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Income distribution in rice-growing villages during the post-Green Revolution periods: the Philippine case, 1985 and 1998

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Abstract

This paper aims to examine changes in household income sources and its impact on household income distribution in the post-Green Revolution periods in 1985 and 1998 in the rural Philippines. We found that there has been a structural shift of household income away from farm in favor of nonfarm labor income sources. This finding indicates that rural development is being led by nonfarm sectors. Such a shift has resulted in an increase in household income inequality as the distribution of nonfarm income has become less equal over time and was markedly more unequal than that of farm income in 1998.

Keywords: Green revolution; Income distribution; Nonfarm employment; The Philippines

1. Introduction

In an agrarian community based mainly on farm production, the major determinant of household income is the size of its landholdings (Quan and Koo, 1985; Adams and Alderman, 1992). The impact of the Green Revolution in rice farming, represented by the development and adoption of modern, fertilizer-responsive and high-yielding modern varieties (MVs) of rice, on household income and its distribution has received much attention in the literature on agricultural development (Barker and Herdt, 1985). It is expected that the Green Revolution would contribute to the equalization of household income distribution (Hayami and Kikuchi, 1982) so far as it increases labor income relative to land income in rural Asia (David and Otsuka, 1994).

Since the mid-1980s, however, income from rice production has been declining due to declining rice prices and stagnation in rice yields (Pingali et al., 1997). [3] During this period the nonfarm sectors have developed and farm households have become more involved in nonfarm activities in East Asia. As a result,

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[3] There is no widely accepted consensus regarding the Green Revolution period. As far as Southeast Asia is concerned, it seems reasonable to assume that the heyday of the Green Revolution ended in the middle of the 1980s judging from the stagnant yield trend and the saturation of the adoption of pest- and disease-resistant, second-generation MVs. See Hayami and Otsuka (1994) and Otsuka et al. (1994).

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nonfarm income has increased remarkably even in the Philippines, where the economic growth rate has been relatively low compared to other East Asian countries (Estudillo and Otsuka, 1999; Hayami and Kikuchi, 2000). For example, in Central Luzon the average share of nonfarm income in rice-growing households increased from 38% in 1986 to 51% in 1995, whereas the share of land income estimated as residual returns declined from 35 to 28% for the same period. This shift of household income structure away from land in favor of nonfarm income implies that the influence of new rice technology on the level and distribution of household income has weakened. Yet, despite the growing importance of nonfarm income, its implication for household income distribution has seldom been analyzed rigorously in the literature.[4]

The purpose of this study is to assess the impact of increasing nonfarm income and decreasing farm income on the overall household income distribution based on a panel data set from five rice growing villages in the Philippines. The same set of households surveyed in 1985, including both farm and landless laborer households, were resurveyed in 1998. Since human capital, measured by schooling, age, and sex, has a relatively small impact on farm income relative to nonfarm income (e.g., Joliffe, 1998; Estudillo and Otsuka, 1999; Fafchamps and Quisumbing, 1999), and since lucrative nonfarm jobs often require human capital (e.g., Psacharopoulous, 1994), we hypothesize that the growing importance of nonfarm income will increase income inequality due to the unequal distribution of human capital. While it is in general not clear whether the distribution of human capital becomes more or less equal over time, we expect that the inequality in human capital did not decrease in the context of the Philippines. This is because the increased returns to investment in human capital in recent years were not generally anticipated due to prolonged stagnation of the economy until the end of the 1980s. To the extent that the distribution of human capital is unrelated to the distribution of land, the impact of increasing nonfarm income on the overall household income distribution may be equality-improving as it may offset the income inequality arising from the inequitable distribution of land.[5] Thus, whether overall income distribution improves or worsens is an empirical question.

The organization of this paper is as follows. After briefly characterizing sample households in Section 2, we examine changes in rice farming from 1985 to 1998 in terms of technology, labor use, and factor shares in Section 3. Section 4 is devoted to an examination of changes in the structure of total household incomes and the identification of factors determining farm and nonfarm incomes. We then assess the changing contributions of farm and nonfarm incomes to overall household income distribution by applying the Gini decomposition analysis in Section 5. Policy implications of this study are discussed in Section 6.

2. Characteristics of sample farms

Our data were collected from the same set of households surveyed in 1985 and 1998 in Central Luzon and Panay Island, two of the major rice-producing areas in the Philippines. Two villages are located in Central Luzon and three in Panay (Fig. 1). These villages are typical rice-growing villages in the country and represent various production environments. Two villages, one in Central Luzon and another one in Panay, are fully irrigated by gravity irrigation systems representing a favorable rice production environment. Similarly, one village each in the two locations is characterized by shallow favorable rainfed environment largely free from flooding and drought, while one village in Panay is located in the most unfavorable, mountainous drought-prone production environment.

The International Rice Research Institute (IRRI) collected the 1985 data, whereas the present authors collected the 1998 data (Table 1).[6] The total sample

[4] In an excellent review of literature about the dynamics of rural transformation in India, Jayaraman and Lanjouw (1999) identify agricultural intensification, changing land relations, and occupational diversification as major factors affecting poverty and inequality.

[5] The distribution of human capital may be correlated with land distribution. Farm households with large landholdings can afford to send their children to high schools and colleges. Where there is an active land market it is possible that better-educated individuals, who have better management ability or access to nonfarm employment, may gradually acquire land through purchase.

[6] See Otsuka et al. (1992) for a detailed discussion of the sampling procedure of the villages and households in the original survey in 1985.

