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Quality Contingent Contracts

Evidence from Tanzania's Coffee Market

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Abstract

The literature on product quality in markets where product attributes are not readily observable indicates that information asymmetries and incentive problems may lead to the under-provision of quality. This paper contributes to this literature by estimating the effects of village-level contractual arrangements on producer incomes and on quality enhancing production practices. Three contract types are studied: spot contracts, contingent contracts with product grading and contingent contracts without product grading. To do this, the study uses original data from a survey of 450 coffee producers in Tanzania's coffee market that take advantage of contractual variation in the Kilimanjaro region. The results indicate that coffee contracts that include village-based product grading have a large positive effect on producer incomes, and that the grading effect is associated with production practices that enhance quality. The results also indicate that cooperative membership has no significant effect on producer incomes.

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Quality Contingent Contracts: Evidence from Tanzania's Coffee Market

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1.0 Introduction

Transactions in Africa's agricultural markets are often characterized as relatively homogenous and unsophisticated. Whilst this may be a fair description of the bulk of the transactions, it does not represent a range of contract based transactions observed in some markets. As value chains become more modern and as demand for high value products increases, institutions for better organization and coordination such as contracts must play a larger role.

This paper studies contracting arrangements relating to incentives and quality determination in a market where product quality is an important variable, but where product attributes are not readily observable. In this context, information asymmetries and incentive problems may lead to the under-provision of quality.

The theoretical literature on contract theory is vast and well developed. Therein, there is a well developed body of work on incentive contracts[2]. Although less advanced, the empirical literature is growing. Consistent with economic theory, empirical studies have shown that incentive based contracts are more likely to be used than spot market transactions when product quality attributes are important, and that price incentives are likely to be used when product quality attributes are observable (Goodhue, 2011). Studies of incentive contract performance in developed countries, particularly the USA, in markets such as tomatoes, wine and the broiler sector have shown that price incentives can be effective in influencing production processes and increasing quality (Wu and Roe, 2006; Alexander et al., 2007; Goodhue et al., 2010). There is also a growing literature that uses experiments to test contract theory (Bull et al., 1987; Wu and Roe, 2005), including research based on field experiments carried out with farmers in developing countries (Saenger et al., 2012) with similar findings.

A large deficit remains in the African context where the empirical evidence on incentive contracts is particularly limited. Much of the recent research relating to agricultural contracts in Africa addresses contract farming arrangements. This is typically defined as a pre-production agreement between a producer and the buyer that may or may not specify the nature of the goods or include the provision of inputs. The main function of contract farming from the producer's perspective is to provide a mechanism for access to output (and possibly input)

[2] The important works of Williamson (1975, 1985) established the impetus for much of the modern work on incentives and organizations. Excellent reviews of the literature on incentives and contracts can be found in Milgrom and Roberts (1992) and Rosen (1992).

markets. These studies typically focus on contract participation or contract performance in relation to household income, food security or other welfare indicator (e.g. Miyata et al., 2007; Bolwig, 2012)[3]. The wide interest in contract farming reflects concerns about the exclusion of smallholders from participation in the growing high value segments of the value chain and the interest in the role of out grower type arrangements in providing them with access to markets. Although they may be effective in some contexts, contract farming arrangements are not always effective for engaging smallholder in high value chains due to the high transaction costs involved compared to arrangements made with medium to large producers (Little and Watts, 1994; Key and Runsten, 1999). It is also not clear that it is the only or even the best mechanism for providing producers with incentives to increase the quality of their output.

This study takes advantage of contractual diversity in Tanzania's coffee market to fill some of the gap in the African context. The aim is to make an empirical contribution to the literature by comparing and estimating the effects of three village-level contractual arrangements on producers' incomes and on the incentives to adopt quality enhancing methods.

Tanzania is a particularly good case study in this context[4]. Tanzania's coffee market reforms of the 1990s have had a mixed outcome at best: coffee production in Tanzania has declined steadily over the last 20 years and producer shares do not seem to have maintained their growth as a proportion of the export price[5] (Baffes, 2004; Krivonos, 2004; Winter-Nelson and Temu, 2002; Ponte, 2004). Moreover, the reforms do not seem to have created mechanisms or sufficient incentives in the market for improving the quality output of the Tanzanian coffee sector. The decline in coffee production has been accompanied by a marked decline in coffee quality, particularly for Arabica coffee (Baffes, 2004).

