Farms, Families, and Markets
New Evidence on Agricultural Labor Markets

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August 2012

Abstract

The agricultural household model has a long history in the development literature and has played a central role in improving understanding of small-scale agricultural households and non-farm enterprises in low income settings. A key insight of the model is that under the assumptions that farmers behave as if all current and future markets exist and treat all prices as given, complex simultaneous decisions about production on the farm and consumption by the farm household simplify into a recursive form. Specifically, production decisions can be modeled as if they are made without reference to household preferences and can therefore be analyzed separately from consumptions choices. This substantially reduces the analytical and data challenges involved in examining farm household behavior. These assumptions have been tested in several important papers that have failed to reject the implications of the recursive model. Using new, longitudinal data from Central Java, Indonesia, this paper rejects the validity of the commonly used recursive model and complete markets, and provides new empirical evidence on the complexity of family behavior. If farm decisions are recursive, demand for farm labor will depend only on market factors and will not be related to the demographic composition of farm households. This hypothesis is tested and rejected. The literature is further extended by establishing that neither unobserved heterogeneity at the farm level, differential monitoring costs for family and hired labor, nor the potential endogeneity of household demographics can explain the relationship between household composition and labor demand on the farm. A model of resource allocation within farm households is then developed to examine labor allocation when markets are incomplete. An implication of this model is empirically tested and not rejected by the data. The results have important implications for understanding labor markets around the world.

JEL Classifications: J23, J24, J43, O12, Q12
Program Area: Labor
Sub-Area: Labor Markets

This paper has benefited from discussions with John Strauss, Dwayne Benjamin, Andrew Foster, Chris Udry, Alessandro Tarozzi, Amar Hamoudi, Peter Arcidiacono, V. Joseph Hotz, Pascaline Dupas, and participants in the Duke Development Reading Group, Labor Seminar, and International Population, Health, and Development Workshop for helpful comments and suggestions.

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1. Introduction

Small, family-run enterprises are the backbone of many developing countries, and millions of households around the world produce goods and services both for their own consumption as well as for sale. These micro-enterprises and family farms operate in complex, interlinked markets for consumption, labor, credit, and output, and face considerable risk and uncertainty. Despite their importance, there is little consensus on the appropriate framework to analyze the market interactions between buyers and sellers in rural areas. Using new, longitudinal data from Central Java, Indonesia, this paper studies the labor market behavior of family farms who grow food both for sale and their own consumption. Understanding these households' constraints and choices is a key challenge for global development.

To investigate both the production and consumption choices in farm households, a large body of literature has utilized the neoclassical agricultural household model. The model incorporates a family operated firm into the household utility maximization problem, and links profit maximization on the farm with time allocation of household members and consumption choices. It has played a key role in both theoretical and empirical studies of rural labor markets, and serves as the theoretical foundation for seminal work in development and agricultural economics. The model has been used to analyze the role of nutrition in farm productivity, agricultural technology adoption, labor supply choices, and responses to policy interventions (e.g. Yotopolous and Lau, 1974; Barnum and Squire, 1979; Strauss, 1982, 1984; Singh et al., 1986).[1] More recently, the model has been used to examine the distributional impact of agricultural productivity shocks (Jayachandran, 2006), to study property rights (Field, 2007), and to investigate the role of child labor in household

[1] Taylor and Adelman (2003) offers an overview of the agricultural household literature. See also Strauss and Thomas (1995), Behrman (1999), or Schultz (2001).

production decisions (Akresh and Edmonds, 2011). In addition to playing a major role in development and agricultural economics literatures, the model has been applied to examine decision-making by small-scale business enterprises and the self-employed.[2]

In general, simultaneously modeling production and consumption decisions is a major challenge. However, if households behave as if they are price-taking utility maximizers in a world of complete markets, production and consumption decisions may be treated as if they are recursive. If farmers behave as if all current and future markets exist, and all prices are given, optimal choices regarding farm production can be treated as if households operate profit maximizing firms. In such a setting, input choices depend only on the prices of inputs and characteristics of the farm. As production choices are made without reference to the preferences of household members, these decisions can be treated as if they are made in a first stage. Consumption decisions can then be treated as occurring in a second stage, taking into account income from farm profits. The key insight of this recursive model is that consumption choices are influenced by production decisions but have no impact on production.

While a strong characterization for any setting, the model under complete markets is advantageous for both theoretical and empirical applications, as it allows studies of farm production choices including technology adoption to be analyzed independently of consumption choices, household characteristics and farm preferences (e.g. Udry, 1996; Conley and Udry, 2010). Furthermore, a subset of seminal papers have not rejected the predictions of complete markets, including influential work using data from rural Indonesia (Pitt and Rosenzweig, 1986; Benjamin, 1992).[3] These papers test whether production choices are invariant to household characteristics that impact consumption allocations, and are

[2] See Grogger (1998) for an application of the model to crime.
[3] Pattanayak and Kramer (2001) also fail to reject complete markets in Indonesia.

unable to reject predictions of recursion. Their failure to reject separation has provided a bedrock foundation for papers that continue to exploit the features and ease of complete markets.

However, despite its widespread use, there is inconclusive evidence on the validity of separation and the recursive form. Others, notably Lopez (1984, 1986), Jacoby (1993), and Grimard (2000), reject separation in data from Canada, Peru, and Coˆte d'Ivoire. More recent work finds mixed results in rural China (Bowlus and Sicular, 2003). However, previous studies are not only inconclusive on separation, but subject to a number of empirical concerns as well. With the exception of Bowlus and Sicular, all of the aforementioned papers rely on a static framework and test market completeness with cross sectional data. While the researchers are careful to control for factors that may bias their empirical strategies, it is difficult to fully address the concern that unobserved heterogeneity at the farm and household level may be driving the results. Unobserved factors such as soil quality or farm-specific knowledge may result in rejections of separation due to a spurious correlation between household characteristics and farm inputs. Similarly, measurement error may play a role in attenuating results toward the null.

This paper's first contribution to the literature is to empirically assess whether separation between production and consumption holds among rural farmers in Central Java, Indonesia using new, longitudinal data from the Work and Iron Status Evaluation (WISE) (Thomas et al., 2011). The data come from a region of the world where past results have led some to conclude that complete markets may exist in the setting (Bardhan and Udry, 1999). We focus on labor markets throughout, and begin by assessing the implication of market completeness that the demand for farm labor is unrelated to the demographic composition of the household. If markets are complete, farmers can hire whatever labor they need through the market, and who lives in a household will have no impact on farm labor.

The empirical results reject a key implication of the recursive model: demand for farm labor does not only depend on market factors, but is influenced by the demographic composition of the household. However, it is possible that these tests are contaminated by unobserved heterogeneity underlying production choices and living arrangements. To address these concerns we then show that neither time invariant unobserved heterogeneity at the farm level, differential monitoring costs for family and hired labor, nor addressing the potential endogeneity of household composition changes the conclusion: household composition affects labor demand.

This result is inconsistent with a world of complete markets, and suggests a wedge exists between the productivities of family and hired labor that links who is in the household to farm labor demand. This result motivates an extension to the model designed to examine decision making in the face of market imperfections. While allowing for heterogeneity in the skills of household and farm laborers, we test an implication of this extended model and show it is consistent with empirical evidence on the sorting of household members to farm versus market work. Where much of the literature testing separation stops at a dichotomous test of complete versus incomplete markets, this extension and empirical evidence is a step towards a fuller understanding of departures from assumptions of complete markets in understanding production, consumption, and time use behavior.

The overall results of this paper are important not only for modeling farm-household decision making, but for the design and evaluation of development policy, and for understanding complex markets around the world. Policy analyses conducted with the recursive model may in fact be missing important outcomes by oversimplifying the relationship between markets, production, preferences, and consumption.

2. Theoretical Framework: A Dynamic Agricultural Household Model

The following section describes a dynamic generalization of the neoclassical agricultural household model in Singh et al. (1986) to formalize intuition and establish the empirically testable implications of the model. The model incorporates production into the intertemporal consumer demand problem with exogenous prices and complete markets.

If implications of the model with complete markets are rejected, formalizing deviations from this framework is a natural next step. However, as discussed in the introduction, the literature is still inconclusive on the validity of the commonly used model. Before considering extensions, we first provide evidence regarding the suitability of separation in the baseline neoclassical agricultural household framework.

2.1 The Farm Household's Problem

Semi-commercial households simultaneously act as both producers and consumers: they make decisions regarding inputs on their farms in one realm, and maximize utility at the household level in the other.

For an infinitely lived household, the objective is to maximize the expected sum of discounted future utility choosing consumption, leisure, savings, farm labor, and other variable farm inputs in each time period and state.[4] The household is constrained by the farm production process, its time endowment, and an intertemporal budget constraint. Formally, the objective is:

$$\max \; E\left[\sum_{t=0}^{\infty} \beta^t u(x_{mt}, x_{at}, \ell_t; \mu_t, \varepsilon_t)\right] \tag{1}$$

[4] The problem may be formulated to a finite time T rather than infinity without loss of generality.

where x_{mt} is a vector of market consumption goods, x_{at} is consumption of agricultural goods (i.e. food, some of which may be grown by the household), and ℓ_t is a vector of household members' leisure. Preferences are captured by μ_t, which includes observed characteristics that parameterize the utility function such as household size and composition, and unobserved characteristics, ε_t. Although we remain agnostic about the particular form of the utility function, we maintain the standard assumptions that it be intertemporally separable, quasi-concave, non-decreasing, and strictly increasing in at least one argument.

The agricultural production function relates labor, variable inputs such as seed and fertilizer, and farm land to output.[5,6] Output in a given period, Q_t, is defined as:

$$Q_t = Q_t(L_t, V_t, A_t) \tag{2}$$

where L_t is labor used on the farm, V_t is a vector of other variable inputs, and A_t is land.[7] Equation (2) models output in period *t* as a function only of variable inputs in the current period. This is appropriate for the empirical application in this paper where one time period of data corresponds to both a planting and harvesting cycle.[8]

Total farm labor consists of the sum of family labor supplied to the farm, L^F_t, and

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[5] Land remains a choice variable in the model, but in the actual rural Indonesian setting studied in this paper there is little new land to acquire, and very few purchases or sales of land in the data. Family farms remain generally stable over time. Ethnographic evidence suggests land is typically inherited by the eldest son rather than divided amongst all siblings. Often the eldest may temporarily share the land with their younger siblings while retaining ownership, but when the younger siblings become deceased, the entire plot falls to the primary heir and their children (White and Schweizer, 1998).

[6] Farms in the region have small capital stocks, and what capital does exist, such as sickles to harvest rice, can effectively be thought of as variable inputs.

[7] Due to the dominance of rice farming in Central Java, and to follow the basic model, equation (2) is for a single output crop. This assumption is not necessary for the validity of the empirical tests. If households are price takers in the relevant output markets, the introduction of multiple outputs from production does not alone affect the primary testable property of the model (see Singh et al., 1986).

