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CONTENTS

(*continued on outside back cover*)

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The Economic Sustainability of Certified Coffee: Recent Evidence from Mexico and Peru

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Summary. — Consumers increasingly act on preferences for a more just and sustainable world by purchasing certified agricultural products. Using survey data from coffee growers in Mexico and Peru, we explore the economic sustainability of certified coffee, looking at conventional, Fair Trade/organic, and Rainforest Alliance certified growers. The analysis reveals that yields rather than price premiums are most important for increasing net cash returns for coffee growing households. Given the link between net returns and producer participation in certified coffee schemes, the findings suggest that certification norms that permit improving yields are essential for improving grower welfare and attracting and maintaining growers.

Key words — Latin American, Peru, Mexico, certified coffee, Fair Trade, organic, sustainability

1. EMBEDDING SUSTAINABILITY IN THE MARKET?

Over the past two decades, considerable growth has occurred in certified, especially Fair Trade and organic, markets (Giovannucci, Liu, & Byers, 2008). The growth comes from consumer concerns related to social, environmental, and health impacts of production and distribution associated with North–South and urban–rural exchange in an increasingly wide range of agricultural commodities and even some more high value items, such as precious gems. Coffee markets have been a leading edge of this movement, with Fair Trade (FT) and organic certifications being the most prevalent.

Fair Trade arrangements with cooperative associations of coffee growers emerged in the late-1980s (Jaffee, 2007; Raynolds, Murray, & Heller, 2007), and have become common in coffee producing regions with many smallholders. The number of organic growers has grown rapidly in the past decade, and FT and organic movements have converged, with many cooperatives marketing dual certified FT/organic coffee. A similar convergence pattern is underway for products like bananas, cocoa, tea, and wine. Another leading example of a sustainable coffee certification scheme is the Rainforest Alliance certification based on the standards of the Sustainable Agriculture Network (SAN). The standards combine norms from FT and organic approaches with broader biodiversity and ecological concerns that include water quality impacts, creation of wildlife corridors, and reforestation. Rainforest Alliance certification started with coffee farms in 1995 in Guatemala and by the end of 2009 roughly 748,000 acres were enrolled in the program, with Peru being one of several countries of intense activity in Central and South America (Rainforest Alliance, 2011).

Sustainable certification schemes are increasingly popular in large part because they unite valued traits related to global poverty, environment, and health outcomes into a single bundle. This bundling allows consumers to express preferences for a more just and environmentally healthy world with daily purchases of basic commodities. An advantage promised to growers is a niche market with higher and more stable prices, and under FT, a social premium to fund coordinated investments in community development projects (Bacon, 2005; Murray, Raynolds, & Taylor, 2003). Because certification involves significant information exchange between transnational coffee marketing companies, NGOs, and local cooperatives and producers, it can also provide links to new products, markets, management practices, and ideas. Moreover, the broadening array of coffee certification schemes offers the possibility of growers searching for a good match and being served better by competition among and innovation across certification programs.

Grower participation choices likely hinge on how coffee certification schemes affect the prices, revenues, and incomes that they receive. Accordingly, a number of recent studies examine economic gains using survey data gathered from coffee growers, generally comparing FT and organic cooperative members with conventional growers (Arnould, Plastina, & Ball, 2009;

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Barham, Callenes, Lewis, Gitter, & Weber, 2011a; Beuchelt & Zeller, 2011; Bolwig, Gibbon, & Jones, 2009; Mendez *et al.*, 2010; Valkila, 2009). Although the methodologies of these studies vary in terms of their returns measures (prices, productivity, profits—with and without labor costs included) and the statistical rigor of their indicators, most of them point in the direction of relatively limited price gains and income improvement associated with FT and organic certification relative to conventional coffee schemes. Several of them also consider impacts on broader livelihood outcomes (Arnould *et al.*, 2009; Barham *et al.*, 2011; Gitter *et al.*, in press; Mendez *et al.*, 2010), such as education, migration, access to credit, and exposure to illness and risk.

In terms of coffee returns, Mendez *et al.* (2010) compared Fair Trade/organic certified growers with conventional ones across several Central American countries and Mexico and found evidence of a price premium but limited impact on incomes and other livelihood measures. Using a small but rich sample of coffee growers in Nicaragua, Valkila (2009) questions whether FT/organic coffee promotes sustainable development or makes marginal contributions to growers trapped in a low-yield, low-income equilibrium. In a separate study in Nicaragua, Beuchelt and Zeller (2011) also find evidence that the higher prices paid to FT/organic growers do not overcome the higher costs associated with their approach, and that FT/organic farmers are more likely than conventional growers to be in poverty following years of participation that included the 2000–03 coffee price crisis, even though FT/organic growers received considerably higher prices during the crisis. By contrast, Bolwig *et al.* (2009) find evidence that smallholder contract farming involving organic practices and certification increases grower revenues in Uganda, but that some of the gains are associated with higher yields and more regular contracts than non-organic growers have at their disposal. Similarly, Barham *et al.* (2011) find that Southern Mexican coffee growers with access to the FT/organic market earned US$ 152 more per hectare than conventional growers, but they show that the majority of the difference is associated with higher yields rather than higher prices. And, as mentioned in the Bolwig, Gibbon, and Jones article, these higher yields may reflect a "selection effect" of better performing farms joining FT/organic cooperatives rather than a direct effect of adopting organic practices. Valkila (2009) also underscores the importance of yields by showing that unless certified coffee price premiums are large, yields will drive profitability.

Of the aforementioned studies, only Arnould *et al.* (2009) find evidence of significant economic gains for FT *vs.* non-FT growers, but they limit their analysis to ANOVA comparisons of price and productivity measures, which means that they make no net income comparisons, and they do not offer estimates of the economic gains. Moreover, their productivity analysis ignores the selectivity concerns raised above, because it does not control for pre-existing differences in yields that FT growers might have had prior to becoming certified.