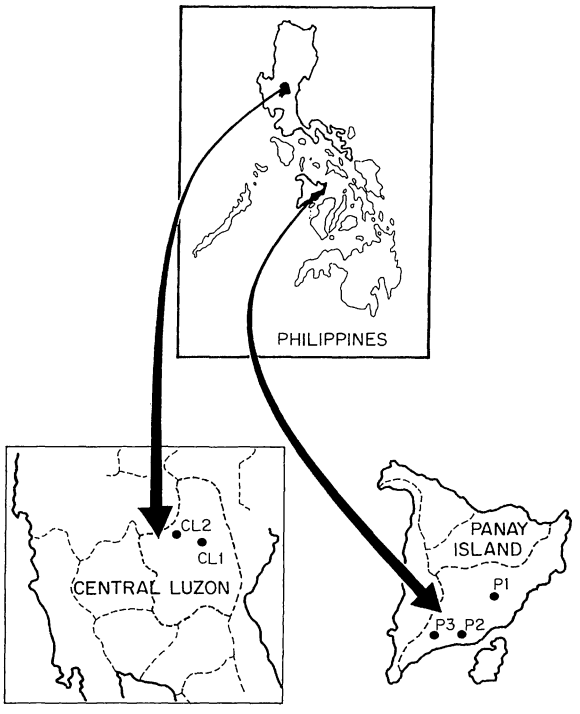

Fig. 1. Location of the study villages.

Table 1
Farm size, tenure status and socio-economic characteristics of sample households in Central Luzon and Panay, 1985 and 1998

Characteristics	Central Luzon		Panay	
	1985	1998	1985	1998
Sample size	183	125	186	122
Farm households	142	92	147	98
Landless households	41	33	39	24
Farm size and tenure				
Farm size (ha)	2.0	1.6	1.2	1.4
Tenure (% area)				
Owner–EP[a]	14	42	33	39
CLT–LH[b]	81	58	33	33
Share tenancy	5	0	34	28
Socio-economic characteristics				
Household size	5.5	4.7	5.8	5.1
Labor force[c]	3.4	3.4	3.8	3.9
Working members[d]	3.0	2.7	3.0	3.1
Average schooling (years)				
Parents	6.0	6.9	6.6	7.2
Children	8.6	9.3	8.5	9.8

[a]EP, Emancipation Patent.
[b]CLT, Certificate of Land Transfer; LH, leasehold tenancy.
[c]The number of household members between 15 and 65 years of age.
[d]Members of labor force who are not in school.

size is 369 households in 1985 and 247 households in 1998. The original 1985 sample consisted of randomly selected 289 farm households and 80 landless households. The sample size declined to 190 farm households and 57 landless households as of our 1998 survey due to out-migration, death, refusal of interview and absence during the survey visit.[7] Note that there were a few farm households in 1985 which became landless households in 1998. Sample households in the landless household category include those that are dependent on casual work in rice farming as well as those whose major source of income comes from formal salaried jobs.

The average landholding of farm households was lower in Panay than in Central Luzon due to higher population density in Panay. However, the average size of farms in Central Luzon declined markedly from 1985 to 1998, while that of Panay increased slightly.

Central Luzon is characterized by a lower proportion of area under owner cultivation reflecting the history of the *hacienda* system that prevailed before the implementation of land reform program in 1972. The major purpose of the land reform program is to transfer land to actual cultivators and promote leasehold tenancy in place of share tenancy (Hayami et al., 1990). The land reform was most effectively implemented in favorable rice growing areas including Central Luzon (Otsuka, 1991). As a result, there was a high incidence of holders of Certificate of Land Transfer (CLT) and leaseholders in this region in 1985. Most CLT holders in Central Luzon have completed the amortization payments and have become owner-cultivators by 1998. Despite its prohibition by land reform laws, in 1998 the proportion of area under share tenancy in our sample villages in Panay remained at 28%.

The average household size in Central Luzon is slightly higher than in Panay (Table 1). We include unmarried children as household members regardless

[7] Unless otherwise stated, the tables referring to 1985 pertain to the full set of sample households. The same set of statistics were also computed for a subsample of households that were present in both the 1985 and 1998 surveys.

of whether they reside in the village or outside.[8] There was a reduction in the average household size in 1998 in both locations. In 1985 and 1998, respectively, about 65 and 75% of the household members belonged to the labor force, defined as those members between 15 and 65 years of age. Among those in the labor force, about 85% are working members, i.e., those members of the labor force who are not in school.

In Central Luzon, the number of working members declined in 1998 because the younger household members opted to go to school. In both Central Luzon and Panay, the number of resident working members declined due to the increase in the number of educated children who were able to obtain jobs outside the village, mostly in large cities and overseas. In Central Luzon, there were only two overseas working members in 1985 but the number increased to six in 1998, whereas in Panay, there were nine in 1985 but increased to 33 in 1998.

Average schooling attainment of working children is close to 10 years with a standard error of 3.14, while that of their parents is only about 7 years with a standard error of 2.33 in 1998. The higher educational attainment of the younger generation is a result of the secular expansion of public expenditures for educational facilities and staff in the country and the increased wealth of the former share tenants, which enabled them to invest in their children's education.

We found that husbands have about 0.5 year more schooling than their wives, while the daughters have 1–2 years more of schooling than the sons. According to Lanzona (1998), women experience significantly higher returns to years of schooling than men do in the Philippines. Hence, parents have invested more in daughters' schooling than in sons' (Quisumbing, 1994; Estudillo et al., 2000).[9]

[8] As we included unmarried children as members of the household, our definition of a household in this paper is more inclusive than the usual 'members of the same family sharing living and eating arrangements'. It is closer to the definition of the family as 'individuals related by blood or marriage'.

