Contract Farming: Opportunity Cost and Trade-Offs

Marc F. Bellemare*

March 19, 2017

*Associate Professor, Department of Applied Economics, and Director, Center for International Food and Agricultural Policy, University of Minnesota, 1994 Buford Avenue, Saint Paul, MN 55108, Email: mbellema@umn.edu.

Abstract

An important literature has established that participation in contract farming leads to higher incomes and has a number of other beneficial effects on the welfare of participating households. Yet no one has looked at the opportunity cost of and the various trade-offs involved in participating in contract farming. I look at the relationship between participation from contract farming and income from (i) labor markets, (ii) nonfarm enterprises, (iii) livestock, and (iv) agricultural sources other than livestock and contract farming. Using data from Madagascar, I find that participation in contract farming is associated with a 46 percent decrease in how much income per capita it derives from labor markets and a 23 percent decrease in how much income per capita it derives from nonfarm enterprises, but also with a 25 percent increase in how much income per capita it derives from livestock and a 24 percent increase in how much income per capita it derives from agricultural sources other than livestock and contract farming.

Keywords: Contract Farming, Outgrower Schemes, Grower-Processor Contracts, Agricultural Value Chains

JEL Classification Codes: L24, O13, O14, Q12

1 Introduction

In economics, the twin concepts of opportunity cost—what one must give up making a given choice—and trade-off—the idea that many optimal choices involve a compromise between two things—are among the first things we teach students in principles courses. Yet no matter how simple those two concepts might appear at first, that simplicity is only apparent, and even professional economists sometimes have a hard time understanding those concepts.[1] But if the average professional economists has a hard time accurately figuring out the opportunity cost of a relatively simple choice or recognizing the trade-offs involved in making that choice, what chance does the average non-economist have when faced with more complicated choices? And what chance does the average developing-country smallholder farmer, who is often illiterate and innumerate, have when it comes to making choices about how to allocate his time to various activities?

[1] For instance, Ferraro and Taylor (2005) report the findings of a survey they conducted at the 2005 annual meetings of the American Economics Association, in which they asked their respondents—all professional economists—to answer the following simple question:

> You won a free ticket to see an Eric Clapton concert (which has no resale value). Bob Dylan is performing on the same night and is your next-best alternative activity. Tickets to see Dylan cost $40. On any given day, you would be willing to pay up to $50 to see Dylan. Assume there are no other costs of seeing either performer. Based on this information, what is the opportunity cost of seeing Eric Clapton?

Respondents were given four choices: (i) $0, (ii) $10, (iii) $40, or (iv) $50. The survey's sobering results indicate that the correct answer was the one least frequently given by respondents, as only 21.6% of respondents picked the right answer. Obviously, readers of this article have a superior grasp of economics, and will thus have already figured out that the correct answer is "(ii) $10."

In this paper, I look at the opportunity cost and trade-offs faced by smallholder farmers who participate in contract farming, and at what this entails for development policy. In this context, participation in contract farming—the economic institution wherein a processing firm contracts out the production of an agricultural commodity to a grower household—has been shown to increase incomes (Bellemare, 2012), improve food security (Bellemare and Novak, 2016), and serve as a partial insurance mechanism against price risk (Bellemare et al., 2017). As most economists know, however, there is no such thing as a free lunch, and so just as it is important to know how the institution benefits grower households, it is also important to know what they have to give up in order to take part in it, beyond the obvious input costs associated with the cultivation of contracted crops.

The work in this article is motivated by a recent review of the contract farming literature by Otsuka et al. (2016), in which the authors note that

> [i]t is less clear ... how far [contract farming] improves farmers' welfare. Although many empirical studies found positive effects of [contract farming] on the income from contracted crops, such evidence is not conclusive, because crops and products under [contract farming] are usually labor-intensive so that income from other crop production or nonfarm activities might be sacrificed ... [I]ncome from other sources should be analyzed along with income from contracted production to identify the net income gain and the degree to which [contract farming] sacrifices other income

... To our knowledge, such a study is lacking ... (p.369)

On the one hand, there are now many studies looking at the effects of participation in contract farming on income or some closely related measure, and the vast majority of those studies find that participation in contract farming does lead to higher levels of income (Porter and Phillips-Howard, 1997; Singh, 2002; Warning and Key, 2002; Simmons, 2005; Maertens and Swinnen, 2009; Minten et al., 2009; Miyata et al., 2009; Rao and Qaim, 2011; Barrett et al., 2012; Bellemare, 2012; Michelson, 2013; Narayanan, 2014). On the other hand, Otsuka et al. (2016) are right in noting how what has to be sacrificed in order to participate in contract farming has so far not been studied by economists.[2]

To fill this gap, I use cross-sectional data on 1,200 households in rural Madagascar to look at the effect of participation in contract farming on various income sources. Specifically, I disaggregate total household in five sources, viz. income from (i) participation in the labor market, (ii) nonfarm enterprises, (iii) livestock, (iv) agricultural sources other than livestock and contract farming, and (v) contract farming, and look at how participation in contract farming relates to the first four of those sources. Relying on the same frame field experiments Bellemare (2012), Bellemare and Novak (2016), and Bellemare et al. (2017) rely on to control for household selection in contract farming, I find that although participation in contract farming appears to

[2]In fairness, Narayanan (2014) looks at the effect of participation in contract farming on profits, which takes into consideration some of the costs associated with contract farming.

have positive spillovers on a participating households' income from livestock and agricultural sources other than livestock and contract farming, it appears to have negative spillovers on their income from labor-market participation as well as from nonfarm enterprises.