In this article, we examine the price and yield contributions to the net revenues of certified coffee growers using data from two studies, one of FT/organic and conventional coffee growers in Southern Mexico (Barham *et al.*, 2011) and second, a panel dataset collected during 2006–10 from Peruvian coffee growers in 10 communities where efforts were made to certify growers under the Rainforest Alliance program and to spread yield-enhancing management practices (Weber, 2011b). For coffee smallholders in both countries, our results underscore two basic points which have been percolating in recent analyses of certified coffee markets. First, price premiums offer growers relatively marginal gains, around 5–10% of total income, which can be even more limited if the cooperative is unable to place much of their production in certified markets (Mendez *et al.*, 2010; Weber, 2011a). Second, the Peru analysis highlights the potential for more significant improvements in yields and net cash income within sustainable coffee schemes. These findings suggest that such initiatives working with smallholders in coffee and potentially other commodities should examine more carefully how to improve productivity as a path to higher incomes and sustainable outcomes rather than focusing primarily on prices. Furthermore, we find evidence that this shift could require in some instances a move away from "organic" practices to allow the use of inorganic fertilizers. The shift toward a nuanced approach to inputs highlights the value of diversity in certification schemes or alternatively, the issue of whether organic norms in coffee production could be adapted to local conditions without sacrificing sustainability goals.

We provide a brief historical description of the certification schemes in question in Section 2. After introducing our main economic measure, net cash return, Section 3 describes the methods and data sources used in Sections 4 and 5 to examine the price, productivity, and net return performance of Mexican FT/organic coffee growers and Peruvian growers where most participated in the Rainforest Alliance certification program. Section 6 considers the implications of our findings for the economic sustainability of coffee certification, especially the need to look beyond price premiums to productivity improvements to provide economic benefits to growers and to broaden, or at least maintain, participation. We also explore in Section 6 how the management practices needed to boost yields and net incomes may require reassessing the environmental gains of the blanket prohibition of inorganic fertilizers under FT/organic schemes since they likely come at the cost of lower economic gains to growers and more limited participation. Research on this and other environmental impacts of alternative coffee production systems is thin and could be part of a broader reassessment of certification schemes. We conclude with reflections on how to improve the assessment of these schemes.

2. CERTIFIED COFFEE IN SOUTHERN MEXICO AND CENTRAL PERU

The growing popularity of third party certifications related to economic and environmental sustainability warrants research on their efficacy. A close look at the certifications reveals substantive differences that may matter for sustainability outcomes. To highlight differences, we compare organic standards with those of the Sustainable Agriculture Network (SAN), on which the Rainforest Alliance certification is based. The former generally focus on keeping the bean free from contact with inorganic agricultural inputs (herbicides, fertilizers, etc.), which result in a blanket prohibition of such products. In contrast, the SAN standards distinguish among inorganic inputs and describe when and how to use approved inputs (Sustainable Agricultural Network, 2010). While taking a less rigid stand on inorganic inputs, it could also be argued that the SAN program emphasizes the management of all natural resources on the entire farm. For example, SAN norms emphasize managing farm and household wastewater, creating buffer strips along waterways, and reforesting degraded areas on the margins of coffee stands. The differences in standards on paper underscore the value of empirically linking certification programs with tangible benefits, environmental or otherwise.

The Southern Mexican states of Oaxaca and Chiapas provide an ideal region to study FT/organic coffee. Coffee cooperatives in the region were some of the first to participate in formal FT coffee arrangements, which require smallholders to organize and market their coffee through cooperatives. Cooperatives and their member growers began the transition to organic cultivation in the 1990s, a relatively smooth transition from low chemical use, "shade grown" coffee methods used at the time. The Oaxacan cooperative UCIRI (The Union of Indigenous Regions of the Isthmus Region), for example, pioneered Fair Trade and organic arrangements, first adopting an organic program in 1986, and later helping to form the first Fair Trade seal, Max Havelaar (VanderHoff Boersma, 2002). Over the period 1995–2005, adoption of organic practices and participation in FT cooperatives expanded dramatically in some regions of Oaxaca and Chiapas, from 10% to 40% in the communities studied in Barham *et al.* (2011).

We note that in Southern Mexico cooperative participation in organic markets came with greater participation in Fair Trade markets. Although FT certification does not require organic certification the two markets have become increasingly intertwined. In practice, it is generally easier to obtain export contracts for dual certified FT/organic coffee. Mendez *et al.* (2010), for example, find that FT/organic cooperatives in the sample sold 87% of their coffee at certified prices while the number was 60% for cooperatives that were only certified FT. Thus, although formal rules do not require dual certifications, the market has provided substantial incentive for cooperatives to combine certifications like FT and organic.

The experience of one cooperative in Peru's top coffee producing region, Junin, provides a unique opportunity to see how yields evolve through better management practices while achieving the Rainforest Alliance certification. The cooperative, Ecoterra, came about through a privately funded project to improve the sustainability of smallholder coffee farms in several communities in Junin, Peru. Most activities started in 2005 and formally ended in 2009. The project first targeted two communities before expanding into neighboring areas through public meetings that outlined activities and goals. The project had two core components: to improve the social and environmental conditions of the communities using the Rainforest Alliance certification program and to help growers increase the profitability of their farms through better practices. The main management practices to increase profitability were systematic pruning of plants to increase yields, new plantings using healthy seedlings and best practices, and applying the right mix of nutrients at the appropriate time.

We note that in certain years, Ecoterra used the Rainforest Alliance certification as a platform to also achieve organic and Utz Kapeh certification for some growers, since having multiple certifications can make it easier to obtain export contracts. However, participation in Utz Kapeh and organic programs was erratic. In contrast, most cooperative members achieved Rainforest Alliance certification every year of the project.

3. METHODS AND DATA

A primary economic measure for examining the welfare of small-scale coffee growing households is net cash return to coffee. This choice stems from the observation that small-scale producer households in developing countries often face liquidity constraints that limit their capacity to adopt new technologies, expand production, invest in key assets such as land and education, or to respond to shocks (Kazianga & Udry, 2006; Sial & Carter, 1996). As such, the net cash return to coffee captures the contributions of prices, productivity, and non-cash inputs to generating much needed liquidity for household expenditures and investments. It differs in typical net return accounting measures in that it does not adjust for unpaid family labor or for depreciation of investments. Our measure is the same as Beuchelt and Zeller (2011) except that their net cash return estimate includes depreciation of the coffee bean de-pulper.