[9] This trend is also found in Indonesia where women are acquiring secondary and tertiary education in relatively larger numbers than male in response to greater relative returns to female higher education (Deolalikar, 1993). According to Behrman and Deolalikar (1995), wage rates remain lower for females than males, but the percentage increases in wages associated with post-primary schooling are greater for females.

There has been a shift in occupational structure of younger household members in favor of nonfarm jobs, which alters household income structure. While the respondents are mainly engaged in farm work, the children are engaged in various types of nonfarm occupations. Among the sons, about 55% work as farmers or farm laborers, 30% hold informal nonfarm jobs such as peddling, carpentry, driving and handicraft, and 15% are professionals, including government and public office employees, medical practitioners, accountants, teachers, and overseas workers. Among the daughters, about 50% are involved in own household keeping, 6% work as farmers or farm laborers, 24% work in informal nonfarm work, and 20% are professionals.

3. Changes in rice farming

This section reviews changes in rice technology, labor use, and factor shares from 1985 to 1998 in order to gain proper insights into the changing importance of rice farming as a source of income of rural households.

3.1. Modern rice technology

The modern rice technology package includes irrigation, MVs and labor-saving technologies such as tractor, thresher and direct-seeding. The ratio of planted area with irrigation rose in both Central Luzon and Panay because of increased adoption of water pumps in the favorable rainfed areas. Owing to the availability of irrigation water and favorable rainfed production environments, as early as 1985, the adoption of MVs was already complete in Central Luzon, while 23% of sample farmers were still planting traditional varieties in the same year in Panay (Table 2). By 1998, however, MV adoption was complete in all study villages and thus the impact of MVs on household income may no longer be substantial in the post-Green Revolution period. The effect of MVs is not a major concern of this study.

Tractor adoption in Central Luzon was close to 100% even as early as 1985, while in Panay about 60% in 1985 and 20% in 1998 of sample farmers were using water buffalos. Thresher adoption has been close to 100% in both Central Luzon and Panay. Direct-seeding, which is a new method of establishing rice plants by broadcasting pre-germinated or

Table 2
Changes in technologies, rice cropping intensity and rice yields in Central Luzon and Panay, 1985 and 1998

Technologies	Central Luzon		Panay	
	1985	1998	1985	1998
Irrigation ratio (% area)	72	77	38	39
Adoption of MVs (% adopters)[a]	100	100	77	100
Adoption of labor-saving technologies (% adopters)				
Tractor	91	98	40	80
Thresher	100	100	97	97
Direct-seeding	30	56	73	97
Rice yield ($t\,ha^{-1}$ per season)[b]	4.3	5.1	3.1	2.3
Rice cropping intensity	1.8	1.8	1.5	1.5

[a]Refers to modern rice variety.
[b]Average of wet, dry and third cropping seasons.

germinated rice seeds into the puddled (prepared) soil, is more widely adopted in Panay. The modern rice technology package introduced in Panay in the 1970s combined early maturing MVs with direct-seeding to increase cropping intensity.

The average rice yield rose from 4.3 to 5.1 $t\,ha^{-1}$ per season in Central Luzon because of the adoption of newer, higher-yielding MVs and better farm management practices. The average yield in Panay declined because of the drought in the rainfed villages in 1998. Rice cropping intensity, which is the number of rice crops in one year, in both Central Luzon and Panay remained the same in 1985 and 1998.

3.2. Labor use

A change in labor use in rice farming per year is affected by labor use per season and cropping intensity. Total labor demand in rice farming per year has declined because cropping intensity has remained fairly the same (Table 2), while there has been a significant decline in labor use per season due to increased adoption of labor-saving technologies.

Labor use per hectare per season in rice production is shown in Table 3. There are three important observations from this table. First, the total labor use per hectare declined significantly in both Central Luzon and Panay. The decline in total labor use comes mainly from the decline in labor input in crop establishment due to increased use of herbicide, which effectively substitutes for manual weeding, and in harvesting and threshing activities, due to improvement in threshing machine. In Panay, the accelerated use of tractors resulted in a decline of labor input in land preparation from 11 to 8 mandays ha^{-1} per season (manday=8 h). Second, labor in rice production is male-dominant: about three-fourths of the total labor use is accounted for by male labor, both family and hired. Third, the proportion of hired labor increased in Central Luzon and remained unchanged in Panay. Landless laborer households, which are the major suppliers of hired labor in rice farming, have not been made worse-off over time, because the returns to hired labor rose due to the increase in the demand for hired labor and the recent surge in wage rates.

Table 3
Labor use per hectare in rice production during the wet season in Central Luzon and Panay, 1985 and 1998

Rice farming activities	Central Luzon		Panay	
	1985	1998	1985[a]	1998
Land preparation	15	14	11	8
Crop establishment	27	13	8	3
Crop care	5	3	10	13
Harvesting and threshing	32	25	25	19
Total (mandays ha^{-1} per season)	79	55	54	43
Composition of labor input (%)				
Family				
Male	36	26	29	24
Female[b]	4	2	6	12
Hired				
Male	38	52	50	62
Female	22	20	15	2

[a]Refers to the sample households in 1998.
[b]Female labor includes small amount of children's labor.