[8] The empirical application of the model is robust to a number of alternative forms of the production function, including those allowing for intertemporal links in production where output in period *t* is a function of inputs in the current period as well as those from a previous period (e.g. Kochar, 1999). The empirical tests and results are also robust to production frameworks that explicitly include capital as an input and specify a transition process for capital over time. The form in equation (2) is maintained for ease of exposition.

outside labor hired onto the farm from the marketplace, L^H_t.

$$L_t = L^F_t + L^H_t \tag{3}$$

Both family and hired labor are assumed in the baseline model to share a common wage as in Benjamin (1992). A household's endowment of labor, E^L, is divided between leisure, time spent working on the family farm, and time in off-farm labor, L^O_t.

$$E^L = \ell_t + L^F_t + L^O_t \tag{4}$$

The household is also constrained by an intertemporal budget constraint that describes the evolution of wealth between periods. With complete credit markets, any income not consumed in period *t* is saved and earns interest at a rate of r_{t+1} between periods. Letting W_t be assets or wealth at the beginning of time period *t*, the budget constraint is as follows:

$$W_{t+1} = (1+r_{t+1})\ [W_t + w_t(E^L - \ell_t) + p_{at}Q_t(t) - w_tL_t - p_{vt}V_t - p_{At}A_t - p_{mt}x_{mt} - p_{at}x_{at}] \tag{5}$$

Wealth in the next period is equal to the interest earned on period *t* wealth and income, less period *t* expenditure. The household earns wage income equal to the wage rate multiplied by the sum of on and off-farm labor, $w_t(E^L - \ell_t)$, the gross from the sale of its output $p_{at}Q_t(t)$, and purchases farm labor, variable farm inputs, land, and consumption goods.

Under the assumption of complete markets for credit, insurance, labor, consumption, and agricultural goods, maximizing the household's objective function subject to restrictions (2)-(5) yields the standard first order conditions. Current consumption demands depend on current prices, wages, the interest rate, and net income, as well as expected future prices, wages, and interest rates. An Euler equation guides intertemporal decisions, and the demands for farm inputs are determined solely by the relationship between their marginal products and prices.

The solution to the joint production-consumption problem reveals that the optimal choice of farm inputs is determined as if households operate their farms as risk neutral profit maximizing firms. There is a clear separation between production and a household's preferences which implies the joint problem may be formulated recursively in a two-step process. In the first stage, households maximize profits on their farms independent of preferences or any consumption side influences by choosing farm labor, variable inputs, and land.[9] Utility is then maximized in the second stage, and consumption allocations are affected by production decisions only through the amount of income provided by farm profits.[10] The result of the second stage is a set of conditional demand functions similar to those obtained in standard intertemporal models, but augmented by farm profits in a particular way. The demand for consumption good c in period t is the following:

$$x_{ct} = x_{ct}(p_{mt}, p_{at}, w_t, r_{t+1}, \pi_t(p_{vt}, p_{at}, w_t, p_{At}), y_t, \lambda_t; \mu_t, \varepsilon_t) \tag{6}$$

where consumption depends on market and agricultural prices, p_{mt} and p_{at}, wages, interest rates, farm profits, π_t, income, y_t, and expected future prices through the marginal utility of wealth, λ_t. The key feature of the recursive framework is visible in equation (6). When separation holds, the family farm only affects consumption demand through the profits

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[9] Letting π_t represent farm profits, households solve the following problem in the first stage:

$$\max \pi_t = p_{at}Q_t(L_t, V_t, A_t) - w_tL_t - p_{vt}V_t - p_{At}A_t$$

This is a straightforward maximization which captures that households treat their farms strictly as risk neutral profit maximizing firms when separation holds.

[10] Strauss (1986) illustrates the recursive form of the model and derives the bordered Hessian matrix for the static version of the farm household's problem under complete markets. The block diagonal form of the bordered Hessian illustrates how production decisions may be modeled as independent of consumption side variables.

determined in the first stage. Variables that affect production, including farm characteristics and the prices of variable inputs, impact consumption only through their influence on farm profits.

2.2 Separation, Farm Production, and Labor Demand

The recursive result greatly simplifies the model, as it implies production decisions may be analyzed independently of preferences and consumption side variables, and households' businesses influence their consumption only in a specific way. While a convenient feature, the validity of separation is an empirical question. This paper follows the previous work in the literature that assesses the validity of the recursive model by testing whether production decisions can truly be characterized as independent of household characteristics. Complete markets also define an additional set of restrictions on consumption allocations that are examined in LaFave et al. (2011).

As previously stated, when separation holds, the demand for variable inputs depends only on the marginal productivity of the inputs, prices, and wages. Following Benjamin (1992), we focus on examining separation of labor demand decisions, although the same principles apply to other variable inputs as well. Consider the first order condition determining the profit maximizing amount of farm labor below:

$$p_{at}\frac{\partial Q_t}{\partial L_t} = w_t \quad \forall\, t \tag{7}$$

This is a straightforward relationship between the marginal revenue product of labor and its price. The total amount of labor demanded by the farm, the sum of both hired and family supplied labor, can be determined by solving equation (7) for L_t as a function of exogenous variables in the model. The result is a labor demand function of the form:

$$L^D_t = L^D_t\,(p_{at}, p_{vt}, w_t, p_{At})\ \ \forall\, t \qquad (8)$$

where L^D_t is total farm labor demand in period t. As a result of separation, household characteristics represented by μ_t and ε_t in the utility function do not affect labor demand. Equation (8) implies that when labor is flexibly hired and households can freely allocate labor between on or off-farm employment in a complete market, two households with the exact same farm will have the same labor demand regardless of their preferences, demographic composition, or other characteristics.

While a useful result, there are a number of potential market imperfections or violations of assumptions within the model that may result in the standard neoclassical model being an inadequate characterization of agricultural household behavior. For example, an intrahousehold bargaining process between household members that occurs over both consumption and production decisions may exist.[11] Additional constraints on the number of hours individuals can work off-farm, the amount of labor available to hire onto one's own farm, or lack of access to credit markets may also pose barriers for agricultural households. Transaction costs, monitoring costs, or preferences for own farm versus market work may stand in contrast to the perfect substitutability and homogeneity of hired and family labor. These and other modifications represent potentially important alternatives to the traditional framework, and a number will be examined in later sections of this paper.

However, if separation does hold and the baseline framework is a valid model, it greatly simplifies the study of producer-consumer households. Before considering extensions, this paper empirically assesses separation under the model presented above.

[11] Separation between production decisions and consumption side variables is robust to intra-household bargaining on the consumption side where household utility is a convex combination of each household members individual utility function (see Chiappori, 1988, 1992; Bardhan and Udry, 1999). The same is not true if bargaining occurs over production decisions. There is ample evidence regarding the failure of the unitary model in developing countries, including Thomas (1990), Udry (1996), and LaFave and Thomas (2011) among many others.

3. An Empirical Model of Farm Labor Demand

Testing the validity of separation is an empirical question, and one which has significant implications for our understanding of agricultural household behavior and rural markets. This section specifies a version of the labor demand function in equation (8) applicable to panel data from Central Java, Indonesia. The empirical model follows directly from the theoretical result that household characteristics are excludable from farm labor demand under the null of complete markets. By including household characteristics in the estimation of equation (8) and testing their significance, one may empirically assess the validity of separation in the neoclassical agricultural household model.

Given a Cobb-Douglas production function as in Benjamin (1992), let the farm labor demand of household *h* in community *j* and time *t* be the following:

$$\ln L_{hjt} = \alpha + \beta N_{hjt} + \delta X_{hjt} + \mu_{jt} + \mu_h + \varepsilon_{hjt} \qquad (9)$$

where L_{hjt} is the total number of person-days of farm labor, N_{hjt} represents excludable household characteristics under the null, X_{hjt} are time-varying household and farm level variables, μ_{jt} community-time fixed effects, and μ_h household-farm fixed effects.[12] With labor measured as log person-days, β represents the approximate percentage change in labor demand due to a change in N. Testing separation amounts to testing whether β is significantly different from zero in this regression model.

By considering the model in a dynamic framework, equation (9) exploits the panel dimensions of the data in two ways to control for variables that could potentially bias the results. Community-time indicators, μ_{jt}, flexibly control for time-varying factors at the local

[12] As households and their farms are stable over time in the study setting, we refer to μ_h as a household-farm fixed effect rather than simply a household fixed effect.

level including the wages and prices households face, as well as common factors that may impact production such as weather patterns. Similarly, the household-farm fixed effect, μ_h, captures all additive, time-invariant unobserved and observed heterogeneity of a given household and their farm. The inclusion of μ_h is potentially important, as it addresses concerns raised in past work that unobserved factors may contaminate estimates of labor demand from a single wave of data. As noted in Benjamin (1992), variables such as soil quality, farm specific knowledge, and managerial experience are both difficult to measure, and may bias cross sectional test results due to omitted variables. This paper examines labor demand within households over time while controlling for time-invariant farm and household heterogeneity as a strategy to overcome these concerns.

With the inclusion of μ_h, identification of β in equation (9) comes from changes in N_{hjt} for a given household across waves. Rather than examining variation across households, this test is more inline with the theory in Section 2, which predicts changes in household characteristics should not impact changes in labor demand when farms operate as if they are profit maximizing firms under complete markets. As households appear multiple times in the data, reported standard errors are clustered allowing for arbitrary correlation within households across time.[13]

Although N_{hjt} may be any number of household characteristics, in the spirit of Benjamin (1992), we use household demographic composition as the excludable variables to test separation. We choose to specify household composition slightly differently than Benjamin and past work, although the results are not sensitive to this choice. For each household, let there be K gender-age specific demographic groups, e.g. the number of

[13] Standard errors calculated using block-bootstrapping with blocks defined at the household level are nearly identical to the results that will be presented with clustered standard errors, and do not change the quantitative nor qualitative results.

children, adolescent, prime age, and senior household members of each gender. N_{hjt} is then the sum of the number of household members in each of the K groups:

$$N_{hjt} = \sum_{k=1}^{K} n_{hjt}^{k} \tag{10}$$

where n^{k}_{hjt} represents the number of household members in a specific demographic group e.g. boys from birth to age 14. This specification has the advantage that the coefficient for each group may be clearly interpreted as the impact on labor demand of having one additional household member in the given gender-age group.[14] Identification of each n^{k}_{hjt} comes from variation due to births, deaths, individuals exiting and joining the household, or aging and transitioning to another demographic category. The results presented below use six different age groups for both males and females: children and adolescents from birth to 14 years old, young adults ages 15 to 19, prime age adults ages 20 to 34 and 35 to 49, adults 50 to 64 and seniors 65 and above. These divisions are intended to capture variation by age and gender in a flexible way, and the results are robust to different age groupings as well as using only household size as the excludable characteristic.

The data required to examine farm labor use and household demographic composition over time is not trivial to collect. The next section presents the new, longitudinal data that makes this study possible.

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[14] Past work in the literature testing separation, including Benjamin (1992) and Bowlus and Sicular (2003), use the following functional form for N:

$$N = log(n) + \sum_{k=1}^{K-1} \frac{n^k}{n}$$

where n is total household size. In this specification, the first term captures scale effects and the later measure shares of different demographic groups. While this allows one to directly estimate the coefficient on household size while controlling for composition, the specification produces estimates of household composition effects that are difficult to interpret. When group K is omitted, an increase in the share of young children, for example, must be interpreted conditional on household size and shares of other groups being held constant. For example, when omitting senior women as group K, the share of children may increase due to an additional young child or one less senior female. While we maintain (10) for clarity, results using this alternative specification are consistent with the findings in the rest of the paper and available upon request.