It is important to note that, taken in isolation, net cash returns is an incomplete metric of the soundness of a certified coffee program or the contribution of programs to grower welfare. For example, Gitter *et al.* (in press) examines the effect of participation in FT/organic certification on the educational attainment of children in coffee producing households in Southern Mexico, and finds that children (especially females) from households with access to certified markets achieved more years of schooling. Moreover, some certification norms address externalities of coffee growing by requiring the proper treatment of waste water from processing coffee cherries, which benefits downstream households, certified or not, but does not enter the household budget. Private net cash returns also do not capture the Fair Trade social premium (5 cents per pound before 2007, 10 cents afterwards) that is retained by the cooperative and invested in social projects according to member preferences. The social premium also does not enter the household budget. But despite its limitations, net cash returns provides an informative measure of what grower households earn by employing their labor and land in coffee production. It is especially useful when assessing the economic viability of grower participation in certification programs. And to the extent that such programs provide broader benefits like technical assistance or greater access to credit, the measure incorporates them if they affect yields, costs, or prices.

Prices and productivity are key factors that affect net cash returns, with productivity measures presented in terms of yields (pounds of coffee per hectare) and cash costs per pound. Higher yields can be especially important to small and medium-size coffee farms, because in many cases limited capacity to secure more cultivable land or finance further investments in coffee can make what they already have in production their main means to expand their income. Cash costs per pound are an important measure for comparing with price premiums from certified programs, such as organic, because the measures taken to secure premiums may involve higher costs that limit net income gains. Lyngbaek, Muschler, and Sinclair (2001) compare the costs and benefits of participating in an organic certification program using data from 10 conventional coffee farms and 10 similar organic farms in Costa Rica. They find that, "When the costs for organic certification and registration are included in the farm budgets, the organic farms would, on average, require a price premium of almost double that currently received in order to match the [Net Income] of their conventional counterparts." Likewise, in larger and representative samples, Mendez *et al.* (2010) and Beuchelt and Zeller (2011) find no evidence that FT/organic coffee growers earn higher profits (cash returns) than do conventional growers.

Eqn. (1) defines net cash returns per hectare for household "i"

$$\Pi_i = p_i q_i - c_i \tag{1}$$

where c_i measures per hectare cash costs, which include paid labor, purchased inputs, and the variable cost of equipment. Processing coffee cherries generally involves fixed investments at the farm (or community) level that include a cement patio, a de-pulping machine, and a fermenting tank. One can

incorporate these costs by depreciating their value over the life of the investment. However, our cost measures focus only on the main variable cash costs of coffee production—hired labor and purchased inputs.

The variable p_i denotes the average price per pound of coffee received by household i that includes premiums associated with its quality attributes, such as the acidity, flavor, bean humidity, and certification of the product under third party labels. In the next section, we provide estimates of the price premium and the price-related gross income gains associated with the Rainforest Alliance certification in Peru and the FT/organic market in Mexico. Then, we explore the sources of variations in productivity, measured mostly by q_i, measuring per hectare yields, but also by the cash cost of producing a pound of coffee which thus includes elements of q_i and c_i from Eqn. (1). In Section 5, we estimate a net revenue function with yields as one of the key explanatory variables to provide a comparison with the price contribution derived in Section 4. In that same section, we also explore how yields have evolved over time for Rainforest Alliance growers in the Peru sample who adopted a range of management practices, including systematic pruning of coffee plants, as part of the sustainable coffee project previously mentioned.

A careful analysis of price premiums, productivity outcomes, and net cash returns proves quite revealing about economic outcomes on Mexican and Peruvian coffee farms where growers participate in different certification schemes with cooperatives that put distinctive emphases on securing price premiums or pursuing productivity improvements. By entering multiplicatively into revenue, both price premiums and productivity growth can increase net cash returns. Our core empirical finding is that certification premiums are limited in these two places for reasons we believe are broadly applicable to the industry, while the potential for productivity improvements is large but potentially dampened by some certification norms.

Our data on economic outcomes come from two main sources:

(1) A random-stratified sample of 845 coffee growing households undertaken in 9 regions in the states of Chiapas and Oaxaca, Mexico in 2005–06 [2]; and

(2) Cooperative records and household survey data gathered during 2006–10 associated with one cooperative in Peru with members in 10 communities in the department of Junin. These households appear representative of growers in the region, having yields in line with the regional average at the time of the cooperative's formation in 2005 (833 lb/Ha for the sample, 900 for the region). Sample growers also have characteristics (coffee land, household size, age of household head) similar to that of a random sample of growers from the region's main cooperatives gathered by Fort & Ruben, 2009. We use information from two sources:

(a) Cooperative records including records of sales by members to the cooperative from 2006 to 2008, baseline characteristics of member growers, and member yields from 2006 to 2009.

(b) A 2010 survey [3] that collected detailed household and production information (e.g., costs, prices, and yields) from 235 past and present project participants (and by extension cooperative members). These 235 growers represent 75% of all growers who initially joined the project. Not all initial participants could be surveyed - many could not be located at the time of the survey, some had died, and others refused to give information. A comparison of the 235 surveyed growers with the 80 growers who were not surveyed reveals that both groups appear identical, suggesting that survey coverage (or lack thereof) was essentially random (see Appendix B for the comparison).

Both the Peru and Mexico data provide rich information on prices and productivity that allow careful examination of household economic outcomes across distinct certification programs. Survey instruments are available upon request, and brief summaries of them are in Appendix A.

4. PRICE PREMIUMS AND INCOME GAINS FROM CERTIFIED COFFEE

For several reasons, identifying income gains associated with price premiums generated by dual certification schemes can be challenging (Weber, 2011a). For example, comparing conventional prices with certified prices can be misleading because of limited demand for certified coffee beans or other marketing constraints, growers often sell coffee through several marketing channels. As a result, the average price they receive (total revenue from sales divided by total quantity sold) summarizes the net effect of a grower's marketing decisions, though it generally does not permit identification of the precise market value of a certification. To do that, a researcher needs information on prices received for selling to markets that recognize a grower's third party certification (organic, FT, Rainforest, etc). The difference between an average premium (premium calculated over all coffee sold) and the market premium (premium averaged over coffee sold to a market that recognizes certification) may be large.

