household members, the sex and age of the household head); (4) education (schooling years of the household head, a dummy representing whether or not the head was educated in a monastery school, the highest education status in schooling years among adult household members); (5) household food security concerns (share of rice consumption in household income, a dummy variable for having had to borrow rice from neighbors for household consumption); and (6) assets (total value of household assets, value of major asset groups, number of major agricultural machines). Several of these variables were found to be robustly insignificant and most of the insignificant variables were excluded from the results reported in this paper. However, at least one variable from each group was retained. See Table 7 for the definition and summary statistics of the retained empirical variables.

The estimation results are shown in Table 8. They show that the dummy variable for the expectation of inheriting land (*Future_inh*) and the indicator variable for the early adoption of new technology in the past (*Past_techn*) are both positive predictors of the paddy acreage share. The effect of the inheritance dummy is positive with statistical significance at the 5 to 10% level on both paddy acreage per gross cultivated land and paddy acreage per net cultivated land. The effect of the early technology adoption variable is statistically significant on paddy acreage per net cultivated land while it is not significant in some specifications for paddy acreage per gross cultivated land.

Table 8 also shows that larger upland fields are associated with a smaller paddy acreage share, and a larger share of rice consumption in household income is associated with a larger paddy acreage share. The positive effect of the rice consumption share indicates that domestic food concern is an important determinant of crop choice in the study region, which corroborates a similar finding regarding the choice of wage contracts in the same region (Kurosaki, 2004).

These results remained qualitatively unchanged when other variables from each group of explanatory variables were employed. Since the left-hand-side variable is truncated between zero and one (*Paddy_gca*) or between zero and two (*Paddy_nca*), non-linear models such as tobit, probit, and logit were also tried. The pattern that *Future_inh*, *Past_techn*, and *Rice_cons* are positive predictors of the paddy acreage share did not change qualitatively.[6]

To investigate whether or not the positive correlation between the paddy acreage share and the two variables proxying for *A* is due to unobservable superiority in paddy production, paddy output per acre and paddy value-added per acre are regressed on the same variables employed to explain the paddy acreage share. The results in Table 9 show that the inheritance expectation variable has a negative coefficient while the technology adoption variable has a positive coefficient, although both coefficients are statistically insignificant. In other specifications not reported in this paper using different sets of explanatory variables, the two variables are also robustly insignificant. Therefore, it can be concluded that farmers who expect to inherit land or possess past experience of adopting new technology grow more paddy crops although their paddy productivity is not higher than that of other farmers. If crop choice were solely determined by the relative profitability of competing crops, this would be a puzzling result. But if we borrow the insights from the theoretical model described in Section 3, the paradox can be resolved: farmers that are more susceptible to pressure from the local administration to follow the crop plan grow more paddy crops even though paddy crops are less profitable than other crops.

Table 9 shows that the education level of the household head also has a statistically significant, positive effect on paddy productivity. This result supports the view that education enhances farm productivity, a fact that has been demonstrated empirically for other developing

countries (see, for example, Jamison and Lau, 1982; Kurosaki and Khan, forthcoming). If farmers were completely free to choose their acreage shares, and the effect of education on the productivity of non-paddy crops was not strong enough, more educated farmers would devote a higher share of their farmland to paddy crops because of their superiority in paddy production. As shown in Table 8, this is not the case, suggesting that the positive effect of education on the paddy acreage through the paddy productivity enhancing mechanism is possibly cancelled out, either because more educated farmers with higher non-agricultural income have more bargaining power vis-à-vis the local administration so that they are able to reduce paddy crops, or because they are more efficient in non-paddy crop than paddy crop production so that their comparative advantage favors non-paddy crops.[7] Paddy productivity is lower for households whose share of rice in the family budget is higher. This seems to suggest that these households are more concerned with household food security so that they grow paddy to the limit on their very marginal land, resulting in lower paddy productivity.

4.2 The Welfare Impact of Paddy Policies

The regression results above have shown that political relations affect the paddy acreage share and the correlation analysis in Section 2 has shown that the paddy acreage share is negatively correlated with per-acre crop income. These findings raise the question how large the negative welfare impact of the paddy output maximization policies, functioning through parameter *A*, is.