This leads to the question whether the existing contracting mechanisms contribute to this situation. This paper compares the effects of the existing grading, contracting and cooperation arrangements in Tanzania's coffee market with the aim of understanding their role in relation to the quality profile of Tanzania's coffee market. It explores whether contracts that embody more

[3] Other studies include; Grosh, 1994; Warning and Key, 2002 and Minot & Roy, 2006.

[4] Tanzania is a small producer of coffee with a market share of less than one percent of global production, making it a price taker in the international market. The majority of coffee grown is of the Arabica variety, with some Robusta coffee grown in the western areas. The focus in this study is on the market for Arabica coffee. Arabica coffee is predominantly produced in two areas, the northern Kilimanjaro and Arusha regions and the southern Mbeya and Iringa regions.

[5] Arabica coffee.

information between buyers and sellers (by way of product grading) improve incentives, incomes and production practices[6].

The first section of this paper describes the grading and contracting arrangements in Tanzania's coffee market and outlines the main premises that are addressed in the analysis. The two subsequent sections present the data and findings. The analysis is based on original data from a survey of 450 coffee producers in the Kilimanjaro region.

The results indicate that coffee contracts that distinguish the quality profile of the individual producer by grading and that award quality premiums accordingly have a significant and positive impact on producer incomes. The results also indicate that this grading effect is associated with production practices that enhance the quality of coffee produced. It is also notable that cooperative membership does not have a significant effect on incomes after controlling for contract types. The implication is that effective incentive contracts could provide smallholders with direct access to high value markets segments independently of the constraints of cooperative organization. All together, these findings point to some of the possible ways in which small African coffee producers could raise their incomes, as well as the overall quality profile of the markets they engage in.

1.1 Coffee grading and contracts

How coffee is graded

In Tanzania, coffee is first fully graded when it makes its way to the hands of the big buyers and processors that have their own grading facilities, then again when it gets to the coffee auction, by the Tanzania Coffee Board. Big buyers send samples of processed coffee to the Tanzania Coffee Board for grading prior to auction and export. Cup tasting is the method that has been and that is still used as the ultimate procedure for the assessment of quality and grade based on size, shape and flavor[7]. Coffee is not generally graded in the village, where the first transaction takes place between buyers and coffee producers.

[6] The analysis does not address how prices are determined under these contracts or whether the prices are fair. Rather, it is an attempt to detect whether the incentive mechanisms work.

[7] This full grading process is relatively costly and time consuming. It is only carried out on bulked consignments of processed coffee and would not be suitable for grading the numerous small village level transactions. It was not possible to obtain reliable estimates of the cost of fully grading each consignment. The cost of the equipment used

Since coffee is graded only at the later stages of the domestic marketing process, the quality of coffee is defined differently by the different people involved in each stage of its production. The coffee producer would consider that he has obtained a good quality crop when the normal production levels are reached and when the crop has not been affected by the climate and/or traditional coffee diseases. Buyers rely on more sophisticated grading criteria that are typically not disclosed to the producers: they will not give a verdict on the quality of the crop until it has been fully graded. This is a system that maintains an underlying asymmetry of information between coffee producers that sell at the village and coffee buyers that process and export coffee beans.

Contract types

For a small coffee producer in a Kilimanjaro village, there are three possible contracting arrangements: a spot contract, a contingent contract with group product grading and a contingent contract with individual product grading[8].

The spot contract is the typical transaction between producers and private buyers. It is a full cash payment made upon receipt of goods. The goods are not graded by the private buyers and quality premiums are not paid.

The transaction between producers and cooperatives is based on a contingent contract. Under this arrangement, the producer receives two payments. The first payment is made when the first transaction takes place at the village when the coffee producer delivers his individual consignment to the cooperative. The second payment is made after the coffee consignments are aggregated, processed, graded and then sold at the auction. The full value of the contract is contingent on the grade allocated and price achieved at the auction. It is a mechanism designed to transfer quality premiums (and also price shocks) collected through auction sales back to the producers.