3.3. Factor shares

Factor shares analysis in rice production is of particular interest for the analysis of household income distribution since returns to factors of production in rice farming are major sources of farm income among farm and landless households. Following the convention (Barker and Herdt, 1985), we disaggregate the gross value of rice production into payments to four major categories of inputs: (1) current inputs, (2) capital inputs including family owned and hired capital, (3) labor inputs of family and hired workers, and (4) land. For owned factor inputs, imputations are made

Table 4
Factor shares (%) per hectare per season in rice production in Central Luzon and Panay, 1985 and 1998

Factors	Central Luzon		Panay	
	1985	1998	1985	1998
Gross output[a]	100	100	100	100
Current inputs	29	17	21	27
Capital	15	6	11	11
Owned	4	1	2	1
Hired	11	5	9	10
Labor	26	26	29	40
Family	12	5	10	9
Hired	14	21	19	31
Land	30	51	39	22

[a]Average of wet, dry and third cropping seasons.

using prevailing wage and rental rates. The return to land is computed as the residual after deducting the sum of payments to current inputs, capital, and labor from the gross value of output.

Factor shares per hectare per season, estimated as the average of wet, dry, and third cropping seasons, are shown in Table 4. The factor share of current inputs in Central Luzon declined partly due to the adoption of integrated pest management, which minimizes the use of chemical inputs, whereas the factor share of current inputs in Panay increased due to an increased use of chemical inputs as a result of increased MV adoption. [10] The factor share of capital in Central Luzon declined due to a decrease in the rental price of hired capital, whereas in Panay the factor share of capital remained the same.

Although the total amount of labor use in rice production per hectare per season declined, the factor share of labor increased in Panay and remained the same in Central Luzon. Such changes can be explained by the increase in the wage rate. We found that real daily wage rates deflated by nominal paddy price index in land preparation and transplanting rose 1.5–2.0 times over the 13-year period. The increase in real wage rates can be explained primarily by the increase in labor demand in the nonfarm sector as the Philippine economy experienced relatively rapid growth during the mid-1990s. During the same period, farm technology, rice price, and other factor prices did not change favorably to increase labor demand in agriculture. The factor share of family labor declined as a result of substitution of family by hired labor. There is hardly any doubt that it was the development of nonfarm sectors, but not agricultural technology, that triggered structural changes in rice economy in the rural Philippines.

The factor share of land increased from 30 to 51% in Central Luzon but decreased in Panay. While the former can be explained by the increased yields due to improved technologies, the latter can be attributed to the decreased yields due to drought in our survey year. Increased factor share of land indicates that income gap between farming and landless households has increased unless the increased land income results in substantial reduction in the labor supply of farm households through the income effect.

4. Determinants of household income

Farm income consists of rice income and income from nonrice crop and livestock production. For farm households, rice income includes the returns to owned capital, family labor, and land, while for landless households, rice income is derived from earnings from hired employment. Nonfarm income consists of income from formal wage employment, informal employment, and remittances from family members working outside the village. [11]

4.1. Changes in income structure

Table 5 shows the breakdown of total household income into different components for farm and landless households. Farm income is the most important income source of farm households comprising 83% of the total household income in Central Luzon and 64% in Panay in 1985. The major contributor to farm income is land income in rice production. The landless households in Central Luzon derive 66% of their total income from farm sources in 1985, of which wage earnings from rice production is a major component. In

[10] We observe a decline in the real price of urea relative to paddy price. Nominal paddy price index rose by more than twice from 1985 to 1998 but the real price of urea deflated by nominal paddy price index declined to about one-half.

[11] None among our sample households explicitly obtained substantial income from income-earning assets other than those used in rice farming. The importance of farm assets is comparatively small as can be ascertained from small factor share of owned capital.

Table 5
Annual income of farming and landless households in Central Luzon and Panay, 1985 and 1998[a]

Income sources	Central Luzon (%)		Panay (%)	
	1985	1998	1985	1998
Farm households				
Farm	83	60	64	24
Rice	69	54	40	11
Nonrice crop and livestock	14	6	24	13
Nonfarm	17	40	36	76
Nonfarm employment	8	34	17	41
Remittances	9	6	19	35
Total	100	100	100	100
Total (in thousands, P/year)	23.2	111.1	16.8	83.8
Landless households				
Farm	66	31	24	16
Rice	51	24	16	5
Nonrice crop and livestock	15	7	8	11
Nonfarm	34	69	76	84
Nonfarm employment	28	58	50	64
Remittances	6	11	26	20
Total	100	100	100	100
Total (in thousands, P/year)	9.4	48.0	13.1	58.4
Income ratio of farm to landless households				
Farm	3.1	4.4	3.5	2.2
Nonfarm	1.2	1.4	0.6	1.3
Total	2.4	2.3	1.3	1.4

[a]US$1=P20 in 1985; US$1=P38 in 1998.

Panay the proportion of nonfarm income of the landless households is substantially higher because some households depend mainly on nonfarm employment.

It is remarkable that the share of farm income, particularly rice income, of the farm households declined considerably from 1985 to 1998. This decline was brought about primarily by the reduction in the share of family labor income in rice production. Family members devoted less time to farm production activities and increased their involvement in nonfarm employment. As a result, the share of nonfarm income rose markedly among farm households in both locations. We also found that the share of land income remained fairly constant in Central Luzon but decreased in Panay due to poor harvest. Recall that the factor share of land in rice production rose considerably in Central Luzon. Yet the fact that the share of land in total income did not rise indicates that land is no longer the only decisive factor determining rural household income.

In Central Luzon the increase in nonfarm income originated mostly from nonfarm employment earnings, whereas in Panay it came from the increase in both nonfarm employment earnings and remittances. Remittances, particularly from overseas workers, rose by about 12-fold in Panay but only about 4-fold in Central Luzon. It is also interesting to observe that remittances have become a more important component of total household income of the farm households than income from rice farming in Panay. Similarly, the share of nonfarm income of the landless households increased at the expense of farm income. Moreover, the wage earnings of the landless households from rice production activities were of secondary importance in 1998. The shift of income structure in favor of nonfarm income among the landless households has been more remarkable in Central Luzon presumably because of its proximity to Metropolitan Manila, which has been the center of recent economic development. The dependence of landless households in Panay on nonfarm employment increased in 1998.