One limitation of third party certified markets can be the limited effective demand that producers face for the certified product. De Janvry, McIntosh, and Sadoulet (2011) develop a detailed microeconomic analysis of this issue for a large Fair Trade coffee cooperative in Central America and suggest that relatively free-entry into FT markets limits producer rents from price premiums, because excess supply of FT coffee constrains how much of a cooperative's sales occur under a FT/organic certification. As the FT sector matures, new entrants compete away any producer rents associated with FT markets.

Perhaps the central measurement issue in estimating certification price premiums is the many sources of variation in farm-level prices, some of which may be correlated with a grower's certification status and could thus confound estimates of premiums. Growers often participate in multiple certified markets, as is the case with dual certified FT/organic coffee. Without single certification comparisons, this dual certification confounds the two. Furthermore, small-scale growers participate in these markets through cooperatives. Differences in average prices between FT/organic growers and neighboring non-certified growers can therefore derive from a combination of an organic premium, a Fair Trade premium, and the marketing advantages (or disadvantages) of a cooperative. To further complicate matters, export markets like FT/organic tend to demand higher quality coffee grown from specific types of soils, microclimates, and most importantly, with specific cultivation, harvesting, and post-harvesting practices that are not explicitly part of the organic or FT certification. Bray, Sanchez, and Murphy (2002) highlight how the rise of cooperatives and organic production practices in Mexico was accompanied by a new focus on quality control. Thus, quantifying premiums associated with selling to FT/organic markets requires careful accounting for the relevant sources that cause variation in prices.

Table 1. *Price premiums for Rainforest Alliance certified coffee in one Peruvian cooperative, 2006–08*

Year	Local market price—US$/lb (excludes premium)[a]	Premium US$/lb	Premium as percent of market price	Median quantity sold to cooperatives (lb)	Median gross income gain (US$)
2006	0.70	0.073	10.4%	1,300	95
2007	0.87	0.073	8.4%	2,136	156
2008	0.94	0.031	3.3%	1,940	60
Average	0.84	0.059	7.4%	1,792	106

Source: Cooperative records, 2006–08. Tabulations made by authors.
[a] This is the local market spot price, which is what the cooperative paid member growers when they delivered their coffee.

We begin with a direct measurement of three years of price premiums for certified coffee collected by a Peruvian cooperative that sold coffee certified as sustainable by Rainforest Alliance. The cooperative paid member growers the current local market price for uncertified coffee when they delivered their coffee. After the coffee had been exported and contracts paid, the cooperative subtracted its cost and the initial payment to growers from total sale revenue. From the remaining revenues, the cooperative calculated a premium to pay member growers per pound of coffee sold to the cooperative. In 2006 and 2007 the cooperative paid a premium of 7.3 cents per pound, which dropped to about 3.3 cents per pound in 2008 (Table 1).

These premium numbers are not distorted by a cooperative export disadvantage (or advantage) since for the years mentioned the cooperative outsourced export logistics to a large coffee export company which charged a standard rate for its services. Thus, the cooperative was only involved in coffee marketing in that it arranged the agreement with the export company so that growers could deliver their coffee directly to the company.

Records of purchases of coffee from member growers allow us to calculate the total amount each member sold to the cooperative each year and, given the premium rate, the gross income gain associated with the premium. Averaged over the three years observed, the median gross income gain received by growers who sold at least some of their coffee to the cooperative was US$ 106. The figure is an upper-bound estimate for improvements in net cash returns, because it does not account for grower costs associated with participating in the certification scheme.

Weber (2011a) uses data from the southern Mexico grower survey to estimate the extent that growers participating in FT-organic markets through cooperatives have a better marketing performance, captured by the average price received for all coffee sold over the season, compared to independent (non-cooperative) growers selling on the conventional market. Without controlling for the potential endogeneity of the FT/organic participation measure in his regression analysis, FT/organic growers received 12.8 cents per pound more than independent growers. Adding control variables thought to be correlated with coffee quality reduces the premium to 12.4 cents while controlling for selection into the FT/organic group (using the percent of growers in the community that are FT/organic growers and its square as exclusion restrictions) reduces the premium to 12.0 cents a pound. These results suggest that a standard FT/organic participation measure might have a slight upward bias. In all regression models, a variable capturing the size of a grower's cooperative is negatively associated with price, which may reflect the difficulty larger cooperatives have selling a high proportion of coffee on certified markets.

The 12.8 cents per pound estimate for a FT/organic premium in the Mexico data is again a gross premium that ignores the costs incurred to comply with organic certification standards or participate in a FT/organic cooperative. Valuing time spent on cooperative activities at the community wage for unskilled labor and adding direct payments, the median cost of cooperative participation for organic growers was US$ 25. Multiplying the premium by the amount of coffee produced and subtracting the cost of cooperative participation yields a median annual income gain for growers participating in FT/organic markets through cooperatives of US$ 103, which corresponds to about 5% of total household annual income for sample growers.

While not a negligible income increase, a median gain of US$ 103 is unlikely to transform a grower household's economic possibilities; it is less than the median remittance received from family members living elsewhere in Mexico ($165) and much less than the median remittance received from a family member in the US ($2,900). It is also considerably less than the nearly $600 that the median household received in 2005 from government transfers associated with Oportunidades (a conditional cash transfer program) and agricultural subsidies (e.g., Procampo). Moreover, the premium estimate omits costs incurred to become organic certified and to maintain that certification with a yearly renewal.

We should note the FT/organic premium estimated here is a point estimate for one region (southern Mexico) in one year while the Rainforest Alliance premium is for only one cooperative over three years. Premiums evolve over time in relation to supply and demand and rules governing certification. For example, the organization that oversees FT, the Fairtrade Labeling Organizations International, increased the FT minimum price by 10 cents a pound in 2008.

We should also note that there may be arrangements outside of third party certifications that can consistently deliver substantial premiums. One possible alternative arrangement is local-to-local partnerships where independent coffee distributors with a loyal customer base form direct relationships with specific groups of growers. Another possibility is through product differentiation where cooperatives cluster members based on their coffee's unique attributes and then market these attributes directly to consumers.