4. Research Setting and Data

4.1 The Work and Iron Status Evaluation

The empirical analysis relies on new data from the Work and Iron Status Evaluation (WISE) project in Central Java, Indonesia (Thomas et al., 2011). The data comes from a large-scale longitudinal survey conducted alongside a randomized controlled trial, and contains detailed information on individuals, households, and the communities in which they live. Following a screening survey at the end of 2001 and selection of a population-representative sample, participant households were interviewed every four months beginning in 2002 and continuing through 2005. A longer-term follow-up was also conducted five years from the start of the survey in 2007.[15] At baseline in 2002, the WISE sample consisted of approximately 146 communities, 4,500 households, and 20,000 individuals in Purworejo.[16]

As the empirical model relies on observing changes in household composition and labor demand within households over time, maintaining minimal attrition is essential to the validity of the study. As a testament to the great effort made by the research team to track respondents over all waves of the survey, ninety-seven percent of the original farm households from the 2002 baseline were interviewed five years later in the 2007 wave.[17]

4.2 Agricultural Household Data

As agriculture is the dominant economic activity in the region, the WISE data contains extensive information on the details of households' farm businesses. Those households who participate in agriculture report on their land ownership and its use, the farm activities

[15] Online Supplementary Table S.1 shows a timeline of the first 11 waves of the survey used in this paper.
[16] Purworejo is a rural region located along the southern coast of Java, and home to approximately one million people.
[17] Thomas et al. (2011) reports further on attrition and the tracking scheme used in the WISE study.

performed by each household member, asset holdings of the farm business, expenditure, profits, and extremely detailed information concerning labor use. For each farm, the data contains the number of hired laborers, the wages they are paid, and the activities and amount of work they perform. This rich set of information allows one to examine detailed interactions between buyers and sellers of labor well beyond previous work testing separation.

Table 1 reports means and standard errors of the data pooled over the eleven waves of WISE used in this paper. Online Supplementary Table S.2 reports statistics for each of the eleven cross sections individually. The sample consists of approximately 4,500 unique farm households and 38,000 household-wave observations. In order for the study to maintain a representative sample over time, the number of households in the survey grows across waves. When individuals move out of original WISE households, their new split-off households become a part of the sample thereafter. This strategy tracks all respondents who were in baseline WISE households as well as adds new family members who join split-off households.

Panel A describes characteristics of the farms in the WISE sample. Small, semi-commercial agriculture is the primary source of income for residents in Purworejo, with wetland rice being grown by 85% of farm households. Rice is typically harvested three times per year and farmers often grow a small amount of oranges, groundnuts, and coconuts as well. Farm households own approximately half an acre of land, and have small capital stocks.

Household composition is quite variable in the sample. Column 2 in Panel B shows the average farm household has approximately four members, with the number in each of the twelve demographic groups varying considerably. As identification in the household-farm fixed effects model requires that compositions change over time, column 3 shows the fraction of households that experience a change in each of the groups. Approximately 80% of households experience a change in composition over the course of the panel. An average of 2 individuals work on the farm in each household, while both men and women participate in nearly all tasks.[18] Household members also sell their labor off farm, with 78% of households ever having a member who works away from the farm as a private employee.[19] Approximately one-third of all off-farm jobs are in the service sector in small shops and restaurants.

The key independent variable in the analysis, labor demand, is constructed as the total time hired labor and household members spend working on the farm. It is measured throughout the regressions and in Panel C of Table 1 as person-days over the previous four months. Household members supply approximately three-quarters of labor used on their own farms, 54 out of 72 person-days, with 75% of household labor supplied by males. The remaining 18 person-days of non-family labor are hired through the market. Nearly all farm households, approximately 90%, report hiring labor at some point in the survey. The most commonly hired tasks are for planting (an average of 6.4 person-days in the last 4 months), harvesting (4.9 person-days), and weeding (4.1 person-days). Ninety-five percent of hired labor is paid a daily wage, with harvesting labor earning nearly three times the wage paid for planting and weeding.

Assessing the validity of separation in the neoclassical agricultural household model is an empirical question. The baseline results follow in the next section.

[18] The exceptions are preparing land and working with livestock, which are nearly exclusively male tasks.

[19] Household members working away from the family farm is a common feature regardless of whether the household hires in labor onto their own farm or not. Seventy nine percent of households that hire in labor have members working off, while 73% of those who do not hire in labor have members who work off-farm.

5. Baseline Tests of Separation

The results presented below show a statistically significant relationship between household demographic composition and labor demand that rejects separation.

5.1 Pooled Cross-Sectional Analysis

Although there are numerous issues with estimating labor demand without properly controlling for unobserved household and farm level heterogeneity, we begin by presenting a pooled cross-sectional analog before moving to the estimation of the dynamic model. This serves to establish a connection with previous literature and provides a baseline to discuss the value added of panel data.[20]

In a pooled framework, let the labor demand of household *h* in community *j* be the following:

$$\ln L_{hjt} = \alpha + \sum_{k=1}^{12} \beta_k n_{hjt}^k + \delta X_{hjt} + \mu_{jt} + \varepsilon_{hjt} \tag{11}$$

where L_{hjt} is total farm labor demand, n^k_{hjt} the number of household members in one of the 12 age-gender groups, and X_{hjt} farm and household characteristics. Household-farm fixed effects do not appear in the model, and variation comes from across households rather than within. Community-time fixed effects, μ_{jt}, are included to control for prices and conditions at the local level, and standard errors are clustered allowing for arbitrary correlation within households and across time as households appear in the full survey multiple times.

Column 1 of Table 2 reports estimates of β_k from the pooled analysis. The results clearly reject separation. All of the male demographic groups and two of the six female

[20] See Online Supplemental Table S.3 for results from individual cross-sectional regressions of the form:

$$\ln L_{hj} = \alpha + \sum_{k=1}^{12} \beta_k n_{hj}^k + \delta X_{hj} + \mu_j + \varepsilon_{hj}$$

groups are significantly associated with higher labor demand. The presence of young girls and older women relates negatively to labor demand, and may be due to members of the household working less on the farm to care for these individuals. The joint tests of the composition coefficients reinforce the rejections.

5.2 A Dynamic Model Accounting for Unobserved Heterogeneity

While the pooled analyses suggest a relationship between household composition and labor demand, the identification strategy may be fundamentally flawed. Among the previously mentioned concerns is the potential for omitted variables that may be correlated with household demographics. For instance, if soil quality or better land is related to greater farm income and household size, separation may be rejected not due to a failure of complete markets, but due to a correlation between having fertile soil and being able to support a large household. As a strategy to control for such factors, the preferred panel model developed in Section 3 includes household-farm fixed effects to sweep away observed and unobserved time invariant heterogeneity common and additive at the farm level. The interpretation of this model is quite different than the previous, as it looks within households rather than across. As the household-farm fixed effect, μ_h, captures a household's average composition and labor demand, the β_k coefficients now measure the impact of having additional household members in each demographic group relative to their within household mean.

The baseline results from estimating equation (9) appear in Column 2 of Table 2. After controlling for time invariant farm and household characteristics as well as community-time influences, there is still is a statistically significant relationship between household composition and farm labor demand. This is a clear rejection of separation. An increase in the number of male household members over the age of 15 results in an increase in labor demand on the farm, as does increasing the number of women between 20 and 64. The joint tests of all composition coefficients, and the male, female, and prime age coefficients show that the result holds jointly along with individual demographic groups. These patterns are intuitive if one thinks of household members being the primary providers of on-farm labor, but are a clear rejection of separation. The similarity between the results in columns 1 and 2 show that while accounting for threats to identification posed by unobserved heterogeneity with household-farm fixed effects is theoretically important, their inclusion does not change the implication of the results: household composition affects farm labor demand.

Along with being inconsistent with separation, the results are in direct contradiction to those supporting complete markets in Benjamin (1992). Unlike the results in Table 2, Benjamin finds no statistically significant relationship between household composition and farm labor demand in a cross sectional sample from the 1980 Agricultural Supplement to the Indonesia Socioeconomic Survey (SUSENAS). Appendix A investigates a number of potential reasons for the difference including model specification and survey design. The findings suggest discrepancies in the two data sets may play a key role.

The baseline results in Table 2 show a clear rejection of complete markets in the WISE sample. The labor demand test executed in this section establishes a link between household demographics and labor use on the farm that suggests a wedge exists between the marginal productivities of family and hired labor. Household members may have certain traits or skills that make them particularly well-suited to family labor. However, understanding why the implications of complete markets are rejected is not immediately clear. The next section further refines the results presented in columns 1 and 2, and extends the literature by explicitly considering a number of potential reasons for rejecting separation. Understanding the causes and consequences of market imperfections is necessary to evaluate their implications, as well as to guide alternative models of producer-consumer household behavior that are consistent with the empirical evidence.

6. Extensions: Investigating Why Complete Markets are Rejected

This section explores the robustness of the previous results to a variety of potentially confounding issues, and aims to understand why complete markets are rejected. We first analyze whether monitoring costs for hired labor account for the wedge between productivities by disaggregating labor demand into different tasks. We then address the potential endogeneity of household composition by exploiting temporal variation in the panel and an instrumental variable strategy. We also explore the relationship between development and market completeness by stratifying households according to their socioeconomic status.

6.1 Differential Monitoring Costs and Farm Tasks

One potential explanation for finding rejections of separation and a connection between household composition and labor demand is the presence of labor market frictions resulting in a wedge between the marginal products and wages of hired and family labor. The most frequently discussed potential friction is a monitoring cost for hired labor, as farmers and day laborers are often thought to be engaged in a principal-agent problem. The extra cost to monitor hired labor results in a wedge between the market wage and the effective shadow wage of family labor.

In the case of rice farming, monitoring costs and the threat of shirking are particularly relevant for certain stages of production but not others. Weeding, planting, and fertilizing are all tasks that are easily masked by the flooded paddy field and difficult to monitor. In contrast, harvesting is a visible activity often paid a piece-rate rather than daily wage, and subject to fewer concerns regarding shirking. By disaggregating labor demand into specific tasks, it is possible to investigate the importance that monitoring costs play in the connection between family demographics and farm labor, and examine if markets function as if they are complete for certain tasks with low monitoring costs.

The agricultural module in WISE contains the number of person-days hired for each of seven tasks performed on the farm, as well as who in the household worked in each task.[21] Task specific labor demand is the sum of person-days hired for a task and labor supplied by family members to a task. Family supplied labor is calculated by matching the farm tasks reported for each household member to their individual employment data.[22]

Labor demand regressions for specific types of labor appear in columns 3 through 5 of Table 2. The tasks are grouped into three categories based on potential monitoring costs, wages, and the amount of hired labor used to complete the tasks. Harvesting has low monitoring costs, requires substantial amounts of labor, and pays an average daily wage nearly three times that of other types of labor (approximately Rp18,000 per day). Weeding, planting, and fertilizing are the second group, and tasks that face high monitoring costs yet rely on large amounts of hired labor. The remaining three tasks; preparing land, working with livestock, and drying, selling and milling the harvest, are done almost exclusively by household members. Young and prime age males do the majority of preparing land and

[21] The seven tasks are: working with livestock, preparing land, planting, weeding, fertilizing, harvesting, and drying, selling and milling the harvest.

[22] Individuals report on the primary activities of all on and off farm labor in every wave. To construct the amount of family supplied hours of harvesting labor, for example, we count the hours on the family farm denoted as "harvesting," by household members reported by the household head to work on the harvest. The same is true for each of the seven activities. There are a small fraction of cases where a household member is listed as performing a farm task by the household head, but does not mention the task as a primary activity of any of their jobs over the previous four months. Results in this section use only family labor from those that could be matched while Supplemental Table S.4 includes results where these potentially missing hours were imputed based on the hours the individual worked doing the same task in surrounding waves. The results are consistent between the two methods of calculating family labor.

working with livestock, while female household members contribute to drying, selling and milling.[23]

Columns 3 through 5 of Table 3 report estimates from the panel labor demand model with household and community-time fixed effects in equation (9). As not every household performs each of the tasks in every period, the samples in columns 3 through 5 are smaller than the full sample in columns 1 and 2.[24] Consistent with separation failing in the baseline results, coefficients on individual demographic groups remain highly significant across all types of labor demand, and the joint F-statistics are well above their critical values. The results show no sign of complete markets holding for tasks where monitoring costs are not a dominant concern.[25]

This is a somewhat surprising result, as much of the literature posits monitoring costs and contracting constraints to be the driving frictions in agricultural labor markets. With monitoring shown to not explain the results, we next turn to examine the potential endogeneity of household composition.