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to grade coffee in this way (roasting machine, sorting equipment, etc.) is above $2000. The buying and milling companies and the Tanzania Coffee Board confirmed that it would not be economical to grade small village consignments in this way, but that the partial grading process at the village level is a virtually costless and sufficiently reliable method for estimating quality.

[8] This contract type is not common in the market. It is an exceptional arrangement that is being analyzed in this study.

There are two types of contingent contract. The first is a group contract that does not differentiate the quality premium between individual producers at the village. The quality premium received (if any) is equally shared between all cooperative members, despite the quality of coffee they had delivered. The second is an individual contingent contract that distinguishes between types of producer (high quality and low quality), and awards the quality premium with the second payment accordingly. It does this using partial grading at the village: a simple inspection of the producer consignment for cleanliness and moisture content based on basic procedures that are suitable for the large numbers of very small transactions that take in the village[9].

Contract dynamics

The three contract types have differing information properties related to the grading process described previously. In general, if both the buyer and the seller observe the qualities of the product, the transaction will be based on full information. However, an asymmetry of information, and information rents, will exist if only one party (the buyer or the seller) observes quality. If there is asymmetry of information, in that the attributes of the product are observable by the buyer but not observable by the seller, the buyer will have an incentive to offer only the lowest price, causing a disruption of the quality incentive and the under-provision of quality in the market[10] (Fafchamps, Hill & Minten, 2006). In this context, for both the spot and the group contingent contract, an asymmetry of information exists, because coffee is not graded in the village, which creates opportunities for buyer rent seeking (both private buyer and cooperatives).

The three contract types also have differing incentive scenarios with regards to the provision of quality in the market. The spot contract does not identify or reward quality. The group contingent contract provides a quality premium but does not distinguish individual contributions, so it creates space for the free rider problem to diminish the individual incentive for the provision of quality of coffee in the group. In contrast, the individual contingent contract gives producers the right incentive to optimize their production practices. It is also more likely to

[9] No special equipment is used and the cost of this village grading process is negligible. Although partial grading does not provide full information about quality characteristics, it gives an adequate indicator of likely quality attributes. In this way, it allows individuals to capture the quality premiums from their own individual output.

[10] Moreover, in a competitive market with asymmetric information, buyers (coffee traders) will not have the incentive to independently invest in long-term mechanisms for improving the quality of the goods by offering a price premium, because they would still have to compete with other buyers for the same goods. This reinforces the under-provision of quality in the market.

induce low quality producers to adopt better practices in order to gain the immediate benefits of the quality premium. This is the premise that this analysis seeks to test in the following sections.

Table 1.1 summarizes the characteristics and incentives delivered by the above contract types discussed here.

Table 1.1: Tanzania coffee market contract types

	Spot contract	**Contingent contract group grading**	**Contingent contract individual grading**
	Without village grading	Without village grading	With village grading
Grading at village	No	No	Yes
Grading at auction	Yes	Yes	Yes
Premium payment	None	Shared	Individual
Incentive	**No**	**No**	**Yes**

Source: Author.

1.2 The data: the Kilimanjaro coffee producer survey 2008

The primary data used in this study is from an original survey of coffee producers designed specifically for the purpose of this research. The survey was carried out in Kilimanjaro, Tanzania's main northern Arabica coffee-growing region between August and November 2008[11]. It targeted small Arabica coffee producers during the peak coffee-buying season. The Kilimanjaro region was selected because unlike some of the southern Arabica coffee-producing regions, it still has a strong and active cooperative presence. Conducting the survey there allowed for comparison between producers who market their produce through private buyers with those who sell to cooperatives.

Survey design

The objective of the survey was to measure contractual variation for small coffee producers in Kilimanjaro.[12] The three contract types described in the previous section were targeted in the survey: spot contract, contingent contract with group product grading and contingent contract with individual product grading.

[11] It was conducted in the Moshi Rural district of Kilimanjaro, which is in the heart of one of Tanzania's prime Arabica coffee-producing regions.