To simulate the impact, household income is regressed on the paddy acreage share (*Paddy_gca*) and other variables representing human capital and household resource availability (Table 10). The dummy variable representing the expectation of inheriting land (*Future_inh*) and the indicator variable for the early adoption of new technology in the past (*Past_techn*) are deleted from the regression to serve as identifying instrumental variables (IVs) for the endogenous variable *Paddy_gca*.[8]

The IV estimation results show that both crop and household income increase with the size of farmland and the level of education. The impact of education on total household income is twice as large as that on crop income. This is consistent with the probit estimation result for the same

households estimated by Kurosaki et al. (2004) showing that more educated individuals are more likely to be engaged in lucrative non-farm jobs. The positive contribution of education to income, mainly through opening up employment opportunities in the non-agricultural sector, is a well-known fact that has been observed in other developing and transitional economies (Kurosaki and Khan, forthcoming). This paper shows that the relation holds in rural Myanmar as well.

The parameter of concern is the effect of the paddy acreage share (*Paddy_gca*) on income. The effect is significantly negative both on crop income and household income. An interesting finding is that the effect of *Paddy_gca* is three times as large on total household income as it is on crop income. This indicates that increasing the paddy acreage share reduces household income not only through the reduction of crop income due to a greater deviation from the crop income maximization point, but also through the reduction of income from other sources due to a decreased allocation of household effort and resources to these sources. To examine the endogeneity bias, the same model was estimated by OLS. The OLS estimates were about one sixth to one fifth of the IV estimates. Thus the OLS estimation underestimated the loss of rural incomes resulting from the policy.

Based on the IV coefficients in Table 10, the loss of household income through parameter *A* could be calculated as follows. When *A* is decreased due to a change in the household status with regard to the expectation of inheriting land (*Future_inh* is changed from one to zero), the paddy acreage share in gross cultivated areas decreases by 6.9 percentage points (see Table 8), resulting in an increase in crop income of 14,300 Kyats and an increase in household income of 41,800 Kyats. These values are 10.4% of the average crop income per household and 21.5% of the average household income respectively. When *A* is decreased due to a change in the household status with regard to early technology adoption (*Past_techn* is changed from 1 to -1), the paddy acreage share decreases by 3.7 percentage points (twice the coefficient reported in Table 8), resulting in an increase in crop income of 7,500 Kyats (5.0% of the average crop income) and an increase in household income of 22,000 Kyats (11.3% of the average household income). Thus the welfare loss from forcing farmers to grow too much paddy is not negligible.[9]

5. Conclusion

Based on a sample household survey conducted in 2001 and covering diverse agro-ecological environments in rural Myanmar, this paper showed that the transition of Myanmar's agricultural sector did not lead to a rapid increase in productivity and rural incomes. Important reasons are that government policies put too much production emphasis on paddy crops with an income per acre that was lower than that of other crops and that the government had the wherewithal to enforce these policies, compelling farmers to plant paddy rather than other crops. Since the enforcement of government crop planning varied not only across villages but also within villages, a theoretical model focusing on the political relations between a farmer and the local administration was developed to derive implications for the empirical analysis of intra-village variations in cropping patterns. The theoretical model predicted that the acreage share of non-lucrative paddy should be higher for farmers who are under tighter control of the local authorities. It was found that the paddy acreage share was indeed higher for such farmers, approximated by their expectation of future land inheritance from their parents and by their previous experience in adopting new technology during the period of socialist planning. Since the inheritance expectation and the technology adoption variables were not found to increase paddy productivity, the argument that these variables reflect unobservable productivity superiority in paddy production was not supported. Therefore, the estimation results were consistent with the prediction of the theoretical model.

What do the findings of this paper say about Myanmar's agricultural performance compared to other transitional economies? First of all, the findings question the validity of the classification by Rozelle and Swinnen (2004: Tables 1 and 2) of Myanmar as an example of high performing East Asia. Unlike in Vietnam and China, output gains in Myanmar were not accompanied by gains in agricultural productivity and rural incomes. Second, the findings nevertheless support the main argument by Rozelle and Swinnen, namely that both productivity and output increased in countries where market forces led to a rapid rise in agricultural produce prices after the transition, while in countries where prices fell after the transition only productivity

increased, with output stagnating or declining. Like in the East Asian high performers Vietnam and China, agricultural produce prices in Myanmar were kept artificially low during the era of socialist planning. But unlike in Vietnam and China, prices did not rise substantially after the planning was abandoned, because of the distortions in agricultural marketing policies. Despite the fall in paddy prices in the later stage of the transition, the distortions in land use policies prevented farmers from adjusting their cropping patterns freely. In a word, the stagnation in income and productivity after the transition in Myanmar's agriculture can be attributed to the distortions in the transition process.

