Labor supply, income, and welfare of the farm household ☆

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ABSTRACT

Considering family labor and hired labor as heterogeneous inputs, we present a theoretical framework in which the optimal decisions of a farm household on on-farm family and hired labor, off-farm labor supply, and leisure are determined uniquely and endogenously. Focusing on two alternative settings with and without off-farm employment constraints, we show that imperfect substitutability between family labor and hired labor is not critical to the separation of household production and consumption. The validity of the separation proposition is shown to depend crucially on whether or not the availability of off-farm job opportunities is limited. We further examine how changes in external economic conditions and government policies affect the time allocation decisions of the household, as well as the composition of household income (i.e., on-farm income and off-farm labor earnings).

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1. Introduction

Issues on the separation of production and consumption decisions in the farm household have long been of interest to economists.[3] The farm household is characterized by a dual role in producing marketable output and coordinating consumption of its members through the allocation of time between work (on-farm and/or off-farm) and leisure. Investigating the separation proposition is important because separation allows for independent estimation of production and consumption, on the one hand, and serves as a foundation for the separate supply and demand analyses in the neoclassical economics, on the other. In a seminal contribution, Benjamin (1992) raised an important issue concerning whether the validity of the separation hypothesis ceases to hold when "family and hired labor are not perfect substitutes in production" (p. 290). One question of interest is:

Would studies showing that family and hired labor are imperfect substitutes be sufficient to undermine the separation proposition?

In this paper, we show that imperfect substitutability between family and hired labor is not critical to the separation between household production and consumption. Interestingly, the validity of the separation proposition depends crucially on whether or not the availability of off-farm job opportunities is limited. To allow for imperfect substitutability, we incorporate a neoclassical-type production function into the traditional income-leisure framework and examine the labor supply and production decisions of a farm household in which family and hired labor are heterogeneous. The assumption of the heterogeneity of labor inputs is supported by several studies on agrarian production.[4] In particular, this assumption parallels Schultz's (1999, p. 7) observation that "family and hired labor may exhibit different productivity and may deserve to be treated as separate inputs."

In the analysis, we first present a model with flexible off-farm job opportunities to characterize the endogenous behavior of a farm household in which on-farm family and hired labor, off-farm labor supply, and leisure are uniquely determined. We further analyze the case with off-farm job constraints. Based on the alternative settings, we examine how changes in economic conditions and government policies affect the labor and production decisions of the household. Further, we discuss the effects of these external changes and government policies on total household income and its composition (i.e., on-

farm income and off-farm labor earnings), as well as on household welfare (i.e., utility). Special emphasis is placed on the interaction of the farm household with off-farm or non-farm job markets.

Studies concerning the effects of non-farm employment opportunities on farm labor, production, and income can be traced back to 1960s and 1970s.[5] With long-term growth in non-farm sectors, it has been observed that agricultural households in many countries (especially the developed countries such as the United States and the European Union) are increasingly interacting with external labor markets either as a way of improving household income or as an option for income diversification. Several studies have documented that income from off-farm activities constitutes an increasingly important part of total household income for farmers.[6] For agricultural households in the United States, for example, it has been shown that there is a positive correlation between farm income variability and off-farm employment, and that off-farm labor earnings play a prominent role for income diversification (Mishra and Goodwin, 1997). Other interesting observations include that farm women's participation in the off-farm labor markets has been increasing and that the majority of farm women in the U.S. are now employed off the farm (Findeis, 2002). In light of the facts,[7] we pay particular attention to the behavior of a farm household in adjusting its labor supply between farm work and off-farm employment.

Our analytical framework extends the income-leisure model of Benjamin (1992), that treats family and hired labor as perfect substitutes. Benjamin tested empirically for the optimal decisions of farm households, and found empirical results in support of the separation hypothesis. In a model with homogeneous labor inputs and flexible off-farm job opportunities, Benjamin found that the optimal mix of family and hired labor is theoretically *indeterminate* (1992, p. 291). We show that this indeterminacy problem can be resolved by the heterogeneity approach in which family and hired labor are treated as separate inputs (Schultz, 1999). Moreover, we show that the imperfect substitutability of family and hired labor is not critical in undermining the separation proposition. One critical element to the separation between household production and consumption is the availability of off-farm employment opportunities.

The remainder of the paper is organized as follows. Section 2 presents a farm household model in which off-farm employment is flexible and the equilibrium in family and hired labor is unique. Section 3 presents a model with off-farm employment constraints. Section 4 concludes.

2. A model with flexible off-farm job opportunities

2.1. The analytical framework

Following the farm household literature, we adopt the traditional income-leisure approach to examine the labor supply and production decisions of a farm family. The household's preferences are defined over income (I) and leisure (L): $U = U(I, L)$. We assume this utility function is twice continuously differentiable and strictly quasi-concave, which implies that indifference curves are strictly convex.