[12] Information about the extent to which coffee growers are able to influence rules and regulations was also collected.

The first two contract types were the standard arrangements offered in the market - the spot contract was offered by private coffee buyers and the contingent contracts with group product grading was offered by cooperatives. The third contract type - contingent contract with individual product grading – was an exceptional arrangement introduced as an exogenous intervention through the local cooperative in one village, which the survey sought take advantage of.

The contingent contract with individual product grading was introduced to the cooperative society of one of the local villages in the area (Kinyamvuo) by a donor-funded project that targeted five village cooperative societies in the region. The project, supported by the Swedish International Development Agency, became operative in the 2004-05 seasons. It introduced two main interventions, the grading of coffee and the promotion of organic production practices. Farmer membership records were created at the start of each season. When coffee consignments were brought to the cooperative collection centre, they were immediately weighed and graded (using basic visual inspection and moisture detection methods). Data about the quantity of coffee collected, the grade assigned and the associated price were recorded in the farmer's record sheet, and the preliminary payment under the contingent contract was made. At this stage, the cooperative collecting agent would also identify the farmer according to their organic certification status. Later in the season, when the second payment of the contingent contract was made, the amount paid to each farmer would be based on the grade they had been allocated and whether their coffee was organic.

This intervention created the opportunity to design the sample based on contractual variation within what is otherwise a relatively homogenous context. Using the village where individual grading is taking place as the treatment group, two other villages were selected where the other contract types (spot and contingent without grading) were being used for comparison purposes. The sample only included farmers that were not certified as organic coffee producers for the purpose of comparability with the other villages.

Three villages were identified using a list of all the registered buyers and cooperatives in the Moshi rural district. A sample size of 450 households was selected for the survey. It targeted coffee producers that came to sell at a buying post (as opposed to visiting the households), and interviewed them directly after they had completed their coffee transaction. In this way, coffee producers who sell in the current season were targeted, as they are considered to be the most

likely ones to have also sold in the previous season.[13] Data from 450[14] coffee producers was collected at the three locations. The sample was constructed as shown in Table 1.2.

The survey data was collected using a structured questionnaire. One enumerator was placed at one buying post in each village, so that data was collected at the three locations simultaneously. Several qualitative interviews with key informants were also conducted before and during the survey period. Those interviewed included the Tanzania Coffee Board, local government officials, private coffee-buying companies, village buyers, cooperative buyers, coffee producers, a private coffee estate and the Tanzania Coffee Association.

Table 1.2: Village sample selection

	Village One	**Village Two**	**Village Three**
Village name	Masia Mshiri	Kinyamvuo	Lole Marera
Marketing channel	Private buyer	Cooperative	Cooperative
Contract type	Spot contract	Contingent contract with group product grading	Contingent contract with individual product grading
Village grading	No	Yes	No
No. of observations	130	159	131

Source: author's own calculations from primary data collected.

The purposive survey design allowed the sample to capture small groups in the population that would not have otherwise been significantly represented in a random or proportionally stratified sample. However, using a non-random sampling approach means that the sample might not represent the characteristics of the population as whole. There is a chance that this approach would tend to overweight sub-groups that are more readily accessible in the local population. More specifically, since the coffee producers interviewed were those that brought their coffee for sale at a buying station, it is possible that those that sell coffee more frequently in the season are disproportionately represented in the sample.

Table 1.3 compares some of the general descriptive statistics of coffee producers categorized in three groups: high, medium and low frequency of sales (the average number of coffee transactions recorded in the survey is 3.8). It shows that these three groups of coffee producers are fairly similar in terms of age, education and asset ownership. So, since coffee producers' basic

[13] Since the survey was based on respondent recall, the previous year was selected as the shortest recollection period for a full season of transactions.
[14] The original number of observations is 450. The final sample was reduced to 420 after data processing.

characteristics do not differ much by selling frequency, a significant bias is not foreseen, nor the need to use a statistical method that corrects for selection bias when an approximating population (sample) is suspected to be unrepresentative of the total population.[15]

Table 1.3: Characteristics of coffee producers by selling frequency

	Selling frequency		
	Low	Medium	High
Age	47	47	52
Asset index	2.8	2.8	2.8
Male	72%	84%	70%
Literate	98%	98%	92%
Influences institutional change through associations	82%	85%	91%
Kinyamvuo (grading village)	20%	34%	75%
Farm size (acres)	1.2	1.3	1.5

Source: author's own calculations from primary data collected.