In a context where the turn to commercial agriculture, contract farming, and the development of modern agricultural value chains has drawn the attention of policy makers as a means of reducing poverty (FAO, 2001; World Bank, 2007), the contribution of this article is to identify the opportunity costs of and the trade-offs involved in participating in contract farming. The findings that households that participate in contract farming derive less income from labor market participation and from nonfarm enterprises thus run counter to some structural transformation narratives (Haggblade and Hazell, 1989; Haggblade et al., 2010), which posit that as rural areas of developing countries modernize, rural nonfarm employment will obtain and rural labor-market participation rates will increase. Perhaps more importantly, since the transition from agriculture to rural nonfarm employment is associated with more inclusive growth patterns and faster poverty reduction than a similar transition from agriculture to urban employment (Christiaensen et al., 2013; Berdegué and Proctor, 2014; Christiaensen and Todo, 2014), knowing the relationship between participation in contract farming and labor market participation and nonfarm enterprises can help develop and inform more comprehensive agricultural development policy interventions.

The remainder of this article is organized as follows. In section 2, I give

an overview of the data and discuss summary statistics. Section 3 presents the simple empirical framework I use in order to estimate and identify the effects of participation in contract farming on various sources of income. In section 4, I present and discuss my empirical results. Section 5 summarizes and concludes with policy implications and directions for future research.

2 Data and Descriptive Statistics

The data used in this article have often been used to study contract farming (Bellemare, 2012; Bellemare and Novak, 2016; Bellemare et al., 2017). Consequently, this section will keep the description of the data to a minimum.

A total of 1,200 households in rural Madagascar, about half of which participated in contract farming, were interviewed in the second half of 2008 for a study of the welfare impacts of contract farming commissioned by the World Bank through the Economic Development Board of Madagascar. Households were randomly selected from two sampling frames—one a list of households participating in contract farming, the other a list of households not participating in contract farming—in each of two villages across twelve communes distributed uniformly across six regions, with two communes per region. Given this wide geographical coverage, the data cover households contracting with more than seven different processing firms over more than 12 different commodities; see Bellemare (2012) for a discussion.

For the purposes of this article, total household income is disaggregated

in five distinct categories. Those categories are income from

1. Participation in the labor market, which includes wage receipts from agricultural labor, animal husbandry, working for the state, working for privately owned, businesses, and from other sources.

2. Nonfarm enterprises, which includes income from crafts, trading, hunting and fishing, forestry, mining, pensions, transfers, transportation, and from other sources.

3. Livestock, which includes income from the sales of cattle, pigs, sheep and goats, and poultry,

4. Agricultural sources other than livestock and contract farming, which includes income from land rentals, cattle rentals, equipment rentals, sales of animal byproducts (e.g., milk, eggs, meat, and manure), and from other sources and

5. Contract Farming.

Table 1 shows the value of total household income and of each income category considered in this paper for the 2007-2008 agricultural year. The average household in the data has a total income of about \$973,[3] or about \$207 per person. That figure is disaggregated on average in about \$14 per person in income from labor markets, \$40 per person in income from nonfarm enterprises, \$27 per person in income from livestock, and \$87 per person in

[3]At the time of survey, US\$1 $\approx$ Ar 2000.

income from agricultural sources other than contract farming and livestock. In addition, and consistent with the sampling strategy, almost exactly half of the households in the data participate in contract farming. For the remainder of the variables in table 1, which are included as controls in the analyses that follow, descriptive statistics are shown but not discussed in the interest of brevity; the interested reader can consult Bellemare (2012) or Bellemare and Novak (2016) for a discussion.

Table 2 shows descriptive statistics for each income source split into whether a household participates in contract farming (column 1) or not (column 2). Bearing in mind that this does not control for confounding factors, this allows taking a first look at whether there are systematic differences across income sources between treatment and comparisons households. The results in table 2 indicate that the households that participate in contract farming report higher levels of income from labor markets, livestock, and agricultural sources other than livestock and contract farming.

Finally, figures 1 to 4 show kernel density estimates for income per capita from labor, nonfarm enterprises, livestock, and agricultural sources other than livestock or contract farming. Those figures, which do not control for confounding factors, show no obvious systematic pattern between income from various sources and participation in contract farming.

3 Empirical Framework

This section presents the equations estimated in this paper as well as the identification strategy I use in an attempt to identify the effect of participation in contract farming on the various sources of income reported by the households in the data.

3.1 Estimation Strategy

For each income category j in the data (i.e., income from labor markets, nonfarm enterprises, livestock, and agricultural sources other than livestock or contract farming),[4] the equation estimated is such that

$$\ln y_{ij} = \alpha_{0j} + \beta_{0j} x_i + \gamma_{0j} D_i + \epsilon_{0ij}, \tag{1}$$

where, in a slight abuse of notation, $\ln y_{ij}$ denotes an inverse hyperbolic sine transformation of household i's income from category j,[5] α is a constant, x is a vector of controls, D is a dummy variable for whether the household participates in contract farming, and ϵ is an error term with mean zero.

Estimating all $j = 4$ versions of equation 1—one for each income category—

[4] I do not run a fifth regression in which income from contract farming is the dependent variable, given that income from contract farming, at least at the extensive margin, is perfectly collinear with participating in contract farming.

[5] The inverse hyperbolic sine (IHS) transformation is a log-like transformation that allows retaining negative- and zero-valued observations and which is preferable to $\ln(y + 1)$ or some other variant of MaCurdy and Pencavel's (1986) old method. Specifically, $IHS(x) = \ln(x + \sqrt{x^2 + 1})$. See Bellemare, Barrett, and Just (2013) for further discussion of and additional references on the IHS transformation.

by ordinary least squares means that the coefficient γ_{0j} only represents the partial correlation between the treatment variable D and the outcome variable y_j.[6]

In order to help disentangle a causal relationship from that correlation, I estimate the following version of equation 1:

$$\ln y_{ij} = \alpha_{1j} + \beta_{1j} x_i + \gamma_{1j} D_i + \pi_{1j} w_{ij} + \epsilon_{1ij}, \tag{2}$$

for all $j = 4$ versions of equation 2 by ordinary least squares, wherein all variables are defined as previously, and where w is a vector of variables capturing the respondent's willingness to pay (WTP) for participation in contract farming. The hypothesis test of interest then involves the null hypothesis $H_0 : \gamma_{1j} = 0$ versus the alternative hypothesis $H_A : \gamma_{1j} \neq 0$. Rejecting the null in favor of the alternative should then be interpreted as evidence that participation in contract farming has spillovers, positive or negative depending on the direction of rejection, on income from sources other than income from contract farming.