6.2 Endogenous Household Composition and Family Labor

Identification in the panel model comes from how changes in household composition relate to changes in farm labor demand. By exploiting the panel, the household-farm fixed effects remove concerns of time invariant unobserved heterogeneity at the farm and household level, and the community-time indicators control for local time-varying shocks and

[23] Results using other combinations of tasks, and each of the tasks individually are available upon request.
[24] Restricting the full sample to those households who perform a task within each of the groups does not change the results.
[25] Of note, the point estimates are largely indistinguishable from each other in each of the task-specific regressions. When testing for differences across columns 3 through 5, only one of the 23 differences is significant at a 5% level. Combined with the results in columns 1 through 5, the statistical similarity between each of the regressions suggests that the overall rejection of complete markets is not driven by aggregating labor across activities, nor are the baseline results masking that separation holds for certain tasks.

fluctuations. The endogeneity concerns that remain are unobserved household specific productivity shocks that may be related to household demographics and bias the results toward rejecting complete markets.

There are a number of ways to address this potential threat. Columns 6 through 9 in Table 2 presents results addressing this concern by exploiting a temporal features of the WISE panel. While no one strategy may be perfect, the results jointly support the baseline rejections of separation as a valid characterization of markets and not a statistical artifact.

Columns 6 and 7 relate contemporaneous labor demand to one period lagged and led composition. If transitory household level shocks create a relationship between household composition in period t and labor demand in period t, moving one period away and examining lags and leads removes some concerns of the contemporaneous endogeneity. If markets are complete, labor demand in period t should be unrelated to past and future household composition. This is not the case, as the results remain consistent with those shown previously. In both the lagged and led specifications, additional male and female household members are related to an increase in labor used on the farm.

The variation in demographics that is the least concerning is from household members aging and transitioning between demographic groups. Unlike changes in composition due to a strategically timed birth or marriage, aging from 14 to 15, for example, cannot be due to household specific shocks. One strategy to bypass the concerns with endogenous composition changes is to look at those households where the only variation is through aging. While this may be a selected group, Column 8 uses the subsample of households with no new entrants, births, exits, or deaths, and shows the results remain consistent.

As a final approach, Column 9 exploits potential instrumental variables to correct for the endogeneity of changes in household composition. Household demographics in previous periods provide a set of potential instruments for current composition in the spirit of Arellano and Bond (1991). Conditional on the household and community-time fixed effects, as well as additional explanatory variables, lagged household composition should impact labor demand only through its relationship with current household composition.[26]

Column 9 reports the second stage estimates from an overidentified model using 1 and 2 wave lags as instrumental variables.[27, 28] Although the sample shrinks by removing early waves where lags are not available, the instruments are highly predictive, with first stage F-statistics well above the critical value associated with weak instruments. Consistent with the rest of Table 2, the second stage results again show a clear relationship between household composition and labor demand. Even after instrumenting for current household composition with lagged values, individual composition characteristics remain statistically significant both individually and jointly. Furthermore, the C-test of overidentification restrictions cannot reject the validity of the 1 period lagged instruments conditional on the exogeneity of the 2 period lags.[29] The results show the rejection of separation is robust to correcting for the potential endogeneity of changes in household composition when lagged values are used as instruments.

While no single strategy may be ideal, the evidence in Table 2 suggests that the endogeneity of changes in household composition is not driving the results. Instead, there appears to be a significant connection between household demographics and labor demand that violates the predictions of complete markets.

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[26] Bowlus and Sicular (2003) use a similar strategy when testing separation using a four-period panel of rural Chinese farmers. While they do not report the point estimates or results using lagged values as instruments, they use lagged differences of household composition to instrument for contemporaneous composition. They find that separation can still be rejected at the 10% level in their IV estimates.

[27] One and 2 wave lags measure household composition 4 and 8 months prior to the current wave.

[28] Full first stage results can be found included in Supplementary Table S.5.

[29] The C-test is also known as the difference-in-Sargan statistics test. The test statistics is the difference of the Sargan-Hansen statistics from the equation with the smaller set of instruments that are valid under both the null and alternative, and the equation with the full set of instruments (Hayashi, 2000, pp. 218-222).

6.3 Complete Markets and Development

While the rejection of complete markets appears robust to disaggregating labor demand and accounting for the endogeneity of household composition, it is still possible that complete markets are a valid characterization for a subset of the population. While market completeness is an extreme condition for any setting, developing or otherwise, households that are wealthier and more advantaged may be better able to cope with shocks, smooth consumption, and function as if markets are complete. This is a common finding in the empirical risk pooling literature (e.g. Townsend, 1994). Results in this section present suggestive evidence that separation may in fact hold for a small fraction of farm households at the top of the socioeconomic distribution.

To test whether markets correspond with development, Table 3 reports results from dividing the sample by their average (real) per-capita expenditure over the course of the study. Columns 1 through 3 of Table 3 report results for the bottom 15% of the distribution, the middle 70% of the distribution, and the remaining top 15%. The results reveal a sharp distinction between the top of the distribution and the remainder below. Columns 1 and 2 mirror earlier results as separation is clearly rejected for households in the bottom 85% of the distribution. In contrast, no individual demographic groups are significantly related to labor demand amongst those households at the top of the distribution, and the joint test of all 12 groups is also not able to reject separation in the subsample (*p*-value 0.14). This is unlikely to be a result of insufficient statistical power, as the 15-70-15 division ensures there are similar numbers of households in the bottom as well as the top of the distribution.[30]

The stratified results provide suggestive evidence that separation between production

[30] The result is qualitatively similar for other divisions of PCE, however the joint test is able to reject separation for the top of the distribution when it is expanded beyond 18% of households. The *p*-value for the joint test where the top of the distribution is defined as 18% of household is 0.015.

and consumption may be valid for a small subset of farmers with potentially better access to information and markets. However, for the majority of farms, who resides in the household matters. This suggests the marginal products and wages of family and hired labor differ in ways that connect household composition to farm labor use. This section has shown that this link is not simply due to the endogeneity of changes in household composition or monitoring costs for hired labor. Having established incompleteness in labor markets, the next section considers how families behave when facing labor decisions. This is an addition to the literature by not only examining separation, but looking within intra-family labor allocation decisions as well.

7. Household Labor Allocation in Incomplete Markets

Recall from Section 2 that the baseline model in the literature specifies a homogeneous type of labor with a common wage for both hired and family workers. The previous results suggest that labor markets and household behavior are significantly more complex. This section describes a model of household labor allocation that allows for heterogeneity in individuals' on and off-farm skills that is consistent with the empirical link between household composition and labor demand.[31] When faced with incompleteness in labor markets, households look within themselves and select those most adept at market work.

Households in the WISE sample are active in both sending family members to work away from the farm, and hiring workers from the labor market, with 70% of households reporting both hiring labor and having family members work away from the farm. This pattern, along with the relationship between household composition and the skill levels of

[31] Conceptually the model is similar to Jacoby (1993), which structurally estimates a farm production function to estimate marginal productivities for different types of family labor (i.e. male versus female) on small farms in the Peruvian sierra.

family members, suggests differential productivities of household members and hired labor may be an important feature of labor markets in the region.[32]

7.1 A Simple Model of Household Labor Allocation

By aggregating labor as the sum of family and hired person-days, the baseline model assumes that there is a common type of labor that is perfectly substitutable between family and hired workers.[33] As an alternative, consider a model with two different types of labor; type *f* labor with skills best suited toward farm work, and type *n* with non-farm skills. Both types of labor may exist among family members within a household and for hire in the market. Households face a decision as to where to sort their own family members as well as who, if anyone, to hire as farm labor. Optimizing farmers will compare the marginal product of each household member in on and off-farm employment, and allocate each type to the sector with its comparative advantage. As a result, subject to the availability of employment, type *n* family members will be sent to work off the farm, while type *f* labor is kept at home.

Farmers are able to hire both types of labor for use in their fields, however, under plausible conditions they will choose to only hire type *f* labor. If the marginal product of farm production from type *f* hired labor exceeds that of type *n* family labor, households will choose to use a combination of hired and family type *f* labor on the farm while sending type *n* labor to the market. As a result, those household members who remain in family farm employment will look substantially different than those sent to work off-farm.

[32] Household size and the number of prime age males and females in the household relates positively to both years of education and cognitive scores of household heads and their spouses.

[33] Examining labor demand for specific tasks in Section 6 was a way to relax the single-labor input assumption. However, even in the case that planting labor may be different than harvesting, for example, complete markets implicitly assumes family and hired workers were perfect substitutes in each task.

7.2 Empirical Framework

The high frequency of households hiring in farm labor while family members work off-farm is suggestive evidence of sorting. However, whether or not heterogeneous skills are present and households sort labor according to its comparative advantage is an empirical question. If sorting occurs based on the relative productivity of each family member in on and off-farm production, individuals' human capital will affect the probability of working on the family farm. This is in contrast to the predictions of a model with a single type of labor. If labor is homogenous, as in the model in Section 2, an individual's marginal product will be the same in on and off farm labor and their individual traits will not predict in which sector they work. If there are differing returns to type n and f labor in off-farm and farm labor, efficient households will send members to the tasks where they have a comparative advantage.

Examining the likelihood a farm household member works off the family farm as a function of their characteristics provides empirical evidence on the validity of a model with heterogeneous skills in incomplete markets. Characteristics that may be relevant for determining comparative advantage in on versus off farm labor include gender, age, education, cognition, and long-run measures of human capital.

For household member i in farm household h, let the likelihood they ever work away from the family farm as a function of their individual characteristics be given by the following:

$$1(\text{Off Farm}_{ih}) = \alpha + \beta_1 A_{ih} + \beta_2 E_{ih} + \beta_3 C_{ih} + \beta_4 H_{ih} + \mu_h + \varepsilon_{ih} \tag{12}$$

where the dependent variable is an indicator equal to one if the individual ever works in off-farm employment.[34] The individual's age, A_{ih}, years of education, E_{ih}, and cognitive score, C_{ih},

[34] This includes working off farm as a primary occupation and providing family farm labor on the side.

are included, as is height, H_{ih}, as a measure of long-term human capital.[35] As in the empirical tests of separation, equation (12) includes a household-farm fixed effect, μ_h, to capture all common observed and unobserved heterogeneity at the household and farm level. With the inclusion of the fixed effects, the model examines variation within households, and the β coefficients on individual characteristics measure individual *i*'s characteristics relative to household *h*'s average.

An additional testable implication of the heterogeneous skill model is that households optimize by sending the individual with the highest comparative advantage for market labor to off farm employment. Instead of each individual's characteristics entering equation (12), this is tested by including indicators for when individual *i* is the most experienced, most highly educated, has the highest cognitive score, or is the tallest among household members. In this formulation, the β coefficients measure the impact of absolute rather than relative characteristics within a household.

All farm household members 15 and older who ever report working on or away from the family farm during WISE are included in the estimation sample.[36] The model examines the decision of where a household member works conditional on being employed.