The policy implications of the empirical analysis are simple. At the time the survey was conducted, there remained vast room for an expansion of agricultural output and rural incomes in Myanmar, even without any innovation in technology or further investment in irrigation. All that was needed to tap this potential was to give farmers more freedom in land use and liberalize paddy/rice marketing. Simulation results based on the regression estimates showed that the loss in rural incomes due to farmers' being forced to grow too much paddy was not negligible. The second phase of marketing liberalization that began in 2003/04[10] does seem to be a step in the direction of further liberation of marketing and land use policies. A follow-up survey under this new regime is a task that remains for further investigations.

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Notes

[1] This section is based on Kurosaki et al. (2004).

[2] The second phase of marketing liberalization began in fiscal year 2003/04, in which the abandonment of paddy procurement and the opening up of rice export to private traders were announced (Okamoto, 2005). However, at present, information on the actual implementation of these reforms is unavailable and their future is very uncertain. For these reasons, this paper analyzes the situation before the second phase only. Note that the primary dataset for this paper was collected in 2001.

[3] The smallest administrative unit in Myanmar is the "village tract," which usually consists of several hamlets or natural villages. While Table 2 refers to "village tracts," in the text and the following tables, they are simply referred to as "villages" for convenience's sake.

[4] Younger household heads are more likely to expect to inherit land from their parents. To control for the human capital effect of accumulated farming experience, the age of the household head is included and retained in the regression even when it is not significant.

[5] The indicator takes 1 if the technology was adopted before the median year of adoption in each village. See also the definition in Table 7.

[6] Results under alternative specifications are available on request.

[7] A model similar to the one reported in Table 9 was estimated with non-paddy output per acre as the dependent variable. The coefficient on education was positive and slightly larger than that for paddy but it was not statistically significant, even at the 20% level. Therefore, the test for whether the efficiency enhancing effect is stronger in the case of non-paddy than paddy crops was inconclusive.

[8] The variables *Future_inh* and *Past_techn* are valid identifying IVs for the endogenous variable *Paddy_gca* in the crop income (*Y_crop*) regression, as shown in Tables 8 and 9. On the other hand, if the two variables directly affect choices made by the farmer with respect to non-crop agricultural self-employment income, agricultural wage income, or non-agricultural income, they cannot serve as identifying IVs for total household income (*Y_hh*). As a reduced-form approach, non-crop agricultural self-employment income, agricultural wage income, and non-agricultural income were

each regressed on the variables listed in Table 8. Since the two variables *Future_inh* and *Past_techn* were not statistically significant even at the 20% level in all of the three regressions, it was concluded that the two can serve as identifying IVs for *Paddy_gca* in the *Y_hh* regression as well.

[9] It should be noted, however, that these figures ignore market equilibrium effects. A decrease in paddy acreage should increase the market price of paddy while an increase in the production of non-paddy crops may decrease their market prices. Incorporating equilibrium effects is left for further analysis.

[10] See endnote 2.

Table 1: Myanmar's Economy and Agriculture

	1985/86	1990/91	1996/97	1998/99	2000/01
Growth rate of real GDP	2.9	2.8	6.4	5.8	13.6
Growth rate of agricultural sector	2.2	2.0	3.8	3.5	9.5
Agricultural sector's share in GDP	39.7	38.7	36.2	34.5	33.1
Agricultural sector's share in exports	42.4	31.8	36.1	28.0	18.9
Agricultural sector's share in workforce			63.4		
Total irrigated area (million ha)	3.0	2.9	4.6	5.1	6.0
Share of irrigated area under paddy (%)	70.1	74.8	82.3	76.6	76.5

Note: "Agricultural sector" in this table does not include livestock, fishery, and forestry.
Source: CSO (2002).

Table 2: Survey Villages

Name	Division (D.)/ State (S.)	Township	Village tract	Topology	Irrigation	Major crops
DELTA1	Ayeyarwady D.	Myaungmya	Kyonethout	Deltaic agric.	Pump	Paddy
DELTA2	Bago D.	Waw	Acarick	Deltaic agric.	Rainfed, Canal	Paddy, pulses
DRY1	Mandalay D.	Kyaukse	Pyiban	Dry zone	Canal	Paddy, vegetables
DRY2	Magway D.	Magway	Kanpyar	Dry zone	Rainfed	Upland crops
DRY3	Magway D.	Taungdwingyi	Wetkathay	Dry zone	Rainfed, Tank	Upland crops, paddy
HILL1	Shan S.	Nyaungshwe	Linkin	Hilly region	Rainfed	Vegetables, paddy, sugarcane
HILL2	Shan S.	Kalaw	Myinmahti	Hilly region	Rainfed	Vegetables, paddy
COAST	Tanintharyi D.	Myeik	Engamaw	Coastal agric.	Rainfed	Paddy, rubber

Source: Authors' survey (ibid. for the tables below).