When it comes to the economic significance of the estimated coefficients, one small difficulty is that in order to recover the marginal effect of participation in contract farming on a given source of income j, the coefficient γ_{1j} has to be transformed given the semi-logarithmic nature of equation 2. Kennedy

[6]It is in theory possible to estimate all four equations represented by equation 1 by seemingly unrelated regression estimation (SURE). There are no advantages to doing so here, however, given that all four income categories are regressed on the same covariates, in which case SURE does not confer an advantage.

(1981) showed that this marginal effect ξ is such that

$$\xi = \exp\left\{\gamma_1 - \frac{1}{2}Var(\gamma_1)\right\} - 1.$$

In what follows, I thus report both the estimated coefficient γ_{1j} for each source of income j as well as the marginal effect ξ_j of participating in contract farming on each source of income j. Because ξ involves a nonlinear transformation of γ_1, the standard errors I report for each coefficient ξ are computed using the delta method.

In the next sub-section, I explain how these WTP variables allow controlling for household selection in contract farming. This selection-on-observables identification strategy is identical to that used by Bellemare and Novak (2016) to identify the effect of participation in contract farming on food security, and by Bellemare et al. (2017) to identify the effect of participation in contract farming on income variability.

3.2 Identification Strategy

Following Smith and Sweetman (2016), a household i will select into participating in contract farming if and only if

$$y_{1i} - y_{0i} > c_i, \tag{3}$$

where y_{1i} is household i's income if household i participates in contract farming, y_{0i} is household i's income if household i does not participate in contract farming, and c_i is household i's cost of participating in contract farming.

Obviously, we cannot observe both y_{1i} and y_{0i} together, as a household either participates or not in contract farming, but not both. This section explains how the WTP variables contained in w in equation 2 allow controlling for the selection of households into contract farming.

During fieldwork, every respondent was asked the hypothetical question "Would you participate in a contract farming agreement that would increase your income by 10 percent but would require an initial investment of $\$b_i$?," wherein the bid amount for respondent i, b_i, was randomly drawn from the throw of a regular (i.e., six-sided and fair) die from the bid set $B = \{\$12.50, \$25.00, \$37.50, \$50.00, \$62.50, \$75.00\}$.[7] Each respondent's binary (i.e., yes or no) answer to the experimental question was recorded.

Each respondent was only asked the experimental question for one of six possible amounts in bid set B, but each respondent's bid b_i, by virtue of being randomly assigned, is completely exogenous to respondent i's observable characteristics x_i. This means that it is possible to impute each respondent's answers to the five questions which he was not asked off of his observable characteristics.

For example, a subset of respondents were asked whether they would

[7]Respondents were asked a question which stated these amounts in local currency. Numbers are presented here in US dollars for clarity.

like to participate in a contract farming agreement which would raise their income by 10 percent, but which would require an initial investment of $50. It is possible to linearly project those respondents' binary answer d to the hypothetical question on those respondents' observables x in order to forecast what other respondents—those who were asked the same question, but for amounts different from $50—would have answered had they been asked the same question. In other words, for each bid level b, I estimate

$$d_i = \delta + \lambda x_i + \eta_i, \tag{4}$$

on the subset of observations i who were asked about that bid level. Estimating equation 4, I obtain $\widehat{\delta}$ and $\widehat{\lambda}$. These estimate coefficients then allow me to forecast the probability that a respondent $-i$ who was not asked about a specific bid level b would have answered "Yes" for that bid level, i.e., $\widehat{d}_{-i} = \widehat{\delta} + \widehat{\lambda} x_{-i}$. For each respondent, then, the vector w in equation 2 encompasses six variables, each capturing the likelihood that the respondent would say "Yes" to each of the bid levels. For one of those bids—the one the respondent was actually asked about—that likelihood is either zero or one, since the respondent's answer was recorded; for all five other bids, that likelihood is a probability obtained from estimating equation 4 for each bid level.

Each bid level b is a (hypothetical) draw of c_i, the household's cost of participating in contract farming. But since the hypothetical question im-

poses on respondents that $y_{1i} = y_{0i}(1 + 0.10)$, i.e., it involves a sure income increase of 10 percent, the vector w in equation 2 effectively proxies for a household's willingness to pay to participate in a non-hypothetical contract farming agreement. Ultimately, this means that the variables on the right-hand side of equation 2 account for selection into contract farming, which constitutes a selection-on-observables design. For an alternative discussion of the identification strategy used in this paper, Bellemare and Novak (2016) explain at length how the vector w allows alleviating concerns about the three usual sources of statistical endogeneity, i.e., reverse causality, unobserved heterogeneity, and measurement error.

4 Estimation Results and Discussion

Table 3 presents estimation results for the specifications in equation **??**, and table 4 presents estimation results for the specifications in equation 2. For each dependent variable, I conduct a Hausman test pitting the specification in table 4 against that in table 3. In no case is the null of the Hausman test rejected. In principle, this means that the null of exogeneity of the treatment variable is not rejected. In practice, I show both the specifications with and without the vector w, since the specifications in table 4 are meant to account for selection.