The disparity between the farm and landless households in terms of total income remained fairly constant, whereas the nonfarm income gap increased (see the last part of Table 5). In Panay the landless households received more income from nonfarm sources than the farm households in 1985, but this trend was reversed in 1998 when the farm households reaped more benefits from employment outside the village. If the farm households continue to receive greater incomes from the integration of the urban and overseas labor markets, then there will be greater inequality in the distribution of income between farm and landless households. [12] Since the share of farm income declined, the contribution of farm income disparity to the total income gap must have decreased. [13]

[12] It appears that the income gap in nonfarm income in favor of farm households will likely continue in the future. We found that among the working children aged 15–65 years old who are no longer in school in 1997, the children from the landless workers' households are less capable of obtaining nonfarm jobs. These children, on the average, obtained only 8 years of schooling, while the children from the farmers' households obtained 10 years of schooling. Sons of the landless households are particularly disfavored because they obtain only 6 years of schooling in contrast to the farmers' sons who obtained 10 years of schooling.

[13] Moreover, there was a decline in the income gap across the five villages indicating that the impact of production environment in determining household income has declined.

Overall, there has been a clear shift of household income away from land in favor of nonfarm labor income. According to our descriptive statistics, the increased availability of nonfarm employment tends to distribute income unequally between the farm and landless households. Hayami and Kikuchi (2000) argue, however, that in another rice village in the Philippines, the expansion of nonfarm employment has acted to equalize the distribution of income as it enables the landless farm households to increase their income. On the contrary, Adams (1996) finds in rural Pakistan that remittances from abroad have a negative effect on equity. Thus, the effect of increased nonfarm income on income distribution needs to be examined carefully. Before that, we would like to identify statistically the factors affecting the amounts of farm and nonfarm income.

4.2. Estimation of income determination functions

In order to identify the determinants of household income, we estimated reduced-form regression functions explaining farm and nonfarm incomes separately for 1985 and 1998. [14] We are particularly interested in the examination of the effects of farm size and human capital variables in the two income components. We estimate separate regressions for the two survey years because the changes in nonfarm employment opportunities, among other things, led to the structural changes in the income determination functions. The F-test reveals that there was a structural change in the nonfarm income function (computed as F=2.67 vs. the critical F=1.67 for 5% level of significance) as well as in the farm income function (computed as F=4.54 vs. the critical F=1.67 for 5% level of significance).

Explanatory variables included the following: (1) new rice technology represented by the interaction term between the MV adoption and the presence of irrigation, (2) farm size, (3) land tenure, (4) the number of working members, (5) proxies for the human capital of working members including sex, age and education, and (6) village dummies.

We estimated an OLS regression model for the full sample in 1985 (N=369), while for 1998, for which we have 247 households, we used the two-stage Heckman (1979) procedure for the 1998 data to correct for selectivity bias. [15] Households surveyed in 1998 were a subsample of the 1985 sample corresponding to the households which were present in both survey years. Sample selectivity bias arises because incomes are observed only for the households which were available in the 1998 survey — a nonrandom sample of households given that some of the 1985 respondents have migrated.

Thus for the first stage, we estimate a probit function where the dependent variable is the probability that the household is present in both 1985 and 1998 and the independent variables are the explanatory variables in the 1985 household income functions. [16] The dependent variable is equal to 1 if the household is present in both years, and 0 if it is present only in 1985. Independent variables are identical to those in the 1985 income determination functions, since the determinants of income in 1985 would affect the household's decision to remain in the village, but not income earned in 1998. The predicted inverse Mills ratio, or selectivity correction, is then used as a regressor in the second stage equation with income as the dependent variable.

CL1 and CL2 village dummies represent irrigated and rainfed villages in Central Luzon, respectively, whereas P1 and P2 dummies correspond to irrigated and rainfed environments in Panay. The most unfavorable village, P3, is used as the base of comparison. Double-log specification is used for continuous variables so that the estimated coefficients are elasticities. On the other hand, if the explanatory variables are expressed in proportions, the coefficient shows the percentage changes in income when the proportion changes from 0 to 1.

We use an interaction term between MV adoption and presence of irrigation because irrigation is the

[14] For an earlier application of the same methodology, see Otsuka et al. (1992) and Estudillo and Otsuka (1999).

[15] In addition to the two-stage Heckman (1979) procedure, we also estimated an OLS model for the income functions in 1998. We found that the results of the OLS model in terms of the magnitude and standard errors of the coefficients of the explanatory variables are fairly similar with the results of the two-stage Heckman (1979) procedure indicating that the selectivity bias is not significantly large.

[16] It is important to mention that the two-stage Heckman (1979) procedure can be theoretically applied only in the 1998 income determination functions because of the identification problem. It is difficult to think of a single identifying instrument that affects the probability of the household being present in 1985 that does not affect household income in the same year.

most important determinant of the productivity impact of MVs. We interacted both MV-irrigation and farm size with farm household dummy, which is denoted by FHD, because there are landless households in the sample. The variable FHD×MV×irrigation measures the combined effect of differential MV adoption and irrigation on component incomes in 1985, whereas the same variable measures the impact of irrigation in 1998, since MV adoption has reached 100%. FHD×log farm size measures the impact of farm size on the household income.