Table 3: Sample Households

	Total number of households			Number of sample households		
	Farm	Non-Farm	Total	Farm	Non-Farm	Total
DELTA1	232	283	515	67	33	100
DELTA2	213	243	456	60	40	100
DRY1	118	101	219	65	37	102
DRY2	326	336	662	24	16	40
DRY3	334	176	510	24	16	40
HILL1	544	298	842	26	12	38
HILL2	422	75	497	34	6	40
COAST	647	520	1167	41	20	61
Total	2836	2032	4868	341	180	521

Table 4: Average Asset and Income of Sample Households

	Farmland (acres)	Total current value of production assets* (1000 Kyats)	Household income (Kyats)		Composition of income sources, excluding unearned income transfers (%)		
			Average of total household income	Average of per-capita household income	Self-employment income from agriculture	Agricultural wage income	Non-agricultural income
DELTA1	5.97	218.2	134,535	30,065	61.5	14.8	23.6
DELTA2	7.17	207.8	155,423	29,745	57.3	24.7	18.0
DRY1	3.32	232.7	209,661	49,378	61.3	11.9	26.8
DRY2	6.13	282.0	216,482	43,975	69.0	10.4	20.6
DRY3	6.06	188.5	87,591	17,084	60.5	29.3	10.2
HILL1	7.06	225.7	194,807	36,447	53.9	22.7	23.4
HILL2	3.92	172.9	169,477	32,147	70.2	11.7	18.1
COAST	5.81	579.0	314,478	44,547	33.8	9.7	56.4
Total	5.62	261.0	184,086	36,177	55.9	15.3	28.8

Notes:

* The sum of the values of livestock, agricultural equipment and machinery, and transportation equipment.

Household income is defined as the sum of wage/salary receipts including the imputed value of in-kind payment such as meals and rice, non-agricultural self-employment earnings (gross revenue minus actually paid costs), agricultural self-employment earnings (sum of the value of output minus actually paid costs), and net receipts of non-earned income. Median market prices within each village were used to impute the value of non-cash transactions such as the paddy produced by farmers and consumed by themselves and in-kind payment to workers. See Kurosaki et al. (2004) for details on the estimation of income.

Table 5: Cropping Patterns of Sample Households

	Number of house-holds#	Average farm size (acres)	Average gross cultivated area (acres)	Acreage share of major crop groups in the gross cultivated area (%)						
				Paddy, total	Summer paddy	Pulses	Oilseed crops	Vegetables	Industrial crops*	Other crops
DELTA1	67	8.97	15.08	99.5	42.3	0.1	0.0	0.1	0.0	0.2
DELTA2	60	12.10	17.14	74.0	8.6	25.5	0.4	0.0	0.0	0.1
DRY1	71	5.38	8.75	62.5	22.5	1.8	16.2	17.4	0.8	1.3
DRY2	24	10.45	21.42	0.0	0.0	35.6	46.7	0.2	0.0	17.4
DRY3	26	9.51	12.27	45.6	1.1	15.9	30.9	2.6	0.2	4.7
HILL1	26	10.44	9.18	15.4	11.4	9.7	12.2	6.4	22.3	34.1
HILL2	32	4.53	5.24	32.1	0.0	6.9	9.4	50.6	0.0	1.0
COAST	44	8.21	7.77	51.7	1.0	0.3	0.0	2.4	33.6	12.0

Notes

Only those households with positive crop acreage during the survey year are included in this table.

* Industrial crops include sugarcane, cotton, and natural rubber.