On the one hand, the marginal effects reported at the bottom of table 3 show that participation in contract farming is associated with a 42-percent

increase in total income, a 28-percent increase in income from livestock, and a 26-percent increase in income from agricultural sources other than livestock and contract farming. Those findings are similar to those reported by Bellemare (2012), who briefly looked at the spillovers from participation in contract farming on other agriculture-related sources of income. On the other hand, the marginal effects reported at the bottom of table 3 also show that participation in contract farming is associated with a 47-percent decrease in income from labor-market participation as well as a 21-percent decrease in income from nonfarm enterprises.[8]

Qualitatively, the results of interest in table 4 are almost identical to those in table 3, with the exception of the effect of participation in contract farming on income from livestock, whose coefficient is significant but whose marginal effect is statistically insignificant. In this case, participation in contract farming appears to lead to a 41-percent increase in total income and a 24-percent increase in income from agricultural sources other than livestock and contract farming.

In sum, it looks as though there are significant spillover effects from participation in contract farming to other sources of income. The most robust such findings are for income from participation in the labor market, income fron nonfarm enterprises, and income from agricultural sources other than

[8]Note that it is possible for total income to increase by 42 percent even if the two sources of income that appear to increase in response to participation in contract farming only increase respectively by 28 and 26 percent, since the major source of this 42-percent increase is income from contract farming.

livestock and contract farming. The findings for income from livestock are less robust, but they suggest that this two source of income might increase in response to a household participating in contract farming, which would be consistent with the findings for income from other agricultural sources.

Taken together, these findings paint a clear picture of the opportunity cost of participation in contract farming. Though the results in column 1 of tables 3 and 4 and the findings in Bellemare (2012) suggest that participation in contract farming raises the income of participating households and has spillovers on income from livestock and income from other agricultural sources, those gains come at the cost of having to forgo income from participation in the labor market and from nonfarm enterprises. Thus, it looks as though Otsuka et al.'s (2016) conjecture—because contract farming is typically labor-intensive, participating households have to sacrifice income from nonfarm activities in order to realize the gains from it—is supported in these data.

This suggest two things, the precise analysis of both of which is beyond the scope of this paper and beyond what one can ask of the data at hand. The first is that as the relative returns to on-farm labor increase, households reallocate their labor time away from labor markets and toward their contracted plots and crops (Barrett et al., 2008; McCullough, forthcoming). The second is that as the relative returns to on-farm labor increase, one would expect households to hire in agricultural labor to maintain their participation in the labor market. That they do not appear to do so is suggestive of labor market

failures in this context, though it is impossible to tell what kind of market failure might be involved. One possible scenario is that hired agricultural labor has to be supervised to avoid moral hazard problems, which can be costly (Feder, 1985; Frisvold, 1994). Another possible scenario is one which, anecdotally at least, appears to hold in Madagascar, and which involves a certain distaste Malagasy peasants have for working for other farmers, which they see as akin to slavery.

This points to an important limitation of the findings in this paper, viz. the impossibility of pinpointing the precise mechanisms whereby participation in contract farming might have spillover effects onto other sources of income.

5 Summary and Concluding Remarks

Starting from an observation made by Otsuka et al. (2016), this article has explored the effects of participation in contract farming on sources of income other than income from contract farming. Looking at the relationship between participation in contract farming and income from (i) labor-market participation, (ii) nonfarm enterprises, (iii) livestock, and (iv) agricultural sources other than livestock and contract farming, it looks as though participation in contract farming, although it appears to have positive spillovers on income from livestock and income from other agricultural sources, is negatively associated with income from labor-market participation and income

from nonfarm enterprises.

Thus, even though the contract farming arrangements in these data have been shown to lead to higher income levels (Bellemare, 2012), shorter hungry seasons (Bellemare and Novak, 2016), and less variable incomes (Bellemare et al., 2017), it looks as though all those gains come at the cost of a kind of involution on the part of participating households, who appear to turn away from non-agricultural activities.

The findings in this paper are potentially important for development policy. Indeed, if the goal of policy makers is to spur rural nonfarm employment or foster entrepreneurship in rural areas of developing countries, those policy makers should pay particular attention to where contract farming activities locate, as the presence of contract farming might undermine efforts to diversify economic activity away from agriculture. Alternatively, policies aimed at encouraging the development of a more modern agricultural sector in developing countries should perhaps be accompanied by measures aimed at helping develop rural labor markets and rural businesses.

That said, the data and methods used in this paper cannot identify the mechanisms whereby participation in contract farming spills over onto other activities (i.e., labor-market participation, nonfarm enterprises, animal husbandry, and other agricultural activities). To properly do so is beyond the scope of this paper, as each such other activity would require its own analysis and, possibly, the estimation of a structural model of how the household allocates its time between various activities. Though the data allow the esti-

mation of such a structural model, I leave that endeavor to future research.

References

[1] Barrett, Christopher B., Shane Sherlund, and Akinwumi Adesina (2008), "Shadow Wages, Allocative Inefficiency, and Labor Supply in Smallholder Agriculture," *Agricultural Economics* 38: 21-34.

[2] Barrett, Christopher B., Maren Elise Bachke, Marc F. Bellemare, Hope C. Michelson, Sudha Narayanan, and Thomas F. Walker (2012), "Smallholder Participation in Contract Farming: Comparative Evidence from Five Countries," *World Development* 40(4): 715-730.

[3] Bellemare, Marc F., Christopher B. Barrett, and David R. Just (2013), "The Welfare Impacts of Commodity Price Volatility: Evidence from Rural Ethiopia," *American Journal of Agricultural Economics* 95(4): 877-899.

[4] Bellemare, Marc F., Yu Na Lee, and Lindsey Novak (2017), "Contract Farming as Partial Insurance," Working Paper, University of Minnesota.