The survey was designed to limit the possibilities of selection and sample bias. Selection bias would occur if unobserved producer characteristics determine the choice of marketing channel and contract type, creating endogeneity in contract preference. This potential for self selection was limited through the survey design. In each one of the villages selected, the contract type observed was the main one offer, with little access for villagers to other contract or transaction types as they would have had to travel to other villages with their consignments. In the case of Lole Marera, where the contingent contract with individual product grading was offered, the village leadership had explicitly banned buyers other than the cooperative from buying coffee. Similarly, the survey was designed to eliminate sample bias. Sample bias would be an issue if the data only included observations that involved an incentive contract. However, the data includes observations of outcomes in the absence of an incentive contract – the spot transaction - to provide a counter scenario to frame the results.

Descriptive statistics

Some of the main characteristics of Kilimanjaro coffee producers are presented in Table 1.4. The survey shows that coffee producers tend to be older in age (around 50 years old on average) and literate, with education up to primary level. As is the case for most commodity crops in Tanzania, the marketing of coffee is dominated by males, as is shown by the high proportion of

[15] These include the Heckman correction (Heckman, 1979), which essentially uses probability measures to adjust estimates for the omission of certain population groups, or bootstrapping methods that create a new approximating population by re-sampling from the original sample.

male sellers.[16] In addition, the majority of coffee-selling households in the sample rely on coffee as the main source of cash income for the household.

Farm sizes in the Kilimanjaro region are generally small, due to the high number of crop-growing households relative to other regions. The sample average of 1.28 acres per household is lower than the 2.47 acre average for the region,[17] due to the exclusive inclusion of smallholders in the survey. Overall productivity in the sample is also relatively low, but increases for households that use more inputs. The survey shows that producers who are also cooperative members have a higher level of input use (Table 1.5). For the large majority of respondents, this is typically a combination of organic fertilizer and pesticide. Cooperative members also use drying tables[18] to process their coffee more often (as opposed to drying coffee beans on the ground, which results in lower quality output, due to inconsistent drying, dirt contamination and a generally poorer flavor).

Table 1.4: Overview of survey data (mean values)[19]

General	%	Education	%
Age	49	Level of education	
Gender		Primary-incomplete	5
Male	73	Primary-complete	75
Female	27	Secondary-incomplete	2
Primary source of income		Secondary-complete	13
Coffee	87	Vocational-college	2
Other	13	None	3
		Literacy	
		Literate	96
		Illiterate	4
Production practices	%	Marketing practices	%
Quantity harvested (kg)	90	Quantity sold (kg)	89
Farm size (acres)	1.28	Selling frequency	3.8
Productivity (kg/ acre)	76	Grades before selling	42

Source: author's own calculations from primary data collected.

[17] Tanzania Sample Census of Agriculture 2003/04

[18] The drying tables are not generally major investments. They are simple flat surfaces that allow farmers to air and dry coffee off the ground.

[19] See Annex 1 for a table showing mean values, standard errors, min and max values and coefficients of correlation.

Table 1.5: Cooperative membership and production practices

	Member of a cooperative	
	Yes	No
No. of inputs used[20]		
One-input	44%	88%
Two-or-more-inputs	56%	12%
Use of drying table		
Yes	74%	42%
No	26%	58%

Source: author's own calculations from primary data collected.

The survey collected several variables relating to the poverty profile of the households, including monetary variables, such as cash income, and non-monetary variables measuring food security, asset and livestock ownership and quality of housing. Cash income is a particularly relevant measure for this analysis, since coffee is the main source of cash income for coffee-growing households in the Kilimanjaro region. It directly indicates the impact of the coffee business on the households' ability to purchase basic goods and services, and to invest in future income. Households with higher cash incomes tend also to own more assets, eat better and live in better homes. A significant level of variability in cash income between households according to marketing channel is found (Table 1.6). Households in the sample that sell to the grading cooperative have significantly higher cash incomes.