7.3 Results

Table 4 contains estimation results for the linear probability model in equation (12) predicting off-farm labor as a function of an individual's human capital. Columns 1 through 3 tests an individual's characteristics relative to the household average, while columns 4 through 6 include

[35] Cognition is measured as the average cognitive score across several non-verbal assessments within WISE. Height is standardized using gender-age norms from the 2000 CDC growth tables, and the mean value is -2.14 (s.d. 0.87). Height-for-age is a well accepted measure of early life investments and long-term human capital (Strauss and Thomas, 2008).
[36] Only approximately 10% of household members age 15 and above never work on or off farm.

indicators for the absolute characteristics within a household.

The results are consistent with the model of heterogeneous skills and household optimizing behavior sketched above. The results in column 1 including male and female household members suggest that high human capital, prime-age males are sent to market work. As predicted, the probability an individual works off farm is increasing in their years of education, cognition, and height. Columns 2 and 3 show this prediction is consistent for both males and females as well.[37] The model is also supported by the alternative specification in columns 4 though 6 examining absolute characteristics of members within the family. The estimates show that the individual with the highest human capital in the household is more likely to work off farm. This is true for years of education, cognition, and long run human capital captured by height.

These results suggest that households optimize in the face of differing returns to heterogeneous labor by sorting family members between farm production and market work. This empirical evidence is a preliminary step toward understanding household behavior in more complex labor markets than those in the traditional agricultural household model. It also suggests a way to examine the effects of market incompleteness on rural households. If certain households are constrained by the market in their ability to send away family members or hire on farm laborers, this will result in a loss from inefficient labor allocation. Ongoing work motivated by the findings in Table 4 looks to assess the impacts of incomplete markets, and further examine the differential marginal productivities of hired and family laborers.

[37] The coefficients and standard errors for males and females in columns 2 and 3, as well as 5 and 6, are obtained through interactions rather than stratifying the sample. This preserves the interpretation of the individual relative to the entire household rather than only household members of the same gender. Columns 2 and 5 are from a fully interacted model with female indicators, and columns 3 and 6 from a fully interacted model with male indicators.

8. Conclusion

Small, family-run farms and microenterprises play an important role in developing settings, and are potential drivers of global growth. In order to understand these households' labor market behaviors and to formulate and evaluate policies, appropriate models of the constraints and choices these household face are essential. This paper shows that the commonly used agricultural household model with complete markets and separation between production and consumption decisions is inconsistent with new empirical evidence from rural Indonesia. Using new, longitudinal data from Central Java, we show a link exists between household characteristics and farm labor demand that is inconsistent with complete markets. This is in direct contrast to seminal findings in the literature that have upheld the predictions of complete markets in rural Indonesia and highlight the complexity facing household decision makers. We also extend the literature by showing neither time invariant unobserved heterogeneity at the farm level, separately examining labor demand for tasks with differential monitoring costs, nor addressing the potential endogeneity of household composition changes the conclusion: households of varying compositions behave differently in labor markets.

Understanding the margins where deviations from complete markets appear is a natural next step. The results suggest a wedge exists between the productivity of family and hired labor that links who resides in the household to farm labor demand. Motivated by this finding, we develop an extended model of resource allocation within agricultural households allowing for heterogeneity in the skills of household and farm laborers. The model predicts that households sort their members to on and off-farm work according to their comparative advantage, and hire in labor with farm specific skills to replace those household members in the market. We provide empirical evidence that an individual's human capital predicts their sector of employment that is consistent with the model's predictions.

This paper has highlighted a number of findings that call for further work. A particular focus for future projects is assessing the welfare loss due to market incompleteness, its underlying causes, and further analyzing family decision making in the face of risk, uncertainty, and market imperfections. The overall results are critical not only for modeling farm-household decision making, but emphasize the importance of recognizing market complexities in designing and evaluating development policy around the world.

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Appendix A: Reconciling Discrepancies with the Previous Literature

This supplement investigates the discrepancy between the baseline rejections of separation shown in Table 2 and the failure to reject separation in Benjamin (1992), a seminal paper in the microeconomics of development. By matching features of the dataset and empirical specification used by Benjamin, we are able to reconcile the otherwise inconsistent results.

Benjamin's analysis uses a one-time agricultural supplement given to farm households across Java as part of the 1980 Indonesia Socioeconomic Survey (SUSENAS). Despite their many similarities, this data set is fundamentally different than WISE in two ways: i) it is cross-sectional while WISE is a panel, and ii) families report working significantly less on their own farms than in WISE. These two discrepancies are addressed in Appendix Table A by modifying WISE to resemble the 1980 data.[38]

The first modification is to account for seasonality. As SUSENAS is collected in the beginning of each year, we restrict the WISE sample to the 3 waves that began in January and had the majority of fieldwork completed by March.[39] This restricts the sample within these waves by approximately 40%. Benjamin also chose to only use rice farmers in his sample, while results presented in the body of this paper include those who were farming other crops as well. Restricting WISE to households that grow rice further reduces the sample by approximately 10%.

Columns 1 through 4 of Appendix Table A repeat the first cross section and panel estimates using this sample. The cross sectional estimates are presented for comparison with

[38] The data from the Agricultural Supplement (Section IV) to the 1980 SUSENAS is no longer available from Badan Pusat Statistik (Statistics Indonesia), although the questionnaire is available from the online RAND Indonesia Data Core (http://www.rand.org/labor/bps.html). Any efforts to make the two data sets comparable rely on summary statistics presented within Benjamin (1992).

[39] These are waves 1, 4, and 7 which began in January of 2002, 2003, and 2004. This is potentially important if there is seasonal variation in the availability of hired labor due to the observance of Ramadan which occurred in the later half of the year throughout WISE.

SUSENAS's single wave of data although the panel models are included and preferred for reasons of unobserved farm and household heterogeneity discussed in the body of the paper. Columns 1 and 2 use the preferred model for household composition used in Table 2, while columns 3 and 4 use Benjamin's alternative specification. Regardless of the specification, the rejections of separation are upheld across columns 1 through 4 in both cross section and panel estimates. Individual coefficients and the joint test over all demographic variables remain statistically significant, rejecting complete markets as in Table 2.

These results suggest that neither the seasonality of the data nor the cross section versus the panel components can account for the discrepancy between the two sets of results. However, one large discrepancy remains; WISE families spend significantly more hours working on their farms than those in the SUSENAS sample. Recall from Table 1 that household members work an average of 54.4 person-days on their farms over the course of 4 months, or an average of 163.2 person-days over the course of a year. In contrast, families in the SUSENAS sample report only 26 person-days of farm labor per year (Benjamin, 1992, Table II p. 300). This is equivalent to a single day's work by a single household member once every two weeks. To address this inconsistency, we down-weight WISE labor supply by a factor of 6.27 (163.2/26) so the WISE mean matches the SUSENAS mean.[40] This transforms the dependent variable from labor demand to a value closer to the amount of hired farm labor.

Columns 5 through 8 of Appendix Table A use the same restricted sample used in columns 1 through 4, but with the down-weighted measure of household labor supply. Even with this transformation, results using the preferred specification for household composition in columns 5 and 6 still reject separation both jointly and with individual gender-age groups

[40] The modified dependent variable is $\log(L^{Hired} + \frac{L^{Supplied}}{6.27})$ as oppose to $\log(L^{Hired} + L^{Supplied})$.

being statistically significant. This is true in both the cross section and panel.

Estimates using the alternative measure of household composition in columns 7 and 8 reveal a different story. Once family labor supply is modified and the alternative specification for household composition is utilized, none of the individual coefficients are significant.[41] This closely matches the failures to reject separation in the previous literature, and suggests the driving factor may be the discrepancy between the amount of labor families report working on their own farms in the different data sets.

[41] Note that separation is rejected jointly in columns 7 and 8 (*p*-value = 0.03 for the cross section and 0.07 for the panel). However, if a random sample of 1443 observations is taken from this modified WISE data to match the sample size in the SUSENAS, neither of the joint tests can be rejected.

Table 1
Summary Statistics

Panel A Farm Characteristics	(1) *Mean*	Panel B Household Composition	(2) *Mean*	(3) *Percent with a Change*	Panel C Farm Labor in the Last 4 Months	(4) *Mean*
Rice Farm (%)	84.89	Household Size	3.83	60.34	*Person-Days of […]*	
	(0.18)		(0.008)	(0.77)	Total Labor Demand	72.45
		Males age […]				(0.30)
Own Land (%)	73.20	Birth to 14 years	0.51	28.87		
	(0.23)		(0.004)	(0.72)	Hired Labor	18.07
Size of Land Owned (m^2)	2076.45	15 to 19	0.19	27.64		(0.19)
	(70.72)		(0.002)	(0.71)		
		20 to 34	0.30	27.02	Family Supplied Labor	54.38
Value of Farm Assets	236.29		(0.003)	(0.70)		(0.22)
(Rp0,000)	(4.50)	35 to 49	0.36	22.36		
Value of Non-Farm Assets	461.01		(0.003)	(0.66)	*Person-Days Hired for […]*	
(Rp0,000)	(5.49)	50 to 64	0.31	24.44	Planting	6.39
			(0.002)	(0.68)		(0.07)
Age of […]		65 and older	0.30	16.07	Harvesting	4.86
Primary Male	54.50		(0.002)	(0.58)		(0.07)
	(0.07)	*Females age […]*			Weeding	4.10
Primary Female	49.23	Birth to 14 years	0.47	26.36		(0.08)
	(0.06)		(0.004)	(0.70)	Other Farm Tasks	2.72
		15 to 19	0.14	24.51		(0.08)
Years of Education of […]			(0.002)	(0.68)		
Primary Male	6.14	20 to 34	0.27	26.19	*Family labor supplied by […]*	
	(0.02)		(0.002)	(0.70)	Male Household Members	40.33
Primary Female	4.98	35 to 49	0.41	23.76		(0.18)
	(0.02)		(0.003)	(0.67)	Female Household Members	14.05
		50 to 64	0.34	25.91		(0.10)
			(0.002)	(0.69)		
N. Households	4452	65 and older	0.25	17.70		
N. Household-wave Obs.	38189		(0.002)	(0.60)		
		Any Change in Household Composition		81.42		
				(0.62)		

Notes: Table reports means and standard errors for variables of interest over the first 11 full waves of WISE. The sample consists of households with farm businesses, approximately 75% of households in the survey. All labor measured as unconditional means of person-days over the past 4 months, and assets as January 2002 Rp0,000.