With respect to farm production, we consider the case where there is imperfect substitutability between on-farm family and hired labor. This consideration parallels Schultz's (1999) observation that

the two labor inputs may not be good substitutes "because of differences in relevant skills and farm-specific management experience, or because incentive and monitoring costs differ in these tasks for family and hired labor" (p. 7).[8] For simplicity we assume that farm production is given by $Q = G(F, H; A)$, where Q represents a main agricultural output, F is on-farm family labor, H is hired-in labor, and A is fixed or exogenously given such as land. The production function is twice continuously differentiable and strictly concave in labor inputs, i.e.,

$$G_F = \frac{\partial G}{\partial F} > 0, G_H = \frac{\partial G}{\partial H} > 0, G_{FF} = \frac{\partial^2 G}{\partial F^2} < 0, G_{HH} = \frac{\partial^2 G}{\partial H^2} < 0,$$

and $G_{FF}G_{HH} - G_{FH}^2 > 0$, where $G_{FH} = G_{HF} = \frac{\partial^2 G}{\partial F \partial H} = \frac{\partial^2 G}{\partial H \partial F}$.

These assumptions indicate that the positive marginal product of each labor input is subject to diminishing returns. Family and hired labor may be technologically complement ($G_{FH} > 0$) or substitute ($G_{FH} < 0$).

Given the assumption that family and hired-in labor are heterogeneous, there are two competitive labor markets: one for hired-in labor whose wage rate is w_h and the other for off-farm family labor whose wage rate is w_o. We assume that off-farm wage is higher than hiring-in wage, i.e., $w_o > w_h$. This assumption is consistent with the facts that farm households' participation in the off-farm labor markets and their off-farm earnings have been increasing (Mishra and Sandretto, 2002).

In this section, we focus the analysis on the case of a flexible off-farm work schedule. The household allocates its time between on-farm work (F), off-farm employment (M), and leisure (L), where $M = T - F - L$ and T is the household's total time endowment in a given period. Because of on-farm work and off-farm employment, there are two sources of labor incomes for the household. One is on-farm income, which is defined as farm revenues net of wage payments to hired-in labor, $y_f \equiv pG(F, H; A) - w_h H$, where p represents the competitive price of the farm product. The other source of income is off-farm labor earnings, defined as off-farm wage times off-farm labor supply, $E_o = w_o M = w_o(T - F - L)$. Total income of the household is then given as

$$I = [pG(F, H; A) - w_h H] + w_o(T - F - L) + Z, \tag{1}$$

where Z is non-labor income (e.g., a direct income payment from government) which is exogenously given.

Substituting Eq. (1) into the utility function yields

$$U = U(pG(F, H; A) - w_h H + w_o(T - F - L) + Z, L). \tag{2}$$

The objective of the household is to maximize utility by choosing F, H, and L. The first-order conditions (FOCs) are given, respectively, as

$$pG_F(F, H; A) - w_o = 0, \tag{3}$$

$$pG_H(F, H; A) - w_h = 0, \tag{4}$$

$$U_I(I, L)(-w_o) + U_L(I, L) = 0, \tag{5}$$

where $U_I = \frac{\partial U(.)}{\partial I} > 0$ and $U_L = \frac{\partial U(.)}{\partial L} > 0$.[9] Eq. (3) indicates that the household supplies labor to the farm up to the level where the

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[5] See, e.g., Nakajima (1969), Bowles (1970), and Yotopoulos and Lau (1974).

[6] See e.g., Anderson and Leiserson (1980), Rosenzweig (1988), Ahearn and Lee (1991), Jacoby (1993), Newman and Gertler (1994), and Mishra and Sandretto (2002).

[7] Technological improvements in the production of agricultural products have resulted in farmers either leaving production agriculture or finding part-time jobs in the non-farm sectors (see, e.g., Barkley, 1990; Gardner, 1992; Ahearn and Lee 1991). Changes in external economic conditions and government policies also contribute to the adjustments of farm households in labor supply, production, and consumption decisions. For contributions regarding the reallocation of labor between farm and non-farm work from a household's perspective see, e.g., Huffman (1976, 1980), Sumner (1982), Benjamin (1992), and Caillavet et al. (1994).

[8] There are several important studies that also treat hired labor as another variable input in farm production. See, e.g., Strauss (1986) and Huffman (1980, 1991).

[9] An alternative approach is to assume that the household has the following utility function: $U = U(X, L)$, where X is a Hicksian composite good whose price (p_X) is normalized to one. The budget constraint facing the household is $X + w_o L = pG(F, H; A) - w_h H - w_o F + w_o T + Z$, where the left-hand side of the equation is *household expenditures* on the two consumption goods, X and L, and the right-hand side of the equation is the *household full income constraint*. Solving for X, we have $X = pG(F, H; A) - w_h H + w_o(T - F - L) + Z$, which is analogous to Eq. (1). It follows that $U(X, L) = U(pG(F, H; A) - w_h H + w_o(T - F - L) + Z, L)$. The objective of the household is to choose F, H, and L that maximize $U(X, L)$. The FOCs are exactly the same as those in Eqs. (3)–(5). Thus, income in our model can also be expressed in terms of the Hicksian composite good (i.e., a numerarie good) whose price is one.