Table 6 shows the estimation results of the reduced-form income determination functions. Significant coefficients of owner, CLT–leasehold and share tenancy dummies imply that landless households are more likely to migrate. Migration will improve the distribution of income not only because migrants would be better-off but also because the proportion of village population who do not have access to land decreases. Those households with more female members have a higher propensity to leave the village because females have stronger propensity to seek nonfarm jobs than males (Lanzona, 1998). In contrast, those households with a higher ratio of working members with tertiary education and those households located in irrigated and favorable villages are more likely to stay.

The coefficient of the MV-irrigation variable is significant in the farm income functions and the value

Table 6
Income determination functions in Central Luzon and Panay, 1985 and 1998

Variables	Probability of being present in 1985 and 1998 (Probit)[a]	Farm income		Nonfarm income	
		1985	1998	1985	1998
Constant	−0.38 (−0.75)[b]	7.34** (22.73)	8.84** (12.06)	6.01** (9.11)	8.49** (7.91)
FHD[c]×MV×irrigation	−0.13 (−0.89)	0.16* (1.95)	0.42* (1.84)	0.11 (0.69)	−0.52 (−1.51)
FHD×log farm size[c]	0.06 (0.60)	0.63** (9.26)	0.45** (4.96)	0.14 (1.06)	0.07 (0.51)
Owner	0.65** (2.53)	1.11** (7.00)	1.21** (5.05)	−0.20 (−0.63)	0.01 (0.04)
CLT–leasehold	0.69** (3.17)	0.72** (5.33)	0.97** (4.28)	−0.23 (−0.90)	0.00 (0.00)
Share tenancy	0.48* (1.69)	0.27 (1.50)	0.76** (2.60)	−0.42 (−1.22)	0.60 (1.43)
Number of working members	0.06 (0.35)	0.21* (1.73)	0.15 (0.97)	0.58* (2.29)	0.87** (3.73)
Ratio of female working members	−0.89* (−2.21)	0.08 (0.34)	−0.12 (−0.45)	0.21 (0.43)	−0.23 (−0.58)
Ratio of working members					
Aged 56–65	−0.21 (−0.49)	−0.48* (−1.71)	0.13 (0.33)	1.58** (2.52)	0.67 (1.10)
Aged 46–55	−0.57 (−1.29)	0.33 (1.14)	−0.23 (−0.58)	1.45** (2.38)	0.24 (0.40)
Aged 36–45	0.19 (0.56)	0.04 (0.21)	0.11 (0.31)	0.91* (1.94)	1.08* (2.10)
Aged 26–35	0.02 (0.08)	0.04 (0.21)	0.08 (0.26)	0.81* (1.81)	1.14* (2.33)
Ratio of working members with:					
Secondary schooling	0.29 (1.15)	0.25 (1.60)	−0.06 (−0.30)	0.86** (2.58)	0.02 (0.05)
College education	0.88** (2.48)	0.17 (0.84)	−0.14 (−0.54)	1.09** (2.74)	1.19** (3.22)
Village dummies					
CL1[d]	0.99** (3.33)	0.85** (4.55)	0.73* (1.88)	−0.37 (−1.03)	0.77 (1.32)
CL2[d]	0.07 (0.24)	0.23 (1.24)	0.90** (3.01)	−0.33 (−0.89)	0.70 (1.56)
P1[e]	0.66* (2.20)	0.41* (2.13)	0.10 (0.29)	0.62* (1.69)	0.79 (1.52)
P2[e]	0.99** (3.55)	0.46** (2.62)	−0.45 (−1.31)	0.17 (0.50)	0.46 (0.92)
Selection control			−0.72* (−1.67)		−0.72 (−1.15)
Log-likelihood ratio	−201.68				
R^2		0.50	0.54	0.16	0.24

*Indicates significance at the 5% level.
**Indicates significance at the 1% level.
[a]Explanatory variables in the probit are the 1985 values of the regressors in the 1985 income determination functions.
[b]Numbers in parentheses are *t*-values.
[c]Farm household dummy.
[d]Irrigated (CL1) and rainfed (CL2) villages in Central Luzon.
[e]Irrigated (P1) and rainfed (P2) villages in Panay.

of the coefficient rose from 0.16 in 1985 to 0.42 in 1998. These coefficients indicate that the availability of irrigation combined with the adoption of higher yielding MV increased farm income by 17% in 1985 and 52% in 1998.[17]

Since land income is the major contributor to farm income, it is not surprising to find that farm size has a highly significant coefficient in the farm income function. The coefficients of 0.63 in 1985 and 0.45 in 1998, which are significantly less than unity, indicate that farm income increases less than proportionally with farm size. There is no evidence that those families with access to larger areas of land earn more income from off-farm jobs as can be seen from the insignificant coefficient of farm size in the nonfarm income function.

Compared with the landless households, owner cultivators, CLT holders and leaseholders, and share tenants have increasingly captured the increased returns to land and entrepreneurship.[18] Note that the absolute values of the CLT–leasehold and share tenancy coefficients are lower compared to owner cultivation because part of the returns to land accrues to the owner of the land.

It is also important to observe that none of the three tenure variables are significant in the nonfarm income regression in both 1985 and 1998. These results indicate that the landless households do not have inherent constraints in getting nonfarm jobs. The coefficients of the number of working members are positive but weakly significant in 1985 and insignificant in the farm income regression in 1998, suggesting that increased total supply of family labor does not lead to increased application of family labor to farming. The coefficient of the same variable in the nonfarm income regression is significantly greater than zero but less than unity in 1985 but not significantly smaller than unity in 1998. It is clear that nonfarm sector plays an increasingly important role in absorption of additions to the rural labor force.

Human capital variables including age, education, and gender do not seem to exert any significant impact on farm incomes. The coefficient of the ratio of female working members is not significant in both farm and nonfarm income functions, which would imply that women tend to work as much as men in both farm and nonfarm sectors.