Table 2

Labor Demand Regressions

	Baseline Results		Labor Demand by Farm Task			Accounting for Endogenous Household Structure			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Pooled Cross Sections	**Household Fixed Effects**	**Harvesting**	**Weeding Planting Fertilizing**	**Land Prep Livestock Dry/Sell/Mill**	**1 Period Lagged Compoition**	**1 Period Lead Composition**	**Households with Only Aging Variation**	**Instrumenting with 1 and 2 Period Lags**
Number of males […]									
Birth to 14 years	0.02**	0.00	-0.03	-0.01	0.01	-0.02	0.03**	0.00	-0.00
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.06)	(0.03)
15 to 19	0.11***	0.09***	0.06**	0.07***	0.17***	0.06***	0.08***	0.09	0.10***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.06)	(0.03)
20 to 34	0.17***	0.14***	0.13***	0.09***	0.15***	0.09***	0.08***	0.18**	0.17***
	(0.01)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.07)	(0.04)
35 to 49	0.19***	0.16***	0.18***	0.12***	0.18***	0.09***	0.05**	0.21**	0.17***
	(0.02)	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.02)	(0.08)	(0.06)
50 to 64	0.27***	0.21***	0.22***	0.15***	0.24***	0.09***	0.12***	0.27***	0.16**
	(0.02)	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.03)	(0.09)	(0.08)
65 and older	0.21***	0.18***	0.18***	0.12***	0.20***	0.05	0.12***	0.23**	0.12
	(0.03)	(0.03)	(0.05)	(0.04)	(0.06)	(0.03)	(0.03)	(0.09)	(0.08)
Number of females […]									
Birth to 14 years	-0.02*	-0.03**	-0.03	-0.04**	-0.03	-0.01	-0.00	-0.08	-0.02
	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.06)	(0.03)
15 to 19	0.01	-0.00	-0.02	-0.02	0.00	0.01	0.00	-0.12*	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.06)	(0.04)
20 to 34	0.01	0.05***	0.06**	0.05**	0.04	0.06***	0.00	-0.02	0.08*
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.07)	(0.04)
35 to 49	0.07***	0.14***	0.10***	0.12***	0.06	0.13***	0.05*	0.05	0.23***
	(0.02)	(0.02)	(0.04)	(0.03)	(0.05)	(0.03)	(0.03)	(0.07)	(0.06)
50 to 64	0.10***	0.10***	0.10**	0.11***	0.04	0.07**	0.07***	0.02	0.14**
	(0.02)	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.03)	(0.08)	(0.06)
65 and older	-0.04**	0.02	0.07	0.04	-0.05	0.01	-0.01	-0.08	0.02
	(0.02)	(0.03)	(0.04)	(0.03)	(0.05)	(0.03)	(0.03)	(0.08)	(0.06)
Joint tests of demographic variables									
All Groups	39.33	13.98	5.46	5.64	7.75	6.29	6.36	2.60	52.89
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Males	55.63	19.62	7.65	7.23	12.32	6.77	9.39	2.40	26.18
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
Females	10.58	7.00	1.81	3.83	1.32	4.56	2.64	2.22	18.28
p-value	0.00	0.00	0.09	0.00	0.24	0.00	0.01	0.04	0.01
Prime age adults 15 to 49	50.02	24.09	8.61	9.91	12.99	10.96	7.20	2.25	45.72
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
C-test - 1 Period Lags (χ^2)									9.07
p-value									0.70
Observations	38189	38189	24353	33166	27387	33781	33185	11596	30150
N. of Households	4452	4452	4022	4166	4176	3950	3810	1585	3888
Joint test of All Regressors	109.5	25.55	11.02	16.16	7.55	20.44	16.9	9.16	17.83
R^2	0.25	0.05	0.03	0.03	0.02	0.04	0.03	0.05	0.04

Notes: Table reports coefficients of interest from estimates of labor demand equations with log of total person-days as the dependent variable. Under separation, each coefficient should be zero. Baseline results appear in columns 1 and 2. Column 1 pools all cross sections and includes a locality-time effect, while Column 2, equation (9) in the paper, adds a household-farm fixed effect to the model in column 1. Columns 3 through 5 report estimates of labor demand for specific farm tasks, dividing total person-days of labor into the tasks listed in each column. Labor demand for each task is calculated as the sum of person days hired to perform the task and labor supplied by household members who are both listed as performing the task and name it as an employment activity. Columns 6 through 9 report results from a number of different regression models that address the potential endogeneity of changes in household composition. Columns 6 and 7 use 1 period lagged and lead household composition rather than contemporaneous values. Column 8 is limited to those households where the only variation in household composition is through aging. These are households with no split-offs, births, deaths, or new entrants throughout WISE. Column 9 reports estimates from the second stage of fixed effect-IV labor demand regressions with 1 and 2 period lagged household composition as IVs for contemporaneous demographics. Full first stage results appear in Supplemental Appendix Table F. The table also reports joint tests of the demographic groups. These are F-statistics for columns 1-8, and chi-squared in Column 9. The C-test in Column 9 is an overidentification test examining the exogeneity of 1 period lags conditional on the validity of the 2 period lags. The R2 reported is for within variation in columns 2 through 9. Along with locality-wave and household fixed effects, additional controls include land ownership status and the size of land owned, whether land is irrigated and size of irrigated land, quintiles of farm and household (real) assets, age and education of the household head and spouse, and month of interview indicators. All standard errors and test statistics allow for clustering at the household level.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Table 3
Labor Demand for Stratified Samples

	Position in Per Capita Expenditure Distribution		
	(1)	(2)	(3)
	Bottom 15%	**Middle 70%**	**Top 15%**
Number of males [...]			
Birth to 14 years	-0.03	0.01	-0.07
	(0.03)	(0.02)	(0.05)
15 to 19	0.11***	0.09***	0.05
	(0.04)	(0.02)	(0.05)
20 to 34	0.17***	0.15***	0.07
	(0.04)	(0.02)	(0.05)
35 to 49	0.34***	0.15***	0.12
	(0.06)	(0.03)	(0.08)
50 to 64	0.28***	0.20***	0.13
	(0.07)	(0.04)	(0.08)
65 and older	0.24***	0.19***	0.04
	(0.08)	(0.04)	(0.09)
Number of females [...]			
Birth to 14 years	-0.03	-0.02	-0.07
	(0.04)	(0.02)	(0.05)
15 to 19	-0.04	-0.00	-0.02
	(0.04)	(0.02)	(0.05)
20 to 34	0.07	0.06***	0.07
	(0.05)	(0.02)	(0.06)
35 to 49	0.14***	0.15***	0.11
	(0.05)	(0.03)	(0.07)
50 to 64	0.03	0.13***	0.09
	(0.06)	(0.03)	(0.07)
65 and older	0.01	0.04	0.03
	(0.06)	(0.03)	(0.07)
Joint test of demographic variables			
All Groups	4.74	11.62	1.44
p-value	0.00	0.00	0.14
Mean person-days of [...]			
Hired Labor	7.42	16.95	33.96
Family Supplied Labor	62.73	55.73	40.38
Observations	5684	26724	5638
N. of Households	660	2966	729
F-test of all regressors	5.96	11.62	6.91
Within R^2	0.06	0.05	0.07

Notes: Table reports estimates of interest for labor demand regressions stratified by the average (real) household per capita expenditure over the course of the survey. Column 1 includes households at the bottom 15% of the distribution, column 2 the middle 70%, and column 3 the top 15%. Joint tests over all demographic groups appear below the coefficient estimates. Along with locality-wave and household fixed effects, additional controls include land ownership status and the size of land owned, whether land is irrigated and size of irrigated land, quintiles of farm and household (real) assets, age and education of the household head and spouse, and the month of interview. All standard errors are calculated allowing for clustering at the household level.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Table 4
Household Labor Allocation
Dependent Variable: 1(Individual Ever Works off Farm)

Relative Characteristics within Households				Absolute Characteristics within Households			
	(1) **All Household Members**	(2) **Male Household Members**	(3) **Female Household Members**		(4) **All Household Members**	(5) **Male Household Members**	(6) **Female Household Members**
Male	0.04***			Male	0.09***		
	(0.01)				(0.01)		
Age Brackets (15-19 Excluded)							
20 to 34	0.05***	0.08***	0.01	1(Eldest)	-0.18***	-0.23***	-0.20***
	(0.02)	(0.02)	(0.03)		(0.01)	(0.01)	(0.02)
35 to 49	-0.00	0.05**	-0.06**				
	(0.02)	(0.02)	(0.03)				
50 to 64	-0.14***	-0.15***	-0.14***				
	(0.02)	(0.02)	(0.03)				
65 and above	-0.38***	-0.37***	-0.31***				
	(0.02)	(0.03)	(0.04)				
Years of Education Brackets (5 and under excluded)							
6 to 8	-0.06***	0.01	-0.05**	1(Highest Education)	0.07***	0.08***	0.04**
	(0.02)	(0.02)	(0.02)		(0.01)	(0.02)	(0.02)
9 to 11	-0.02	0.07**	-0.06**				
	(0.02)	(0.03)	(0.03)				
12 and above	0.09***	0.17***	0.06*				
	(0.02)	(0.03)	(0.03)				
Cognitive z-score	0.02**	0.02***	0.02*	1(Highest Cognitive Score)	0.04***	0.03**	0.04**
	(0.01)	(0.01)	(0.01)		(0.01)	(0.02)	(0.02)
Height-for-age (z-score)	0.02***	0.02*	0.02	1(Highest Height-for-Age)	0.03***	0.03**	0.03*
	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.02)
Household Fixed Effects	Yes	Yes	Yes	Household Fixed Effects	Yes	Yes	Yes
Constant	0.77***	0.71***	0.79***	Constant	0.63***	0.74***	0.72***
	(0.02)	(0.03)	(0.04)		(0.01)	(0.02)	(0.02)
Observations	10679	10679	10679	Observations	10679	10679	10679
N. of Households	4450	4450	4450	N. of Households	4450	4450	4450
F-test of All Regressors	113.28	66.78	66.78	F-test of All Regressors	119.29	83.63	83.63
Within R^2	0.17	0.18	0.18	Within R^2	0.09	0.11	0.11

Notes: Table reports regression results for whether an individual ever works off farm in the private or government sector as a function of their individual characteristics. Sample consists of all individuals over the age of 15 from farm households who ever work on or off farm. Columns 1 through 3 include individual characteristics relative to the household average due to the household fixed effect. Columns 4 through 6 also includes a household fixed effect, but characteristics are specified in absolute terms within a household with indicators for the eldest, highest education, highest cognitive score and highest height-for-age. Cognition is measured as the average gender-age z-score across non-verbal cognitive assessments in WISE. Coefficients in columns 2 and 3 and 5 and 6 are from models fully interacted by gender rather than stratifying the sample. This preserves the same interpretation for male and female estimates relative to all household members rather than only those of the same gender. Standard errors are calculated allowing for clustering amongst individuals within a household.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Appendix Table A

Comparison with Previous Findings

Restricted Sample - Rice farmers interviewed in January, February, and March

	(1) Cross Section	(2) Panel
Number of males […]		
Birth to 14 years	0.04*	0.04
	(0.02)	(0.04)
15 to 19	0.18***	0.08*
	(0.04)	(0.04)
20 to 34	0.14***	0.22***
	(0.03)	(0.04)
35 to 49	0.13*	0.14
	(0.06)	(0.09)
50 to 64	0.30***	0.27***
	(0.07)	(0.09)
65 and older	0.27***	0.16*
	(0.08)	(0.10)
Number of females […]		
Birth to 14 years	-0.01	-0.05
	(0.03)	(0.05)
15 to 19	-0.01	-0.10**
	(0.05)	(0.05)
20 to 34	0.06	0.10*
	(0.06)	(0.05)
35 to 49	0.15**	0.22***
	(0.07)	(0.08)
50 to 64	0.19***	0.32***
	(0.06)	(0.08)
65 and older	-0.03	0.12
	(0.06)	(0.08)
Joint Test (F-stat)		
All Groups	8.33	5.81
p-value	0.00	0.00
Household Fixed Effects	No	Yes
Observations	1725	6269
N. Households	1725	3341
Overall F-test	10.20	5.70
R^2	0.34	0.06

	(3) Cross Section	(4) Panel
Household size (log)	0.30***	0.26***
	(0.08)	(0.08)
Share of […] in Household		
Males 15 to 54	0.59***	0.21
	(0.14)	(0.17)
Males 55 and over	0.48**	0.15
	(0.24)	(0.23)
Females 15 to 54	0.19	-0.05
	(0.17)	(0.21)
Females 55 and over	0.10	-0.10
	(0.21)	(0.23)
Joint Test (F-stat)		
All Groups	8.55	4.39
p-value	0.00	0.00
Household Fixed Effects	No	Yes
Observations	1725	6269
N. Households	1725	3341
Overall F-test	10.80	5.43
R^2	0.33	0.05