5. YIELDS AND NET CASH INCOMES OF CERTIFIED COFFEE PRODUCTION

Next we focus on how yield differences (pounds of coffee per hectare) affect grower net cash income across space and certification status. A key finding from Barham *et al.* (2011) is that in Southern Mexico yield differences account for two-thirds of the net revenue per hectare gap that cooperative growers participating in FT/organic markets earn above conventional growers, who participate in neither. Furthermore, net revenue and yields varied more across regions than across cooperative status. As with price premiums, the greater yields of cooperative growers may stem from selection (less marginalized growers converting to organic) or from an endogenous effect (cooperatives providing technical assistance that increases

Table 2. *Farm outcomes for certified growers in Mexico (2005) and Peru (2010)*

	Certified organic growers in Mexico in 2005[a]				Sustainable growers in Peru in 2010[a]	
	Oaxaca		Chiapas		Junin	
	Mean	SE	Mean	SE	Mean	SE
Yield (lb/Ha)[b]	515	13	713	16	2,073	146
Average prices ($/lb)	0.79	0.014	0.90	0.04	1.21	0.01
Cash costs per Ha [b]	116	125	162	185	690	59
Cash cost per lb	0.29	0.03	0.23	0.02	0.61	0.22
Net cash revenue per ha [b]	280	23	494	34	2,125	185
Observations	291		126		233	

Source: Household surveys described in Section 3.
[a] Monetary amounts are in current year prices.
[b] The denominator is area in production, not total coffee area.

yields). Whether organic or conventional practices are used, yields will vary with management intensity (e.g., frequency of pruning, quantity of fertilizer) such that a plantation intensively managed using organic norms may have greater yields than a passively managed conventional plantation (Haggar *et al.*, 2011). Holding management intensity constant, an unlikely interpretation of the higher yields of organic growers is that organic practices strongly increase yields, as previous studies suggest the contrary (Perfecto, Vandermeer, Mas, & Soto Pinto, 2005; Valkila, 2009; Van der Vossen, 2005).

Higher yields mean higher gross revenue but not necessarily higher net revenue; they could simply reflect greater input use and hence greater costs. Table 2 presents estimates of cash costs and net cash income per hectare for organic growers in Chiapas and Oaxaca in 2005 and the sample of Rainforest Alliance growers in Junin in 2010. The comparison is not meant to suggest causal relationships between certification programs and net revenue. Interpreting mean differences across certified and uncertified growers as the effects of certification (Mendez *et al.*, 2010) should be met with skepticism. Instead, we compare across the Peru and Mexico samples to highlight the range of economic outcomes realized by small-scale growers and specifically, the role of yields in shaping those outcomes.

Despite substantially higher cash costs, the mean net revenue per hectare of the sample of Peruvian growers was respectively about seven and four times that of organic growers in Oaxaca and Chiapas in 2005. Given that some of the gap is due to differences in market prices, it is important to compare net revenue holding prices constant. At the mean price received by growers in Chiapas, the Peruvian growers would have had a net revenue per hectare of US$ 601, or 20% higher than the organic growers in Chiapas and more than double that for growers in Oaxaca. Differences in cash returns may be starker than what the data suggest. There were almost no growers with young plants (less than three years old) in the Mexico sample in contrast to the Peru sample where the average grower had 0.4 hectares not yet in production. While we exclude the cost of hired labor for planting from the calculation of cash costs, the survey did not separate other cash costs associated with new areas. Thus, part of the cash costs in the Peru case could be associated with recent growth in investment.

One concern is that the yield and return differences across the Peru and Mexico samples is an artifact of the different years that the data correspond to. Coffee growing conditions may have been particularly poor in 2005 in southern Mexico and very good in central Peru in 2010. Historic yield data for the period 1999–2008 reveal that 2005 was an above average year for Chiapas (10% higher than the state average yield over the period) but below average for Oaxaca (28% below).[4] The 2010 growing season was typical for Junin—the 2010 yield for the region was only 4% higher than the average for 2000–10. While the below-average yields in 2005 in Oaxaca should be noted, the comparisons between the Junin and Chiapas samples are not driven by abnormal yields in either region in their respective years.

Another concern is that the growers from the Peruvian cooperative are not representative of small-scale growers in the region. It is true that the project that they participated in, which is at least partly responsible for recent yield growth, introduced practices not common in Peru at the time. However, as mentioned in Section 2, the Peruvian growers were similar to other growers in the region in terms of basic household characteristics and yields when the project began.

The growers in Chiapas have lower per pound cash costs than growers in Peru, and this may reflect lower labor costs associated with mostly family labor. It also may mean that they could benefit from expanding their production given their low unit costs. As mentioned in Section 3, small-scale growers often have a limited ability to expand cultivable land, which explains why yield improvements can lead to major differences in net cash income.

To provide a more robust estimate of the marginal effects of yields on net revenues (Π_i) as defined in Eqn. (1), we estimate a net revenue function for 2010 for the Peru sample

$$\Pi_i = \alpha_0 + \alpha_1 Yield_i + \alpha_2 X_i + C_{g(i)} + \mu_i \quad (2)$$

where the vector X_i contains farm-specific variables, including farm size (*Ha Coffee Baseline*—acres of coffee when the grower joined the cooperative, which corresponds to either 2005 or 2006), farm elevation, family labor, the ratio of adult labor to coffee land, the age and education of the household head, and a community dummy variable. The results are shown in Table 3. The main variable of interest is the yield variable, which has an economically large coefficient (0.86) and is precisely estimated (standard error of 0.06). Thus, each additional pound of coffee harvested increases net revenue by US$ 0.86.