[5] Bellemare, Marc F., and Lindsey Novak (2016), "Contract Farming and Food Security," *American Journal of Agricultural Economics* forthcoming.

[6] Bellemare, Marc F. (2012), "As You Sow, So Shall You Reap: The Welfare Impacts of Contract Farming," *World Development* 40(7): 1418-1434.

[7] Berdegué, Julio, and Felicity J. Proctor (2014), "Cities in the Rural Transformation," Working Paper, RIMISP.

[8] Christiaensen, Luc, Joachim de Weerdt, Yasuyuki Todo (2013), "Urbanization and Poverty Reduction: The Role of Rural Diversification and Secondary Towns," *Agricultural Economics* 44(4-5): 435-447.

[9] Christiaensen, Luc, and Yasuyuki Todo (2014), "Poverty Reduction During the Rural–Urban Transformation—The Role of the Missing Middle," *World Development* 63: 43-58.

[10] FAO (2001), *Contract Farming: Partnerships for Growth*, Rome, Italy: FAO.

[11] Feder, Gershon (1985), "The Relation between Farm Size and Farm Productivity: The role of family labor, supervision and credit constraints," *Journal of Development Economics* 18(2-3): 297-313.

[12] Ferraro, Paul J., and Laura O. Taylor (2005), "Do Economists Recognize an Opportunity Cost when They See One? A Dismal Performance from the Dismal Science," *B.E. Journal of Economic Analysis & Policy (Contributions)*, 4(1): 1-12.

[13] Frisvold, George B. (1994), "Does Supevision Matter? Some Hypothesis Tests Using Indian Farm-Level Data," *Journal of Development Economics* 43(2): 217-238.

[14] Haggblade, Steven, and Peter Hazell (1989), "Farm-Nonfarm Linkages in Rural Sub-Saharan Africa," *World Development* 17(8): 1173-1201.

[15] Haggblade, Steven, Peter Hazell, and Thomas Reardon (2010), "The Rural Non-farm Economy: Prospects for Growth and Poverty Reduction," *World Development* 38(10): 1429-1441.

[16] Kennedy, Peter E. (1981), "Estimation with Correctly Interpreted Dummy Variables in Semilogarithmic Equtions," *American Economic Review* 71(4): 801.

[17] MaCurdy, Thomas E., and John H. Pencavel, (1986), "Testing between Competing Models of Wage and Employment Determination in Unionized Markets," *Journal of Political Economy* 94(3): S3-S39.

[18] Maertens, Miet, and Johan F.M. Swinnen (2009), "Trade, Standards, and Poverty: Evidence from Senegal," *World Development* 37(1): 161–178.

[19] McCullough, Ellen B. (2016), "Labor Productivity and Employment Gaps in Sub-Saharan Africa," *Food Policy* forthcoming.

[20] Michelson, Hope C. (2013), "Small Farmers, NGOs, and a Walmart World: Welfare Effects of Supermarkets Operating in Nicaragua," *American Journal of Agricultural Economics* 95(3): 628-649.

[21] Minten, Bart, Lalaina Randrianarison, and Johan F.M. Swinnen (2009), "Global Retail Chains and Poor Farmers: Evidence from Madagascar," *World Development* 37(11): 1728–1741.

[22] Miyata, Sachiko, Nicholas Minot, and Dinghuan Hu (2009), "Impact of Contract Farming on Income: Linking Small Farmers, Packers, and Supermarkets in China," *World Development* 37(11): 1781-1790.

[23] Naryananan, Sudha (2014), "Profits from Participation in High-Value Agriculture: Evidence of Heterogeneous Benefits in Contract Farming Schemes in Southern India," *Food Policy* 44: 142-157.

[24] Otsuka, Keijiro, Yuko Nakano, and Kazushi Takahashi (2016), "Contract Farming in Developed and Developing Countries," *Annual Review of Resource Economics* 8: 353-376.

[25] Porter, Gina, and Kevin Phillips-Howard (1997), "Comparing Contracts: An Evaluation of Contract Farming Schemes in Africa," *World Development* 25(2): 227-238.

[26] Rao, Elizaphan J.O., and Matin Qaim (2011), "Supermarkets, farm household income, and poverty: Insights from Kenya," *World Development* 39(5): 784–796.

[27] Simmons, Phil, Paul Winters, and Ian Patrick (2005), "An Analysis of Contract Farming in East Java, Bali, and Lombok, Indonesia," *Agricultural Economics* 33(s3): 513–525.

[28] Singh, Sukhpal (2002), "Contracting Out Solutions: Political Economy of Contract Farming in the Indian Punjab," *World Development* 30(9): 1621–1638.

[29] Smith, Jeffrey, and Andrew Sweetman (2016), "Viewpoint: Estimating the Causal Effects of Policies and Programs," *Canadian Journal of Economics* 49(3): 871-905.

[30] Warning, Matthew, and Nigel Key (2002), "The Social Performance and Distributional Consequences of Contract Farming: An Equilibrium Analysis of the *Arachide de bouche* Program in Senegal," *World Development* 30(2): 255–263.