Table 6: Correlation between Crop Acreage Shares and Per-Acre Crop Income

	Village-average of crop income per acre of farmland (Kyats/acre)	Village-average of paddy shares in the gross cultivated areas (%)	Intra-village correlation coefficients between crop acreage shares and per-acre crop income		
			Paddy acreage shares	Acreage shares of crop group *i*	(Name of crop group *i*)
DELTA1	11,222	99.5	-0.019	0.162	(Vegetables)
DELTA2	12,958	74.0	-0.443 *	0.448 *	(Pulses)
DRY1	33,305	62.5	-0.385 *	0.555 *	(Vegetables)
DRY2	25,718	0.0	n.a.	0.599 *	(Other crops)
DRY3	9,582	45.6	-0.529 *	0.349 *	(Oilseed crops)
HILL1	13,200	15.4	-0.094	0.319 *	(Industrial crops)
HILL2	33,313	32.1	-0.364 *	0.308 *	(Vegetables)
COAST	14,256	51.7	-0.473 *	0.810 *	(Vegetables)

Note: * indicates that the coefficient is statistically significant at the 5% level. See Table 5 for the number of observations.

Table 7: Variables Used in the Regression Analyses

Variable	Definition	Mean	Std. Dev.	Min.	Max.
1. Dependent variables					
Crop choice model					
Paddy_gca	Acreage of paddy crop divided by the total acreage of gross cultivated area of the farm.	0.648	0.341	0	1
Paddy_nca	Acreage of paddy crop divided by farm size (acreage; defined as the total acreage of net cultivated area).	0.954	0.608	0	2
Paddy productivity model					
VQ_paddy	Output value of paddy divided by the acreage under paddy crop (100,000 Kyats/acre).	0.233	0.123	0.000	0.805
VA_paddy	Value-added of paddy divided by the acreage under paddy crop (100,000 Kyats/acre).	0.135	0.140	-0.434	0.705
Household income model					
Y_crop	Household income from self-employment in agriculture (crop income only) (100,000 Kyats).	1.375	1.328	-0.640	10.757
Y_hh	Total household income (100,000 Kyats).	1.941	2.745	-1.275	42.481
2. Explanatory variables					
Household and individual characteristics					
Lowland	Acreage of lowland fields managed by the household	6.262	6.029	0	44
Upland	Acreage of other types of fields (mainly upland fields) managed by the household (acres).	2.124	4.230	0	34.11
Future_inh	Dummy variable for the expectation of the household to inherit cultivation rights from parents' households.	0.163			
Past_techn	Indicator variable for the past adoption of new technology* before the median year of adoption in each village (=1 if adopted earlier than the median, =-1 if adopted later than or equal to the median, =0 if the household began farming after the median).	Past_techn=-1: 143 observations, Past_techn= 0: 98 observations, Past_techn= 1: 85 observations			
Educ_head	Education status of the household head in terms of completed years of schooling (years).	3.095	3.074	0	16
Age_head	Age of the household head (years).	47.414	13.067	21	93
Rice_cons	Importance of rice in the family budget, defined as "the value of the annual amount of rice consumed at home" divided by "the annual household income". When the value was larger than unity, it was truncated at one.	0.282	0.278	0.005	1.000
Thresher	Dummy for owning a threshing machine for paddy.	0.021			
Village fixed effects					
DELTA1	Dummy variable for DELTA1.#	0.206			
DELTA2	Dummy variable for DELTA2.	0.184			
DRY1	Dummy variable for DRY1.	0.218			
DRY3	Dummy variable for DRY3.	0.080			
HILL1	Dummy variable for HILL1.	0.080			
HILL2	Dummy variable for HILL2.	0.098			
COAST	Dummy variable for COAST.	0.135			

Notes: (1) The unit of observation are farm households with positive areas under cultivation in the survey year and living in villages other than DRY2. The number of observations thus is 326. The number of observations is 291 for VQ_paddy and VA_paddy because these variables are not defined for 35 households that did not grow paddy crop at all.
(2) When the variable is a dummy, the percentage of those observations taking one is reported.
This dummy variable is used as reference in regression analyses.

* The key technology is: DELTA1=summer paddy production using diesel pumps, DELTA2=summer paddy production using perennial canals, DRY1=summer paddy production using Manawthakha variety, DRY3=IR variety for monsoon paddy production, HILL1=Shwewar-tun (Ywe) variety for monsoon paddy production, HILL2=Kauk Phwar Phy variety for monsoon paddy production, COAST=summer paddy production using artificial irrigation.