Panel data for the Peru sample show that much yield growth has occurred in recent years, and it has been associated with participation in cooperative activities aimed at improving yields through better management. To estimate the net impact of the yield improvements associated with participation in the project (and by extension, the cooperative Ecoterra), we use a fixed-effect yield function for sample growers. From the sample, 41 of the 236 growers exited the project in 2007 or before, and we refer to them as non-participants. Conversations with cooperative leaders and non-participant growers suggested that exit was related to disagreements over the administration of the project and the certification price premium. Data ob-

Table 3. *Net revenue, Peru sample—2010*

Variables	Coefficient	SE
Yield (lb/Ha)	0.86***	0.06
Ha coffee baseline	−213.80**	92.93
Ha coffee baseline squared	4.90**	2.38
Elevation	−0.05	1.34
Youth (10–16)	−85.22	133.68
Adults (17–65)	126.74*	74.68
Adults/coffee land	−177.89*	93.85
Education	62.53*	36.48
Age	−79.93	101.90
Age squared	0.95	0.96
Intercept	1,775.36	4,222.45
Control for community	Yes	
Observations	232	
Adjusted *R*-squared	0.48	

Source: Household survey organized by the authors and described in Section 3.
Robust standard errors are calculated.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Table 4. *Yield growth and project participation for Peru sample, 2006–10*

Variable	Coefficient	SE
Year 2007	−82	134
Year 2008	−17	133
Year 2009	−224	172
Year 2010	24	181
Year 2007 × participant	187	140
Year 2008 × participant	564***	156
Year 2009 × participant	577***	183
Year 2010 × participant	326*	197
Constant	675***	33
Observations/growers	1,062	236

Source: Cooperative records and household surveys described in Section 3.
Robust standard errors clustered by grower are calculated.
* Significant at the 10% confidence level.
*** Significant at the 1% confidence level.

tained for growers through a baseline survey applied at the beginning of the project reveal that growers who later exited had 1.4 more hectares than participants (mean differences are statistically different at the 10% level) and yields almost 50% higher than participants (difference significant at the 1% level). Thus, the evidence suggests that productive growers, perhaps seeing less gain from participating in the project, chose to exit early likely before adopting the technical assistance suggestions.

The yield model estimated includes a grower fixed effect (γ_i), a year fixed effect (τ_t) and an interaction between the year effect and a participation dummy variable.

$$Yield_{it} = \delta_0 + \sum_{t=2007}^{2010} \delta_t(\tau_t * Participant_i) + \tau_t + \gamma_i + v_{it} \quad (3)$$

The specification in (3), enabled by multiple observations on the same grower, provides a level of robustness generally not seen in the literature on the economics of smallholder coffee production, which relies almost solely on cross sectional data (Arnould *et al.*, 2009; Barham *et al., 2011; Beuchelt & Zeller,* 2011; Bolwig *et al.,* 2009; Mendez *et al.,* 2010; Valkila, 2009). Specifically, it controls for pre-existing differences across growers and time-invariant and grower-specific characteristics that affect the outcome. The coefficients on the interaction between the year variables and the participation indicator captures the dynamic effect of participation in the project if there are no shocks (outside of project activities) that affect participant and non-participant outcomes differently.

The results in Table 4 show that participant growers saw higher yields in 2008, 2009, and 2010. Taking the participation effect in 2010 as the best proxy for the long-run yield effect of better practices, participant growers produce 326 pounds of coffee per hectare more than non-participant growers. Multiplying the yield increase by the 0.86 dollar per pound additional value gives the typical farm US$ 280 more per hectare in net revenue. With a typical farm size of around 4 hectares, the potential net revenue gain associated with the improved yields was $1,120, which swamps the median and mean gain of $106 and $187 from price premiums.

It is worth highlighting that the Peruvian growers in the project received a price premium for being Rainforest Alliance certified that was similar in magnitude to that received by the FT/organic growers in Mexico ($106 compared to $103). Thus, both groups of growers received a price premium, but in both cases the economic importance of yields overshadowed that of price premiums. Clearly, projects that can deliver both price and yield improvements offer the best scenario, but the potential tradeoff between small price premiums and large yield improvements may be a more likely scenario for dual FT/organic certification without technical or organizational innovation. Most importantly, the improvements in yields from the project in Peru suggests that many peasant coffee growers may be far from the frontier of potential production, and that improved management could create major income gains.

6. IMPLICATIONS FOR COFFEE CERTIFICATION SCHEMES

Our analysis suggests that yields can be a far more important determinant of returns to household resources allocated to coffee than price premiums associated with FT/organic or Rainforest Alliance certifications. For growers to continue in a certification program, they must have incentive to continue to grow coffee and to participate in the program. Economic sustainability of coffee growing, therefore, implies a sufficient rate of return to warrant employing household resources in coffee production.

Our data from Peru do not readily permit identifying the contribution of particular practices to the yield growth realized by many participant growers. Still, project records and conversations with growers and extension agents point strongly to two activities that are responsible for much of the growth in yields: systematic pruning and appropriate fertilizing, especially following pruning.

Systematic pruning involves annually cutting a proportion of all coffee plants to about a meter in height; for example, cutting all plants in every third row. As growers observed the effects of systematic pruning, the practice expanded rapidly despite initial skepticism (Weber, 2011b). Coffee plants reach peak production around five years of age after which yields can decline, though how much depends on the management of the plant (fertilizer use, pest management, etc.). According to research by the Colombian National Center for Coffee Research, pruning can cause older plants (at least five years old) to produce quantities on par with new plants, thus delaying the decline in yields associated with aging. [5]

There are moments in the production cycle when applying fertilizer will best aid a plant's growth and production, which

is why the project emphasized fertilizing with the right mix of nutrients at the right time. And while appropriate fertilizing was emphasized for its own merits, expansion of systematic pruning magnified its importance. Pruning stimulates plants and increases nutrient uptake. Failure to replenish soil nutrients absorbed by pruned plants can dramatically lower the effectiveness of pruning in later years. Put differently, sustaining the higher yields induced by systematic pruning requires appropriate fertilizing.

By prohibiting the use of inorganic inputs, organic standards potentially depress yields, the main determinant of grower net revenue. Adequate fertilizing is critical for growers who intensively manage their farms (e.g., use systematic pruning) and in doing so have high nutrient demands. Haggar *et al.* (2011) find that with sufficient chicken manure, it can be agronomically feasible for organic growers to achieve yields close to those of intensely managed conventional farms. However, many organic fertilizers, like guano in Peru or composted coffee husks, often lack optimal nutrient balance, providing too much of some compounds and too little of others (Van der Vossen, 2005) and as a result are less effective than inorganic fertilizers designed to maximize the plant's nutrient uptake (Berry *et al.*, 2002).