We found that the older people (aged 56–65) are less involved in farm production, while those members older than 26 years of age are heavily engaged in nonfarm employment in 1985. In 1998, however, the younger groups (aged 36–45 and 26–35) have become more active in nonfarm activities. These findings are consistent with our observations that in 1985 the predominant nonfarm employment opportunities are those in which almost all age groups can participate in, such as informal trade, carpentry and small manufacturing. In contrast, formal employment in the nonfarm sector became more dominant in 1998 and, hence, the better-educated members of the younger generation are those engaged in nonfarm jobs. This interpretation is further supported by a positive and highly significant coefficient of college education in the nonfarm income function in 1998.[19] In contrast, there is no significant difference in the nonfarm income between secondary school and college graduates in 1985.[20] Almost all the village dummies have insignificant coefficients in the nonfarm function in both 1985 and 1998. These results suggest that nonfarm job markets are relatively well integrated.

The selection control variable has a negative and insignificant coefficient in the nonfarm income function, which indicates that those households who have remained in the village do not earn significantly less

[17] While the impact of MVs on nonfarm income is insignificant in our study villages, MV adoption affects the growth of nonfarm activities in study villages in India (Hazell and Ramasamy, 1991).

[18] According to Estudillo et al. (1999), private profitability for farm households in rice production has risen over the past 30 years partly due to higher domestic rice prices relative to world rice price, improvement in yields, and the shift of tenure relations in favor of leasehold-tenancy and owner-cultivation.

[19] We estimated an income determination function using the average age and education of the working members in the household as human capital variables instead of the ratios of working members falling into different age and education groups. Again, we found that education has a positive and significant effect on nonagricultural income in 1998. Moreover, we found that education-squared has a positive and significant coefficient in the nonagricultural income function indicating that the nonagricultural income increases more than proportionately with education.

[20] Initially we tried to include education variables as ratio of working parents and children falling into different schooling categories. However, we found serious multicollinearity between the education of parents and children indicating that parents' education is an important determinant of children's education (Couch and Dunn, 1997).

nonfarm income as those households who have left the village. There is a weakly significant negative selection bias in the farm income function implying that those households who have remained in the village have lower farm income. It appears that the selection bias is not too large partly because of the weak effect of locational selection and partly because of the large variance of selection variable.[21]

5. Income distribution

In order to examine whether the increased importance of nonfarm income and decreased importance of farm income have resulted in inequitable distribution of overall household income, we apply a decomposition analysis of the Gini measure of inequality as developed by Fei et al. (1978) and Pyatt et al. (1980). This decomposition formula is designed to assess the inequality of distribution of a particular source of income relative to the distribution of overall income. Note, however, that the computed percentage contribution to overall inequality by income components under the Gini decomposition rule may be substantially different from the decomposition of an alternative measure of inequality (Shorrocks, 1983). We have chosen the Gini decomposition formula because of the popular use of the Gini ratios in the economic analysis.

The Gini decomposition formula is shown as follows:

$$G(Y) = \sum s_i R(Y, Y_i) G(Y_i) = \sum s_i \, \mathrm{PG}(Y_i),$$

where $G(Y)$ equals the Gini ratio of the total household income, Y_i equals the income of the ith source, s_i equals the share of the ith type of income, $R(Y, Y_i)$ equals the rank correlation ratio, $G(Y_i)$ equals the Gini ratio of the ith income, and $\mathrm{PG}(Y_i)$ equals the pseudo-Gini ratio of the income inequality. The rank correlation ratio is defined as

$$R(Y, Y_i) = \frac{\mathrm{Cov}\{Y_i, r(Y)\}}{\mathrm{Cov}\{Y_i, r(Y_i)\}},$$

where $r(Y)$ and $r(Y_i)$ denote the ranking of households in terms of Y and Y_i, respectively. It is clear that R is equal to 1 if $r(Y)=r(Y_i)$. Otherwise, R is shown to be less than 1. In general, the larger the correlation between Y and Y_i, the larger is the R.

In the computation of $G(Y)$, households are ranked in accordance with Y, but in the case of $G(Y_i)$, they are ranked in accordance with Y_i. In order to adjust this difference, the rank correlation appears in the formula. In fact, $R(Y, Y_i)G(Y_i)$ is equal to the pseudo-Gini ratio, $\mathrm{PG}(Y_i)$, which is obtained if we use ranking of households in accordance with total income Y in the computation of component Gini ratio for Y_i. $\mathrm{PG}(Y_i)$ can be regarded to represent the "within-sector" inequality. If $\mathrm{PG}(Y_i)$ is greater than $G(Y)$, the distribution of ith type of income is less equal than other types of income. Thus, by making a comparison between $\mathrm{PG}(Y_i)$ and $G(Y)$, we can assess whether ith type of income is inequity-increasing or inequity-decreasing. The importance of $\mathrm{PG}(Y_i)$ in overall inequality is weighted by its share in the overall household income.

We show in Table 7 the Gini coefficients of total household income inequality for the full set of sample households in 1985 and a subset of the 1985 sample that took part in the 1998 survey. The Gini coefficient of total household income corresponding to the full set of sample households in both locations in 1985 is higher than that of the subsample due to the presence of a larger number of landless households. Thus, if there had been no migration, the income inequality in 1998 would have been substantially higher. The absolute contributions of farm income are largely the same for both the full sample and subsample of households in the two locations. In contrast, nonfarm income has a higher absolute contribution to total inequality in the full set of households due mainly to the high pseudo-Gini coefficient of nonfarm income.