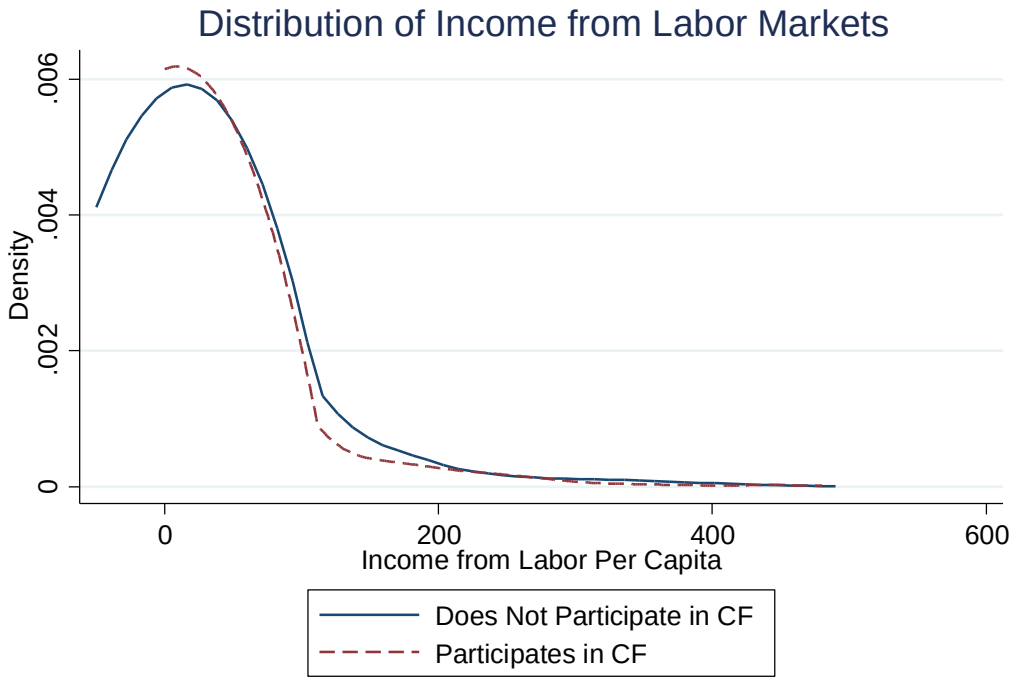

Figure 1. Income from Labor Markets.

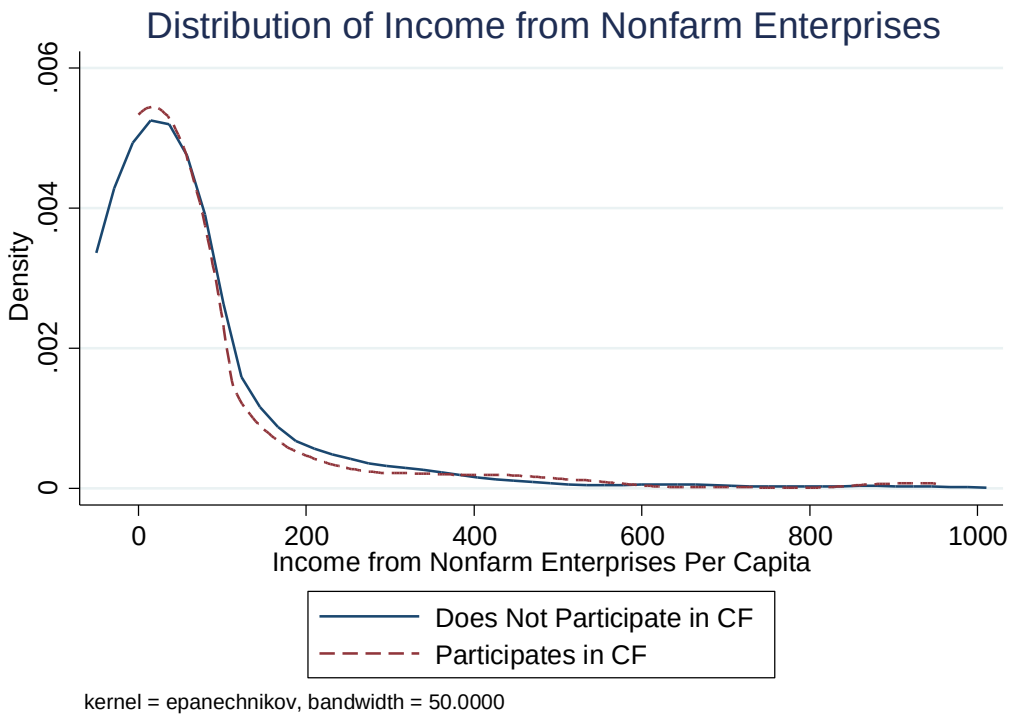

Figure 2. Income from Nonfarm Enterprises.