Furthermore, in some and perhaps many contexts, costs will prohibit replenishing soils through organic fertilizers alone. As a rule, coffee farms generate insufficient organic material to replenish the soil (Beuchelt & Zeller, 2011; Valkila, 2009). To maintain yields, growers must purchase inputs external to the farm, organic or otherwise. In areas with large livestock or poultry industries, obtaining sufficient organic fertilizers may be economical while in other areas, particularly in agroclimatic zones well-suited for coffee growing, transportation costs associated with bulky organic fertilizers may prevent organic growers from obtaining enough fertilizer.

It is also worth mentioning that intensely managed organic and conventional production systems both require substantial cash expenditures. Organic and conventional growers using a passive management regime (just weeding and harvesting, or perhaps just harvesting) will have similar practices and by extension cash costs. The question of liquidity, therefore, depends primarily on management intensity, not fertilizer type. Of course, the specific liquidity needs of organic and conventional growers will vary. For example, organic growers often have greater labor needs and greater labor expenditures (Beuchelt & Zeller, 2011; Calo & Wise, 2005), which may translate into greater total cash expenditures for organic growers relative to conventional growers in high-wage areas.

Input price risk is also not unique to conventional growers. In general, organic growers who adequately fertilize will have to purchase most of their fertilizer. Thus, like conventional growers, organic growers can also bare the risk of higher fertilizer prices. Rising oil prices will increase petroleum-based fertilizers but also the cost of transporting organic fertilizer to coffee producing areas (e.g., taking guano from coastal Peru to coffee growing areas in the eastern foothills of the Andes). The cost of organic fertilizer as well as its attractiveness relative to inorganic fertilizer will therefore vary over space and time.

Because acquiring sufficient organic fertilizer with the right nutrient attributes to sustain economically significant yield increases is likely to be very costly or even infeasible in some areas, an assessment of a blanket prohibition of inorganic fertilizers is needed and should consider:

1. The direct health effects of common inorganic fertilizers for producers and consumers;
2. The extent to which inorganic and organic fertilizers leach into water sources; and,
3. The indirect effects of organic fertilizer use, and the associated lower yields, on land use and deforestation.

The ecological and health gains from a strict prohibition of inorganic fertilizer are unclear, since inorganic fertilizer varies in its composition and secondary effects. There are no convincing reasons based on existing scientific analysis that shows that using guano, for example, is safer to humans than a more nutrient-balanced synthetic fertilizer. On the second point, it is not clear that fertilizer run-off is a serious problem on coffee farms with significant leaf litter, terracing and hedges, especially when compared to annual crops on erosive soils.

On the third point, if using only organic fertilizer reduces yields, it may create pressure to expand on the extensive margin. The extensive margin of deforestation to establish new coffee stands is probably the most significant source of environmental damage associated with coffee cultivation. New stands of coffee frequently displace forests or agro-forestry land uses. Lower yields for a poor, coffee-dependent household with limited off-farm labor opportunities would tend to lower the shadow wage (i.e., opportunity cost) of household labor. If primary forests are available for coffee conversion, low yields and correspondingly low shadow wages would raise the incentive to expand production. In a case of soil mining, the household finds it too costly to replenish soils by fertilizing and instead works the land until returns have fallen enough to warrant abandonment for more fertile lands. This scenario depends on the reality of land markets and access; soil mining makes little sense if acquiring new land is very costly. In some areas of Peru, such as in the northeast, coffee growing is expanding into areas with weak land institutions, making it possible to acquire new lands by squatting.

While there are possibly strong connections between low yields and expansion on the extensive margin, simply raising yields may not alleviate the problem of converting forests to coffee fields. An innovation that increases productivity can also increase incentives to expand on the margin (Angelsen & Kaimowitz, 2001). Ninan and Jyothis Sathyapalan (2005) note for the case of India that high returns to coffee means a higher opportunity cost of standing forest. Also, higher income from higher productivity could finance land purchases and new plantings. Higher productivity, however, could also mean greater income to launch households into other activities that require a minimum investment. Investing in the education of youth, for example, is only feasible if the household can make sustained investments of a certain size. Yet, at an aggregate level, it should be clear that significant productivity improvements on existing coffee stands would tend, over time, to reduce pressure on the extensive margin of forested lands.

7. TOWARD SYSTEMATIC ASSESSMENT OF COFFEE CERTIFICATION SCHEMES

Representative grower data from Mexico and Peru, two global leaders in certified coffee, show that yields rather than price premiums are most important for increasing net cash returns for coffee growers. To the extent that any existing certification norm limits yield improvements, they may create "traps" for marginal low intensity growers, especially if price premiums are small and decrease over time with more competition. By contrast, to the extent that enhancing yields and productivity is critical to the well-being of coffee growing households, any "sustainability" initiative must consider embracing advances in geographically appropriate best management practices. We close by considering the implications of the limits of our

current knowledge on what is "sustainable" to advancing the dialogue on what comes next for certification schemes.

As suggested by the distinctions between Fair Trade, organic, and Rainforest Alliance in this paper, the marketplace is becoming crowded with labels that claim to promote a social or environmental issue or "sustainability" in general (see Daviron & Ponte, 2005 and Raynolds *et al.,* 2007 for overviews). Official certification standards seem comprehensive, but in fact they are technical documents that small-scale growers generally do not read. Extension agents, certifiers, and other professionals distill the documents into specific practices that growers adopt (or show progress in adopting) to pass inspection. The extension agents of the Peruvian cooperative studied here have experience with both Rainforest and organic certifications—at different times some member growers have received organic certification. The key differences that agents identified were that organic norms focus on a clean bean, one that is free of any chemical products while the norms of the Sustainable Agriculture Network used by Rainforest Alliance had a more comprehensive reach, stressing green landscapes through whole farm management.