Down-Weighted Household Labor Supply to match 1980 SUSENAS Mean

	(5) Cross Section	(6) Panel
Number of males […]		
Birth to 14 years	0.08***	0.03
	(0.03)	(0.05)
15 to 19	0.08**	0.03
	(0.04)	(0.05)
20 to 34	0.09**	0.16***
	(0.04)	(0.05)
35 to 49	0.04	0.03
	(0.07)	(0.09)
50 to 64	0.16*	0.18*
	(0.08)	(0.11)
65 and older	0.15	0.09
	(0.10)	(0.11)
Number of females […]		
Birth to 14 years	0.04	0.00
	(0.04)	(0.06)
15 to 19	-0.01	-0.12**
	(0.07)	(0.05)
20 to 34	0.03	0.06
	(0.07)	(0.06)
35 to 49	0.07	0.16*
	(0.07)	(0.09)
50 to 64	0.08	0.26***
	(0.08)	(0.09)
65 and older	-0.02	0.12
	(0.07)	(0.08)
Joint Test (F-stat)		
All Groups	2.96	3.13
p-value	0.00	0.00
Household Fixed Effects	No	Yes
Observations	1725	6269
N. Households	1725	3341
Overall F-test	12.76	5.50
R^2	0.35	0.07

	(7) Cross Section	(8) Panel
Household size (log)	0.15	0.11
	(0.09)	(0.09)
Share of […] in Household		
Males 15 to 54	0.11	-0.07
	(0.17)	(0.19)
Males 55 and over	-0.09	-0.37
	(0.27)	(0.26)
Females 15 to 54	-0.16	-0.28
	(0.19)	(0.22)
Females 55 and over	-0.07	-0.23
	(0.25)	(0.26)
Joint Test (F-stat)		
All Groups	2.57	2.03
p-value	0.03	0.07
Household Fixed Effects	No	Yes
Observations	1725	6269
N. Households	1725	3341
Overall F-test	14.72	6.14
R^2	0.35	0.06

Notes: Table reports results from labor demand regressions with (log) person-days or farm labor demand as the dependent variable. The sample is restricted to rice farmers interviewed in January, February and March to be consistent with the timing of the Indonesia Socioeconomic Survey (SUSENAS) and data selection in Benjamin (1992). Cross section estimates use households that meet the selection criteria in wave 1 of WISE and panel estimates combine households that satisfy the selection criteria in waves 1, 4 and 7. These waves began data collection in January of 2002, 2003, and 2004 and had the majority of interviews completed by March. Columns 5 through 8 report estimates using a rescaled measure of labor supplied by households to their farms to rectify the inconsistency between WISE and 1980 SUSENAS. WISE families report working an average of 163 person-days per year on their farms while SUSENAS farmers report 26 (Benjamin, 1992 Table II). Labor supply in columns 5 through 8 is defined as original labor supply divided by a factor of 6.27 (163.2/26). Columns 1, 2, 5, and 6 use the preferred specification for household composition in this paper, while columns 3, 4, 7, and 8 use an alternative form matching that chosen by Benjamin (1992). Regressions also control for the following: land ownership status and the size of land owned, whether land is irrigated and size of irrigated land, quintiles of farm and household (real) assets, age and education of the household head and spouse, and month of interview indicators. Locality fixed effects are included in the cross sections, and locality-wave and household fixed effects are included in the panel estimates. Indicators for the primary crop are included in the cross section, but are controlled for with the household fixed effect in the panel. Standard errors in parentheses are calculated accounting for clustering at the locality level in the cross section, and the household level in panel models. The R2 for the panel models is for within variation.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Farms, Families, and Markets
New Evidence on Agricultural Labor Markets

**** Online Supplementary Tables ****
**** Not for Publication ****

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August 2012

Supplementary Table S.1

Work and Iron Status Evaluation (WISE) Study Timeline

Year	Starting Month	Wave Number	Survey Month
2001	September	0	-8
	October		
	November		
	December		
2002	January	1	-4
	February		
	March		
	April		
	May	2	0
	June		
	July		
	August		
	September	3	4
	October		
	November		
	December		
2003	January	4	8
	February		
	March		
	April		
	May	5	12
	June		
	July		
	August		
	September	6	16
	October		
	November		
	December		
2004	January	7	20
	February		
	March		
	April		
	May	8	24
	June		
	July		
	August		
	September	9	28
	October		
	November		
	December		
2005	January	10	32
2007	January	11	56

Notes: Table shows a timeline of the 11 waves of WISE data used in this paper and the screening survey. Dates on this chart mark the beginning of data collection for the wave, not that all households were contacted in the specific month. For example, wave 1 started in January of 2002 and finished in April. The survey month is relative to the baseline for the health intervention (0 in May 2002) and is comparable with the classification of waves in Thomas et. al (2011).

Supplementary Table S.2

Summary Statistics by Wave

	Wave										
	1	2	3	4	5	6	7	8	9	10	11
Date	Jan 2002	May 2002	Sep 2002	Jan 2003	May 2003	Sep 2003	Jan 2004	May 2004	Sep 2004	Jan 2005	Jan 2007
Person-Days of […]											
Total Labor Demand	84.49	81.88	60.67	71.67	81.83	71.49	66.84	75.03	66.12	71.35	64.47
	(1.19)	(1.17)	(0.88)	(0.95)	(1.06)	(0.95)	(0.89)	(0.92)	(0.81)	(0.91)	(0.88)
Hired Labor	24.15	23.37	11.95	18.40	21.36	15.98	16.13	19.07	15.43	17.77	14.74
	(0.83)	(0.85)	(0.51)	(0.63)	(0.71)	(0.56)	(0.53)	(0.61)	(0.44)	(0.60)	(0.45)
Family Supplied Labor	60.36	58.51	48.71	53.27	60.48	55.51	50.71	55.96	50.70	53.58	49.73
	(0.82)	(0.79)	(0.73)	(0.73)	(0.78)	(0.74)	(0.69)	(0.70)	(0.69)	(0.70)	(0.76)
Household Size	3.99	3.94	3.94	3.90	3.87	3.86	3.80	3.79	3.77	3.72	3.58
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Number of Males age […]											
Birth to 14 years	0.54	0.53	0.54	0.52	0.51	0.51	0.50	0.50	0.49	0.48	0.45
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
15 to 19	0.21	0.20	0.20	0.19	0.20	0.19	0.18	0.19	0.18	0.18	0.16
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
20 to 34	0.32	0.32	0.32	0.32	0.31	0.31	0.30	0.29	0.28	0.28	0.26
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
35 to 49	0.37	0.37	0.37	0.36	0.36	0.36	0.36	0.35	0.36	0.35	0.34
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
50 to 64	0.32	0.31	0.32	0.32	0.31	0.32	0.32	0.31	0.31	0.31	0.32
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
65 and older	0.30	0.30	0.29	0.30	0.29	0.29	0.30	0.31	0.31	0.31	0.30
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of Females age […]											
Birth to 14 years	0.50	0.48	0.47	0.49	0.48	0.47	0.47	0.47	0.47	0.45	0.41
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
15 to 19	0.15	0.15	0.15	0.15	0.14	0.14	0.13	0.14	0.13	0.14	0.13
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
20 to 34	0.28	0.28	0.28	0.28	0.27	0.27	0.26	0.26	0.26	0.25	0.24
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
35 to 49	0.42	0.41	0.42	0.40	0.40	0.41	0.40	0.40	0.41	0.40	0.39
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
50 to 64	0.35	0.34	0.34	0.35	0.34	0.34	0.34	0.34	0.34	0.34	0.34
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
65 and older	0.24	0.25	0.24	0.24	0.25	0.25	0.24	0.25	0.25	0.25	0.25
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Rice Farm (%)	88.04	85.37	76.35	87.55	86.09	78.09	88.32	87.79	83.76	86.99	84.97
	(0.55)	(0.60)	(0.74)	(0.55)	(0.58)	(0.70)	(0.54)	(0.55)	(0.62)	(0.58)	(0.62)
Own Land (%)	73.75	73.86	73.84	73.99	73.35	73.41	73.44	72.28	72.46	72.03	72.79
	(0.75)	(0.75)	(0.76)	(0.74)	(0.74)	(0.74)	(0.74)	(0.75)	(0.76)	(0.77)	(0.78)
Size of Land Owned (m^2)	2318.30	1900.16	2015.72	1862.10	2001.38	2001.99	2391.31	2391.31	2026.73	2336.42	2240.94
	(243.40)	(66.11)	(246.60)	(59.57)	(112.73)	(112.27)	(404.52)	(46.39)	(174.38)	(369.67)	(370.67)
Value of Farm Assets	244.51	297.73	255.08	249.24	242.67	246.07	213.75	204.85	217.59	193.18	235.37
	(12.98)	(22.01)	(11.77)	(18.60)	(8.96)	(22.48)	(12.01)	(6.84)	(14.24)	(6.20)	(17.02)
Value of Non-farm Assets	454.34	444.14	453.29	441.43	458.42	448.57	461.57	451.43	454.52	441.80	568.04
	(20.16)	(16.97)	(20.08)	(18.14)	(16.64)	(18.42)	(17.44)	(15.56)	(20.32)	(16.92)	(19.50)
Age of […]											
Primary Male	54.67	54.42	54.48	54.43	54.21	54.29	54.41	54.52	54.56	54.64	54.88
	(0.22)	(0.22)	(0.23)	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)	(0.23)	(0.23)
Primary Female	49.19	49.02	48.88	49.16	49.04	49.04	49.12	49.35	49.32	49.56	49.92
	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)	(0.22)	(0.22)
Years of education of […]											
Primary Male	5.95	6.00	6.01	6.02	6.10	6.12	6.17	6.19	6.21	6.30	6.52
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Primary Female	4.58	4.79	4.85	4.83	4.97	4.95	5.04	5.03	5.14	5.18	5.42
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
N. Observations	3421	3478	3306	3557	3610	3528	3536	3572	3486	3421	3274

Notes: Table reports means and standard errors for variables of interest in each of the first 11 full waves of WISE. The sample consists of households with farm businesses, approximately 75% of households in the survey. All labor measured as unconditional means of person-days over the past 4 months, and assets as January 2002 Rp0,000.