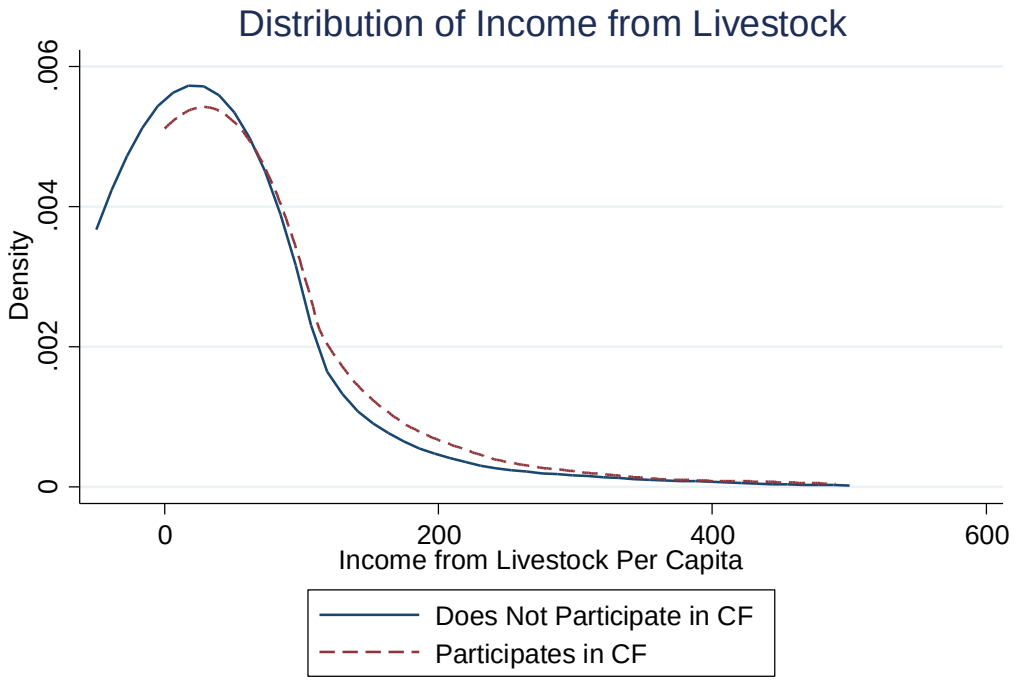

Figure 3. Income from Livestock

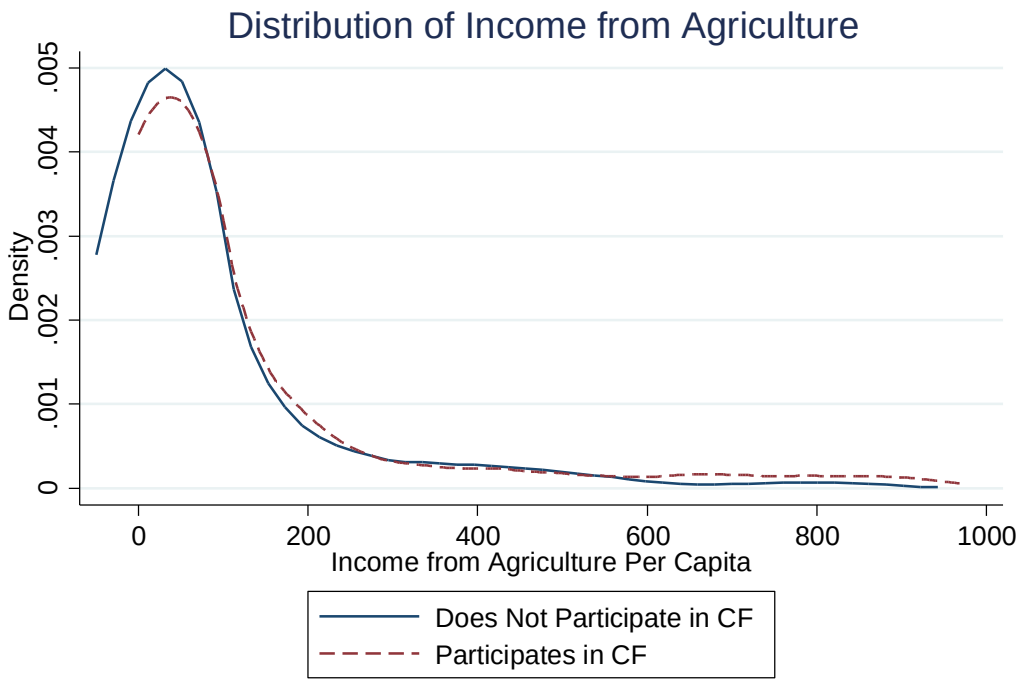

Figure 4. Income from Agriculture

Table 1. Summary Statistics (n=1,178)

Variables	Mean
Income from Labor Per Capita (1,000 Ar)	27.925
	(2.789)
Income from Nonfarm Enterprises Per Capita (1,000 Ar)	79.998
	(11.166)
Income from Livestock Per Capita (1,000 Ar)	53.191
	(4.771)
Income from Agriculture Per Capita (1,000 Ar)	173.720
	(15.452)
Contract Farming Participation (Dummy)	0.498
	(0.016)
Household Size (Individuals)	5.571
	(0.075)
Household Dependency Ratio	0.449
	(0.008)
Household Head Single (Dummy)	0.124
	(0.011)
Household Head Female (Dummy)	0.088
	(0.010)
Household Head Migrant (Dummy)	0.125
	(0.011)
Household Head Age (Years)	43.274
	(0.431)
Household Head Education (Years)	5.682
	(0.106)
Household Head Agricultural Experience (Years)	20.621
	(0.433)
Household Head Member of a Farm Organization (Dummy)	0.222
	(0.014)
Household Head Fady Days	22.204
	(1.105)
Productive Assets (100,000 Ar)	4.440
	(0.522)
Nonproductive Assets (100,000 Ar)	13.965
	(0.876)
Total Landholdings (Ares, or 100 Square Meters)	145.569
	(10.138)

Note: Means are weighted using sampling weights. Standard errors in parentheses.

Table 2. Balance Tests

	Contract Farming		
Variables	**Participant**	**Non-Participant**	**Difference**
Income from Labor Per Capita	18.011	37.506	***
	(2.283)	(5.014)	
Income from Nonfarm Enterprises Per Capita	86.958	72.469	
	(19.812)	(10.199)	
Income from Livestock Per Capita	58.848	47.439	*
	(7.376)	(5.988)	
Income from Agriculture Per Capita	197.959	148.083	***
	(25.556)	(17.215)	

Note: Means are weighted using sampling weights. Last column reports the results of t-tests of whether the mean is the same between participants and non-participants. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3. OLS Results for Different Income Categories Ignoring Selection