Table 8: Determinants of Crop Choices

Dep. variable=	Paddy_gca		Paddy_nca	
	Coeff.	Std. Err	Coeff.	Std. Err
Individual and household attributes				
Lowland	0.0052 **	(0.002)	0.0000	(0.004)
Upland	-0.0180 ***	(0.007)	-0.0267 ***	(0.007)
Future_inh	0.0693 *	(0.039)	0.1111 *	(0.064)
Past_techn	0.0183	(0.017)	0.0775 ***	(0.027)
Educ_head	-0.0003	(0.005)	0.0047	(0.007)
Age_head	0.0016	(0.001)	0.0003	(0.002)
Rice_cons	0.1713 ***	(0.045)	0.1279 **	(0.064)
Thresher	0.1539 **	(0.066)	0.0863	(0.132)
Village fixed effects				
DELTA2	-0.2403 ***	(0.027)	-0.5983 ***	(0.060)
DRY1	-0.2867 ***	(0.038)	-0.6168 ***	(0.078)
DRY3	-0.4124 ***	(0.049)	-0.9430 ***	(0.071)
HILL1	-0.6213 ***	(0.066)	-1.3008 ***	(0.085)
HILL2	-0.5715 ***	(0.054)	-1.2346 ***	(0.080)
COAST	-0.2723 ***	(0.060)	-0.9495 ***	(0.090)
Intercept	0.7970 ***	(0.059)	1.6227 ***	(0.096)
F-stat for zero slopes	64.27 ***		72.08 ***	
R^2	0.580		0.679	

Note:
Estimated by OLS with Huber-White heteroscedastic robust standard errors in parentheses. Significant at 1% (***), 5% (**), and 10% (*).

Table 9: Determinants of Paddy Productivity

Dep. variable=	VQ_paddy		VA_paddy	
	Coeff.	Std. Err	Coeff.	Std. Err
Individual and household attributes				
Lowland	-0.0014 *	(0.001)	-0.0012	(0.001)
Upland	-0.0006	(0.003)	-0.0018	(0.004)
Future_inh	-0.0003	(0.014)	-0.0090	(0.022)
Past_techn	0.0043	(0.002)	0.0016	(0.002)
Educ_head	0.0001 **	(0.000)	0.0005	(0.001)
Age_head	0.0023	(0.008)	0.0027	(0.010)
Rice_cons	-0.0712 ***	(0.018)	-0.0743 ***	(0.021)
Thresher	0.0004	(0.025)	-0.0160	(0.030)
Village fixed effects				
DELTA2	-0.0609 ***	(0.010)	0.0330 ***	(0.011)
DRY1	0.0881 ***	(0.016)	0.0699 ***	(0.020)
DRY3	-0.1555 ***	(0.020)	-0.0545 **	(0.022)
HILL1	0.1726 ***	(0.048)	0.1592 ***	(0.054)
HILL2	-0.1135 ***	(0.024)	-0.2548 ***	(0.035)
COAST	0.0145	(0.018)	0.0874 ***	(0.020)
Intercept	0.2549 ***	(0.026)	0.1242 ***	(0.029)
F-stat for zero slopes	25.29 ***		17.47 ***	
R^2	0.559		0.510	

Note: see Table 8.

Table 10: Impacts of Paddy Policies on Household Income

Dep. variable=	Y_crop			Y_hh		
	Coeff.		Std. Err .	Coeff		Std. Err
Individual and household attributes						
Paddy_gca (endogenous)	-2.0604	*	(1.223)	-6.0303	*	(3.239)
Lowland	0.0793	***	(0.020)	0.0633	*	(0.034)
Upland	0.0701	**	(0.028)	0.1522	**	(0.071)
Educ_head	0.0824	**	(0.039)	0.1792	***	(0.052)
Age_head	0.0122	**	(0.005)	0.0133		(0.013)
Rice_cons	-1.6232	***	(0.266)	-1.4464	**	(0.741)
Thresher	0.2779		(0.337)	1.7899	*	(1.061)
Village fixed effects						
DELTA2	-0.3635		(0.314)	-1.3724		(0.895)
DRY1	-0.1142		(0.406)	-1.6347		(1.045)
DRY3	-1.2900	**	(0.563)	-3.8970	**	(1.452)
HILL1	-1.5014	*	(0.909)	-5.1521	**	(2.129)
HILL2	-0.9057		(0.756)	-4.3283	**	(1.945)
COAST	-1.0468	***	(0.361)	-1.5997		(1.038)
Intercept	2.2273	**	(1.117)	6.1751	**	(2.701)
F-stat for zero slopes	15.80	***		9.71	***	
R^2	0.385			0.146		

Notes:

(1) Estimated by the instrumental variables method. See Table 8 for the first stage regression result for Paddy_gca.

(2) Huber-White heteroscedastic robust standard errors are reported in parentheses. Significant at 1% (***), 5% (**), and 10% (*).