

## Abstract

This dissertation proposes empirical methods to study nonseparable agricultural household models with market failures, especially those for labor, and applies them to the data on Japanese rice farmers.

In case the markets for some types of labor are missing or constrained, the virtual or "internal" wages play an important role in equilibrating the demands for with the supplies of labor within the household. A clear recognition of their distinct role helps establish the formal equivalence between the optimality conditions associated with the nonseparable model and those associated with the corresponding separable model. The formal equivalence in turn gives rise to demand and supply functions for the nonseparable model which include the endogenous internal wages in place of the corresponding exogenous market wages.

Then, all the structural parameters in the model can be estimated in two steps. The production function is estimated first to obtain the marginal revenue products of farm labor or the demand wages, which are equated to the reservation or supply wages in equilibrium. Parameters of the utility function are estimated by use of a demand system including the internal wages in place of the market wages.

Furthermore, the comparative statics analysis is conducted by decomposing the response of quantity variables into two parts. One is the direct effect of changes in exogenous variables with the internal wages being fixed, which coincides with the response of the household in the competitive markets for labor. The other is the internal wage effect of changes in the endogenous internal wages caused by those in the same exogenous variables. Thus, the internal wage effect is thought of as being responsible for the anomalous behavior of agricultural households facing market failures for labor.

These methods are applied to the data on Japanese rice farmers for the period 1982-91. Chapter 2 assumes the homogeneity of on- and off-farm labor as well as the constrained off-farm wage employment. The internal wage estimated by use of a Cobb-Douglas production function is much lower than the corresponding market wage, so that the off-

farm employment constraint is inferred to be binding under this specification. The examination of the internal labor market shows that the slope of the supply function is steep and that both the demand and supply functions shift greatly in response to changes in the price of rice and to those in the opportunities for off-farm wage employment. Thus, changes in these two exogenous factors cause large changes in their internal wage, which in turn cause large internal wage effects on their rice supply. In particular, these effects are large enough to make the supply function of rice slope downward. Furthermore, Appendix of this chapter proposes an alternative decomposition of the comparative statics based on the internal wage effects for a general class of production and utility functions to show its tractability over the traditional decomposition in the empirical analysis.

Chapter 3 offers a two-step interpretation for the response of internal prices in an agricultural household model with missing markets for both food and labor. Responses of the internal prices depend on their responses in an isolated manner in the case of one missing market for either commodity, which may be called initial effects. Then they depend on cross price effects between food and labor which cause the interactions between the internal markets for the two commodities. This intuitive interpretation helps reveal not only how the “internal instability” of agricultural households arises but also which assumptions are crucial in producing it.

Chapter 4 conducts an empirical analysis similar to that in Chapter 2 by allowing for the heterogeneity of on- and off-farm labor as well as that of male and female farm labor, which requires the interpretation proposed in Chapter 3. The internal wages estimated by use of a better specified translog production function are higher than the one estimated in Chapter 2, and the statistical test shows that the Cobb-Douglas specification is restrictive. The results of the comparative statics analysis reveal that the internal markets for labor exhibit a structure common to males and females, i.e., the demand function is relatively flat and shifts in response only to the price of farm commodity, while the supply function is relatively steep and hardly shifts in response to the market prices. This common structure combines with the low substitutability between male and female labor to cause generally small responses of the internal wages to changes in the market prices, which in turn cause

the associated small internal wage effects on quantity variables. The internal wage effect of changes in the price of rice on its supply is significantly large but smaller than the one estimated in Chapter 2, so that the own price response of rice supply turns out to be positive. These results seem to reflect the gender division of labor as observed in many other countries and the peculiar division of labor within Japanese rice-farming households that younger members work mainly for off-farm wage employment while elderly members remain in rice farming.

The final chapter summarizes the results in the previous chapters to conclude that the nonseparable models estimated in this study is empirically relevant in studying the behavior of Japanese rice farmers once we recognize the weak correlation of the internal wages with the corresponding market wages.