Variables	(1) Total	(2) Labor	(3) NFEs	(4) Livestock	(5) Agriculture
	Dependent Variable: Log of Income by Category				
Contract Farming Participant	0.349***	-0.620***	-0.228	0.252*	0.238**
	(0.051)	(0.123)	(0.148)	(0.129)	(0.108)
Household Size	-0.131***	0.015	-0.055	0.053*	-0.120***
	(0.012)	(0.029)	(0.035)	(0.031)	(0.026)
Dependency Ratio	-0.425***	-0.620**	0.124	-0.605*	-0.103
	(0.124)	(0.298)	(0.359)	(0.314)	(0.262)
Single	-0.030	0.463	0.488	-0.202	-0.285
	(0.122)	(0.292)	(0.352)	(0.308)	(0.257)
Female	-0.392***	-0.503	-0.834**	-0.046	0.066
	(0.139)	(0.334)	(0.402)	(0.352)	(0.294)
Migrant	0.109	-0.024	0.386*	0.236	-0.307*
	(0.080)	(0.191)	(0.230)	(0.201)	(0.168)
Age	0.003	-0.003	0.007	-0.033***	0.008
	(0.004)	(0.009)	(0.011)	(0.010)	(0.008)
Education	0.067***	0.060***	0.078***	-0.020	0.056***
	(0.008)	(0.020)	(0.024)	(0.021)	(0.017)
Agricultural Experience	-0.000	-0.020**	-0.015	0.039***	-0.007
	(0.004)	(0.009)	(0.011)	(0.009)	(0.008)
Member of a Farm Organization	0.099	-0.090	-0.310*	0.112	0.250*
	(0.063)	(0.152)	(0.183)	(0.160)	(0.134)
Fady Days	-0.001	-0.008***	0.003	0.001	-0.002
	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)
Working Capital	0.006***	-0.004	0.007*	-0.011***	0.005*
	(0.001)	(0.003)	(0.004)	(0.003)	(0.003)
Assets	0.007***	-0.008***	-0.002	0.014***	0.009***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.002)
Landholdings	0.001***	0.000	-0.000	0.000	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	5.675***	3.194***	1.890***	3.654***	2.985***
	(0.158)	(0.379)	(0.456)	(0.399)	(0.333)
Marginal Effect	0.416***	-0.466***	-0.213*	0.276*	0.261*
	(0.072)	(0.066)	(0.116)	(0.165)	(0.136)
Observations	1,178	1,178	1,178	1,178	1,178
Village Dummies	Yes	Yes	Yes	Yes	Yes
R-squared	0.532	0.140	0.110	0.091	0.418

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. OLS Results for Different Income Categories Accounting for Selection

Variables	(1) Total	(2) Labor	(3) NFEs	(4) Livestock	(5) Agriculture
Dependent Variable: Log of Income by Category					
Contract Farming Participant	0.345***	-0.609***	-0.249*	0.233*	0.218**
	(0.052)	(0.122)	(0.150)	(0.130)	(0.110)
Household Size	-0.127***	0.012	-0.064	0.037	-0.123***
	(0.015)	(0.034)	(0.040)	(0.034)	(0.030)
Dependency Ratio	-0.405***	-0.649*	0.230	-0.378	-0.083
	(0.152)	(0.376)	(0.432)	(0.382)	(0.311)
Single	-0.001	0.454	0.483	-0.196	-0.201
	(0.144)	(0.309)	(0.362)	(0.376)	(0.306)
Female	-0.388**	-0.658*	-0.794*	-0.180	0.072
	(0.181)	(0.368)	(0.410)	(0.418)	(0.341)
Migrant	0.096	-0.044	0.394	0.041	-0.349
	(0.104)	(0.245)	(0.292)	(0.253)	(0.219)
Age	0.015**	-0.019	0.012	-0.026*	0.019
	(0.007)	(0.015)	(0.017)	(0.015)	(0.013)
Education	0.068***	0.060***	0.080***	-0.027	0.061***
	(0.009)	(0.022)	(0.025)	(0.022)	(0.019)
Agricultural Experience	-0.011*	-0.004	-0.018	0.038***	-0.016
	(0.007)	(0.015)	(0.016)	(0.014)	(0.012)
Member of Farm Organization	0.108	-0.086	-0.289	0.043	0.289*
	(0.072)	(0.177)	(0.202)	(0.186)	(0.148)
Fady Days	-0.002*	-0.007**	0.003	-0.002	-0.003
	(0.001)	(0.003)	(0.004)	(0.003)	(0.003)
Working Capital	0.010***	-0.009	0.011	-0.009	0.009
	(0.003)	(0.006)	(0.007)	(0.005)	(0.005)
Assets	0.008***	-0.009***	-0.002	0.014***	0.010***
	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)
Landholdings	0.000	0.000	-0.000	0.001*	0.001**
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Yes to $12.50 Investment (Imputed)	-0.009	0.088	-0.210	0.099	-0.155
	(0.165)	(0.402)	(0.493)	(0.392)	(0.306)
Yes to $25.00 Investment (Imputed)	0.117	0.172	0.321	0.155	0.047
	(0.129)	(0.344)	(0.397)	(0.358)	(0.271)
Yes to $37.50 Investment (Imputed)	0.073	-0.376	0.069	-0.147	0.464
	(0.141)	(0.341)	(0.395)	(0.357)	(0.334)
Yes to $50.00 Investment (Imputed)	-0.117	-0.199	0.205	0.158	0.038
	(0.133)	(0.308)	(0.412)	(0.322)	(0.244)
Yes to $62.50 Investment (Imputed)	0.532*	-0.640	0.200	0.395	0.441
	(0.292)	(0.550)	(0.588)	(0.555)	(0.473)
Yes to $75.00 Investment (Imputed)	-0.117	0.432	-0.129	0.581	-0.095
	(0.168)	(0.387)	(0.473)	(0.455)	(0.290)

Constant	4.864***	4.149***	1.306	2.428**	1.941*
	(0.558)	(1.197)	(1.320)	(1.227)	(0.997)
Marginal Effect	0.410***	-0.460***	-0.229**	0.251	0.235*
	(0.072)	(0.067)	(0.114)	(0.170)	(0.140)
Observations	1,178	1,178	1,178	1,178	1,178
Village Dummies	Yes	Yes	Yes	Yes	Yes
R-squared	0.535	0.143	0.111	0.094	0.419

Bootstrapped standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1