In both locations, the contribution of farm income to total income inequality declined, absolutely from 0.40 to 0.21 and relatively from 87 to 46% in Central Luzon, and absolutely from 0.23 to 0.04 and relatively from 57 to 9% in Panay if we use the subsamples. The absolute decline took place because both the farm income share and pseudo-Gini coefficient declined considerably. Moreover, the pseudo-Gini coefficients

[21] We did a regression run of the total income using the same right-hand side variables used in Table 6. Results of the regression function of total income in 1985 are fairly similar to farm income and that of total income in 1998 is fairly similar to nonfarm income. These results are reasonable considering that farm income comprises a major portion of total household income in 1985, whereas nonfarm income is the more dominant income source in 1998.

Table 7
Contributions of income components to total household income inequality in Central Luzon and Panay, 1985 and 1998

Inequality components	Central Luzon			Panay		
	1985		1998 subsample[a]	1985		1998 subsample[a]
	Full sample	Subsample[a]		Full sample	Subsample[a]	
Gini coefficient	0.49 (100)[b]	0.46 (100)	0.45 (100)	0.46 (100)	0.40 (100)	0.47 (100)
Contribution of income components						
Farm income	0.40 (81)	0.40 (87)	0.21 (46)	0.25 (55)	0.23 (57)	0.04 (9)
Income share	0.81	0.85	0.56	0.58	0.59	0.22
Pseudo-Gini	0.49	0.47	0.36	0.43	0.39	0.19
Nonfarm income	0.09 (19)	0.06 (13)	0.24 (54)	0.21 (45)	0.17 (43)	0.43 (91)
Income share	0.19	0.15	0.44	0.42	0.41	0.78
Pseudo-Gini	0.50	0.41	0.56	0.49	0.43	0.55

[a]The subsample refers to the households which were present in both the 1985 and 1998 surveys.
[b]Numbers in parentheses are percentage contributions to the total Gini coefficient.

of farm income are comparable to the overall Gini coefficients in both locations in 1985 but the overall Gini coefficients exceeded the pseudo-Gini coefficients by wide margins in 1998. These findings indicate that farm income has become an income-equalizing source of income in recent years. As a matter of fact, farm income has a negligible contribution to income inequality in Panay in 1998. The contribution of farm income to total income inequality declined primarily due to the increased demand in hired labor and the increase in farm wage rates which enabled the landless households to improve their income position relative to the farm households. This is reflected in the declining effect of landholdings on farm income as revealed by the regression analysis.

Conversely, the contribution of nonfarm income to the inequality of income distribution increased appreciably. The inequality contribution in Panay rose much more than in Central Luzon primarily because the working household members in Panay are more actively involved in employment outside the village as reflected in a larger nonfarm income share. In 1998 about 25% of the working members in Panay were nonresident working members who migrated to the cities and overseas, while in Central Luzon the proportion of nonresident working members was only 7%. The presence of a large number of nonresident working members in Panay is likely to contribute to the rise in income inequality because the returns to labor in urban and overseas labor markets are considerably higher than labor returns in village employment. The pseudo-Gini coefficients of nonfarm income are similar between the two locations and exceed the overall Gini coefficients considerably in 1998, which implies that nonfarm income has become a major source of income inequality in place of farm income.[22]

The decreasing contribution of farm income and the increasing contribution of nonfarm income to total household inequality attest that the inequality associated with land distribution has exerted a smaller influence on the distribution of household income in recent years, whereas the inequality in the distribution of human capital assumes much greater importance in the determination of household income inequality. It is difficult to compare directly the inequality of human capital distribution with that of land distribution. The coefficient of variation in schooling is 11.6 in 1985 and 10.3 in 1998 suggesting that inequality in schooling among working members of subsample households remained largely the same. Similarly, there has been no substantial change in inequality of land distribution among subsample of households in terms of the Gini coefficient of land distribution, which is 0.49 in 1985 and 0.54 in 1998. Therefore, the inequality of nonfarm income distribution seems to

[22] Leones and Feldman (1998) found that remittance income in a less developed village in Leyte Province in the Philippines is a major contributor to household income inequality. They reported that when the remittance income was removed, nonfarm income did not contribute much to total household income inequality. It implies that the returns to labor in overseas employment is substantially higher than the returns to labor in local jobs.

have widened not because the distribution of human capital has worsened but because returns to human capital have considerably widened.

Human capital determines the access of rural labor to better employment opportunities outside own farms where labor returns are higher. If the current trend continues, the income gap between the better- and less-educated rural households may expand further.

6. Conclusions

Using data from five rice-growing villages in the Philippines in 1985 and 1998, this paper aimed to identify the determinants of changes in household income structure and income inequality. We found that there was a structural shift of household income in favor of nonfarm income during the post-Green Revolution period. Such an increase can be explained by the rapid growth in the nonfarm sector as well as the increased integration of rural with urban and overseas labor markets, which expanded the nonfarm employment opportunities for the rural population.

The shift in household income structure resulted in a remarkable increase in the inequality of nonfarm income. The regression analyses of the determinants of household income found that college education was the most significant factor determining nonfarm income. Thus, it is clear that nonfarm income is concentrated among the more educated segment of the rural population.

In contrast, the share of farm income in the total household income as well as the inequality of its distribution declined substantially in the last 13 years. This implies that neither Green Revolution technology nor the access to land has a decisive influence on the distribution of income among rural households. It follows that the most important determinant of household income distribution in rural areas is likely to be the distribution of human capital rather than land during the post-Green Revolution era. Thus, in order to achieve the equitable development of rural areas, policies to promote equitable and larger investments in human capital must be designed. More explicit policy recommendations, however, cannot be formulated before undertaking in-depth studies of the determinants of schooling and occupational choices.

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