Some norms, like the prohibition of inorganic fertilizers by organic programs, can constrain growers and limit the profitability of their farms and by extension participation in certification programs. Because these norms come with clear economic costs that limit the reach of the program, the environmental benefits associated with them should be assessed. The existing literature on the sustainability of coffee production has a number of common weaknesses. Three critical ones are a focus on narrow measures of sustainability such as the presence of shade (Blackman, Albers, Avalos-Sartorio, & Murphy, 2008; Perfecto *et al.,* 2005), reliance on simulation-based analyses (Gobbi, 2000; Kitti, Heikkila, & Huhtala, 2009; Masuda, Yanagida, Moncur, & El-Swaify, 2010), and the use of small, non-random samples that do not control for confounding factors (Lyngbaek *et al.*, 2001; Martinez-Torres, 2008). Almost no research exists on the environmental outcomes of different certification programs, let alone one that uses a representative random sample of producers. An exception is Philpott, Bichier, Rice, and Greenberg (2007), which focuses on assessing biodiversity on selected parcels. Interestingly, the study finds no difference in vegetation, ant, or bird diversity between Fair Trade, organic, and uncertified farms.

More rigorous discussion and evaluation of sustainable initiatives could improve their design, and lead to a greater effect on the primary outcomes important to consumers and coffee growing communities. Future evaluations would be particularly valuable if they could quantify systematically the impacts and causal mechanisms of sustainability initiatives. They also need to move beyond a dichotomous framework (e.g., shade grown *vs.* no shade or chemical *vs.* organic) and consider the variety of ways that coffee growing households interact with their environment as well as the human development implications of their participation in sustainable initiatives. Evaluations of environmental outcomes should also consider effects on the extensive margin and focus on the core environmental issues associated with coffee production. It is also important to clarify if certification provides more incentives for growers to continue an existing practice or if it causes a change in practice, an issue mentioned by Bacon, Méndez, and Fox (2008).

An obvious risk is that critical evaluations may cause consumers to doubt the claims of any or all certification programs. In cases where consumer expectations have exceeded what programs can deliver, some adjustment in expectations may be necessary. Yet, constructive evaluations can also bring expectations in line with what is actually deliverable and sustainable. While marketing materials from organizations like the Fairtrade Labeling Organizations International or Rainforest Alliance make consumers aware of sustainable programs, consumer confidence should rest heavily on third-party evaluations. Such evaluations could work against a race to the bottom in certification standards. Informing consumers about different certifications and their effects can counteract the effects of imperfect information in the competition among certification programs for consumers or among certifiers for growers that may undermine standards over time. In essence, we suggest an optimistic vision of evolving sustainability norms that are context appropriate and recognize that certification schemes need to be flexible and incorporate potential income gains on both the price and productivity side of efforts to improve producer welfare and their continuing participation in certified schemes.

NOTES

1. The views expressed here are the authors' and should not be attributed to the Economic Research Service or the USDA.

2. The Mexico data are from the survey project, "Fair Trade–Organic Coffee, Rural Development, and Migration from Southern Mexico." Led by Josefina Aranda, Jessa Lewis, Tad Mutersbaugh, and David Runsten, this project was funded by the Rockefeller Foundation.

3. The Peru survey is from the project "Impact study of sustainable coffee cultivation in the central jungle" funded in part by the Peruvian National Coffee Board (La Junta Nacional del Café) and Rainforest Alliance.

4. Yields for each state were calculated from statistics available through the statistical website of each state, which can be accessed through the Mexican government portal: http://www.campomexicano.gob.mx/campo/index.php.

5. See recommendations by Centro Nacional de Investigaciones de Café, www.cenicafe.org, in their page "Sistemas de Produccion" and Avance Tecnico 0215.

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APPENDIX A. DESCRIPTION OF PRIMARY DATA SOURCES

A.1 *Mexico*

The sample frame includes coffee growing households that were members of cooperatives engaged in Fair Trade and organic coffee production (the two arrangements became intertwined in the late 1990s), and households that were not members of cooperatives and remained outside of the Fair Trade/organic market. Respondents from both groups were chosen at random from lists of coffee growers. Coffee growers in each region were enumerated and divided into two basic groups: those that are organized and participate in Fair Trade/organic coffee production and those that do not. Each group was further stratified by prior information on migration history, and a random sample was drawn from the strata. Each coffee household was weighted appropriately in the data analysis according to the selection probability of their particular stratum.

The survey occurred in 2005–06 and asked about the 2004–05 season, a period of relatively normal coffee prices that followed the price crisis of 2000–03. The household data include comprehensive information on income, remittance and

subsidy flows as well as a detailed look at coffee production, pricing, and cultivation costs (for detailed information on the study, see Lewis & Runsten, 2008).

A.2 *Peru*

The baseline survey was applied by cooperative extension agents when a grower joined the project. It collected basic production, economic, and household information. The 2010 survey was organized by the authors and asked more detailed questions, especially relating to the economic situation of the household and the coffee farm. Local persons with experience conducting surveys for internal certification inspections were trained to enumerate the survey. The survey started in mid August and finished in late September of 2010 and asked about the 2010 growing season. Enumerators attempted to visit all 315 growers that joined the project initially, however, for reasons mentioned in the text, only 235 were located and surveyed.

APPENDIX B. COMPARING BASELINE INFORMATION FROM COOPERATIVE RECORDS (2005/2006) FOR GROWERS WHO WERE SURVEYED IN 2010 WITH THOSE NOT SURVEYED IN 2010

Variable	Surveyed ($n = 235$)		Not Surveyed ($n = 80$)		Statistically different at the 10% level?
	Mean	SE	Mean	SE	
Ha coffee	4.30	3.58	4.15	4.36	No
Ha other crops	0.73	1.82	0.66	1.66	No
Has credit (0/1)	0.15	0.36	0.16	0.36	No
Non-coffee agricultural sales	552	2,809	245	458	No
Average plant age	10.08	4.74	10.10	6.72	No
Kg of coffee per Ha	552	506	597	1,073	No
Age	45.09	12.57	45.22	13.01	No
Children (Ages 0–9)	0.87	1.19	0.77	0.94	No
Youth (Ages 10–16)	0.81	1.00	0.75	0.96	No
Adults (Ages 17–65)	2.58	1.84	2.53	1.55	No