Supplementary Table S.3
Labor Demand Regressions - Each Cross Section

	Wave										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Number of males […]											
Birth to 14 years	0.02	0.02	0.03	0.05**	0.03*	0.00	0.04**	0.02	0.01	0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
15 to 19	0.09***	0.12***	0.16***	0.12***	0.12***	0.15***	0.10***	0.12***	0.10***	0.05	0.14***
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
20 to 34	0.16***	0.16***	0.17***	0.20***	0.19***	0.14***	0.15***	0.13***	0.14***	0.14***	0.14***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)
35 to 49	0.18***	0.19***	0.20***	0.23***	0.22***	0.18***	0.14***	0.16***	0.22***	0.22***	0.13***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
50 to 64	0.31***	0.36***	0.24***	0.24***	0.25***	0.29***	0.23***	0.27***	0.33***	0.28***	0.17***
	(0.04)	(0.05)	(0.06)	(0.04)	(0.05)	(0.05)	(0.06)	(0.04)	(0.05)	(0.04)	(0.05)
65 and older	0.26***	0.30***	0.22***	0.12**	0.17***	0.26***	0.14**	0.20***	0.23***	0.17***	0.10*
	(0.05)	(0.06)	(0.07)	(0.05)	(0.05)	(0.06)	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)
Number of females […]											
Birth to 14 years	-0.00	-0.03	-0.03	-0.04*	-0.02	-0.01	0.00	-0.02	-0.02	-0.04*	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
15 to 19	-0.01	-0.01	0.02	-0.01	0.04	0.04	0.04	0.05	-0.01	-0.01	0.00
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)
20 to 34	0.01	-0.00	0.07	0.00	0.02	0.02	0.03	0.01	-0.03	-0.03	0.04
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
35 to 49	0.12**	0.06	0.10**	0.08*	0.05	0.13***	0.02	0.08**	0.04	0.06	0.05
	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
50 to 64	0.12**	0.13***	0.13***	0.10**	0.11***	0.13***	0.08**	0.07*	0.04	0.11***	0.04
	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
65 and older	-0.02	-0.10**	-0.08*	-0.02	-0.03	0.01	-0.02	-0.03	-0.07**	-0.01	-0.05
	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)
Joint tests of demographic variables (F-stats)											
All Groups	11.64	15.20	8.31	8.66	14.21	8.23	5.83	11.83	8.93	10.69	4.41
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Males	17.22	17.11	9.88	12.87	13.35	10.36	8.00	16.48	13.45	14.76	7.05
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Females	2.81	6.66	3.88	2.941	3.06	2.63	1.60	2.39	2.40	2.82	0.78
p-value	0.01	0.00	0.00	0.00	0.01	0.02	0.15	0.03	0.03	0.01	0.59
Prime age adults 15 to 49	11.02	11.57	13.55	13.66	15.16	10.06	6.07	12.88	8.74	0.83	0.64
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	3421	3475	3302	3557	3610	3527	3536	3570	3486	3420	3273
R^2	0.39	0.38	0.37	0.43	0.45	0.34	0.38	0.43	0.39	0.41	0.42

Notes: Table reports coefficients of interest from estimation of labor demand equations for each of the 11 cross sectional waves with log of total person-days of farm labor the dependent variable. Under separation, each coefficient should be zero. The reported F-statistics and *p*-values are for joint tests of the specified coefficients. Regressions also control for the following: community fixed effects, land ownership status and the size of land owned, whether land is irrigated and size of irrigated land, quintiles of farm and household (real) assets, age and education of the household head and spouse, month of interview and indicators for the farm's primary crop. Standard errors in parentheses are calculated accounting for clustering at the community level.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Supplementary Table S.4
Labor Demand by Farm Tasks
Including Imputed Labor Supply Hours†

	Demand for […] Labor				Differences across coefficients (harvesting as base)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Labor Type	**Total**	**Harvesting**	**Weeding Planting Fertilizing**	**Land Prep Livestock Dry/Sell/Mill**	**Total**	**Harvesting**	**Weeding Planting Fertilizing**	**Land Prep Livestock Dry/Sell/Mill**
Number of males […]								
Birth to 14 years	0.00	0.00	0.01	0.03	0.00	-	-0.01	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)	(0.03)
15 to 19	0.09***	0.09***	0.08***	0.15***	0.00	-	0.01	-0.06**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)	(0.03)
20 to 34	0.14***	0.14***	0.13***	0.18***	0.01	-	0.01	-0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)	(0.03)
35 to 49	0.16***	0.15***	0.14***	0.23***	-0.01	-	0.01	-0.08*
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)		(0.04)	(0.05)
50 to 64	0.21***	0.18***	0.18***	0.26***	-0.03	-	0.00	-0.08
	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)		(0.04)	(0.05)
65 and older	0.18***	0.14***	0.14***	0.23***	-0.04	-	0.00	-0.09
	(0.03)	(0.04)	(0.03)	(0.05)	(0.04)		(0.05)	(0.06)
Number of females […]								
Birth to 14 years	-0.03**	-0.02	-0.04***	0.00	0.02	-	0.03	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)	(0.03)
15 to 19	-0.00	-0.01	0.01	-0.01	-0.01	-	-0.02	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)		(0.02)	(0.03)
20 to 34	0.05***	0.02	0.06***	0.05*	-0.03	-	-0.04	-0.02
	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)		(0.03)	(0.03)
35 to 49	0.14***	0.07*	0.13***	0.09**	-0.07*	-	-0.06	-0.02
	(0.02)	(0.04)	(0.02)	(0.04)	(0.04)		(0.04)	(0.05)
50 to 64	0.10***	0.06	0.11***	0.10***	-0.04	-	-0.04	-0.04
	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)		(0.04)	(0.05)
65 and older	0.02	0.01	0.02	-0.01	-0.01	-	-0.01	0.02
	(0.03)	(0.04)	(0.03)	(0.04)	(0.04)		(0.04)	(0.05)
Joint tests of demographic variables (F-stats)								
All Groups	13.98	6.50	12.18	11.46				
p-value	0.00	0.00	0.00	0.00				
Males	19.62	10.67	15.21	17.36				
p-value	0.00	0.00	0.00	0.00				
Females	7.00	0.92	6.92	3.15				
p-value	0.00	0.48	0.00	0.00				
Prime age adults 15 to 49	24.09	11.43	20.89	18.75				
p-value	0.00	0.00	0.00	0.00				
Mean person-days of labor	72.45	18.73	45.78	28.66				
Observations	38189	27498	34926	36847				
N. of Households	4452	4193	4270	4434				
F-test of All Regressors	25.55	12.89	17.99	10.90				
Within R^2	0.05	0.03	0.03	0.02				

Notes: Columns 1 through 4 report estimates of labor demand equations for all types of labor and specific farm tasks. Column 1 matches results in Table 2, while columns 2 through 4 divide person-days of labor into the tasks listed in each column. Labor demand for each type is calculated as the sum of person days hired to perform the task and labor supplied by household members who are listed performing the task. Joint tests of coefficient groups and *p*-values appear below. Along with locality-wave and household fixed effects, additional controls include land ownership status and the size of land owned, whether land is irrigated and size of irrigated land, quintiles of farm and household (real) assets, age and education of the household head and spouse, and the month of interview. Columns 5 through 8 report the differences across coefficients for each task and harvesting. Standard errors appear below. All standard errors in columns 1 through 8 are calculated allowing for clustering at the household level.

† Family labor hours were imputed for those individuals who were reported to have worked on a farm task but did not report the task in their employment history. Imputation was based on the number of hours the individual spends doing the task in surrounding waves or the age-gender average hours spent on the task.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Supplementary Table S.5

Labor Demand Regressions - First Stage Results

1 and 2 Period Lagged Household Composition as IVs

	Dependent Variable											
	Number of males […]						Number of females […]					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Birth to 14 years	**15 to 19**	**20 to 34**	**35 to 49**	**50 to 64**	**65 and older**	**Birth to 14 years**	**15 to 19**	**20 to 34**	**35 to 49**	**50 to 64**	**65 and older**
Number of males […] in previous period												
Birth to 14 years	0.63***	-0.01	-0.02*	0.02**	-0.01*	0.00	-0.00	-0.02***	0.01	0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
15 to 19	-0.02**	0.60***	0.01	0.02**	-0.01	-0.00	0.01	-0.02***	-0.02**	0.02***	-0.01	-0.01*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
20 to 34	-0.00	-0.01	0.53***	-0.01	-0.00	-0.01*	0.00	0.00	0.02*	0.01	0.00	-0.00
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
35 to 49	0.01	-0.00	-0.07***	0.60***	-0.04***	-0.02**	0.02*	0.01	-0.01	0.02*	-0.00	-0.02
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
50 to 64	-0.01	-0.00	-0.05***	0.01	0.54***	-0.06***	0.02	-0.01	0.01	-0.02	0.04***	-0.03***
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
65 and older	-0.01	-0.01	-0.04**	0.01	-0.05***	0.49***	0.01	-0.01	0.02	-0.02*	0.01	-0.01
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Number of females […] in previous period												
Birth to 14 years	-0.01	-0.01	-0.01	0.04***	-0.02**	-0.00	0.62***	-0.02**	-0.01	0.02**	-0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
15 to 19	0.01	-0.01	0.01	0.02***	-0.00	-0.01*	-0.03**	0.58***	-0.00	0.02**	-0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
20 to 34	0.02	-0.00	0.03***	-0.00	0.01	-0.01	-0.00	-0.00	0.53***	-0.03***	-0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
35 to 49	0.02	0.02**	0.01	0.01	-0.01	-0.01	-0.03*	0.05***	-0.07***	0.58***	-0.07***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
50 to 64	-0.00	0.02	-0.01	0.01	0.00	-0.03***	-0.02	0.03***	-0.03**	-0.02	0.51***	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
65 and older	0.02	0.02*	-0.01	0.02*	-0.01	-0.02**	0.01	0.01	0.00	0.01	-0.00	0.52***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Number of males […] 2 periods ago												
Birth to 14 years	-0.06***	0.05***	-0.02**	0.01	-0.00	-0.00	0.00	0.01	-0.03***	0.02***	-0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
15 to 19	-0.01*	-0.03**	-0.01	-0.00	0.00	0.00	-0.01	0.01	-0.01	0.01	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
20 to 34	-0.02*	-0.00	-0.06***	-0.01	0.01	-0.00	-0.00	-0.00	0.00	-0.01	0.01	-0.01**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
35 to 49	0.01	-0.00	-0.04**	-0.04***	0.01	-0.01	-0.01	0.01	-0.03**	0.02**	-0.00	-0.01
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
50 to 64	-0.03*	0.01	-0.02	-0.03**	0.02	-0.02**	-0.02	-0.01	-0.00	-0.02*	0.04***	-0.03***
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
65 and older	-0.01	0.00	-0.01	-0.02	0.04**	-0.05***	-0.01	-0.02*	-0.00	-0.01	0.02	-0.02*
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Number of females […] 2 periods ago												
Birth to 14 years	-0.00	0.00	-0.01	0.00	-0.00	0.00	-0.03	0.04***	0.00	0.01	-0.01*	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
15 to 19	0.01	-0.02**	-0.01	0.00	-0.00	-0.00	0.00	-0.05***	0.00	-0.00	-0.00	0.01*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
20 to 34	0.01	-0.02**	-0.01	-0.00	0.01	-0.01	0.02*	-0.02**	-0.03**	-0.00	-0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
35 to 49	-0.02	0.01	0.00	-0.01	0.03***	-0.03***	0.02	-0.00	-0.02	-0.01	0.02*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
50 to 64	-0.00	-0.03**	0.01	-0.02**	0.01	-0.00	0.01	-0.02	-0.00	0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
65 and older	0.01	-0.02*	-0.00	-0.02	0.01	-0.00	0.01	-0.02	-0.01	0.00	-0.00	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Joint Test of IVs												
F-stat	154.1	112.9	103.2	130.7	127.9	72.71	142.4	107.8	102.5	125.1	101.8	51.85
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	30,150	30,150	30,150	30,150	30,150	30,150	30,150	30,150	30,150	30,150	30,150	30,150
N. Households	3,888	3,888	3,888	3,888	3,888	3,888	3,888	3,888	3,888	3,888	3,888	3,888
F-test of All Regressors	76.01	54.30	48.76	71.72	65.68	74.64	70.36	50.76	54.15	69.21	53.68	38.52
R^2	0.33	0.27	0.24	0.31	0.29	0.39	0.32	0.26	0.27	0.31	0.27	0.28

Notes: Table reports coefficients of interest from the 1st stage of labor demand regressions using 1 and 2 period lagged household composition as instruments for the number of household members in the contemporaneous demographic group in each column. A joint F-test of the IVs is included below the point estimates. Along with locality-wave and household fixed effects, additional controls include land ownership status and the size of land owned, whether land is irrigated and size of irrigated land, quintiles of farm and household (real) assets, age and education of the household head and spouse, and the month of interview. Standard errors calculated allowing for clustering at the household level.

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level