Table 1.6: Cash income by marketing channel (where respondent's primary source of income is coffee)

Cash income (Tsh)	Mean	Std. dev.	Min	Max
Private buyer	134,670	104,266	10,000	700,000
Cooperative grading	773,039	794,235	120,000	4,800,000
Cooperative no grading	293,836	222,185	-	1,000,000

Source: author's own calculations from primary data collected.

1.3 Data analysis and results: is grading beneficial?

Table 1.6 showed that households that sell through the grading cooperative channel have significantly higher levels of cash income, whilst the lowest levels of cash income are recorded for households that sell to private buyers. In contractual terms, this suggests that the contingent contract significantly outperforms the spot contract. It also raises the question of whether this effect is to be attributed to the cooperative or to the grading contract. If it is related to the

[20] In almost all cases, one input refers to the use of fertilizer and two inputs refer to the use of fertilizer and pesticide.

cooperative, then there should be little variation between the grading and non- grading cooperatives. Yet the cash income reported by households that sell through an individual contingent contract with grading is almost four times as high as the cash income of those that sell through a group contingent contract without grading. This indicates that, whilst membership of a cooperative seems to have a positive effect, contingent contracts markedly augment producer incomes when combined with individual grading.

Since the survey sample includes two types of cooperative, one with grading and another without, it is possible to examine the effect of grading on cash incomes in more detail by disaggregating the effects of cooperative membership and grading, in order to examine the relative impact of each on household welfare. This is done here with a simple ordinary least squares (OLS) model that holds cash income as the dependent variable and grading and cooperative membership as the explanatory variables:

$$log\gamma_i = \alpha G_i + \beta C_i + \mu_i \quad (1)$$

where γ_i is the household cash income, G_i is a dummy variable indicating whether the producer grades their coffee, C_i is a dummy variable indicating whether the producer is a member of a cooperative. The results (in column one of Table 1.7) show that the increase in income from grading is larger than the increase in income from being a cooperative member. It shows that coffee producers that sell through a grading channel are better off, even when cooperative membership is taken into account.

This, however, is a very tentative result, since model (1) does not take other variables that may influence the dependent variable into account. Attaining more robust results requires that a range of other variables that may affect the dependent variable are taken into account. This is done here using a log linear OLS regression model that is designed to estimate the effects of grading and cooperative membership whilst controlling for other factors that may influence cash income:

$$log\gamma_i = \alpha G_i + \beta C_i + \sum \delta log X_i + \mu_i \quad (2)$$

where X_i is a vector of controls. The control variables include household characteristics (age, dummies for gender and literacy) and production and marketing variables (farm size, use of

drying table and quantity sold). The quantity of coffee sold is included as an explanatory variable, even though, arguably, cash income and quantity sold are almost synonymous when coffee is the producer's main source of income. The reason is that within the coffee-selling season, the causality between the two variables is likely to run in only one direction: from sales to cash income. The cash income of a coffee producer could affect productivity and the quantity sold, but only in the subsequent season, if some of that income is invested in production-enhancing inputs or activities. Therefore, endogeneity is not automatically considered to be an issue with this variable. Moreover, the significant relationship that is found between cash income and many of the other explanatory variables, even when sales are accounted for, indicates that cash sales are not synonymous with cash income. In fact, excluding quantity sold from the list of control variables may result in omitted variable bias, whereby the coefficients of the other explanatory variables may be distorted by the omission.

Ethnicity is not included as a variable, since the area covered is generally ethnically homogenous. However, a village dummy is used to control for village specific variables. These include factors such as prices, village leadership and institutions, infrastructure and capital endowments. Controlling for village effects is particularly important, because of the way the survey sample was designed. The villages in the sample correspond with marketing channels. Grading, for instance, took place only in Kinyamvuo village. Therefore, controlling for specific village-related factors is necessary for accurately measuring the effects of grading and cooperative membership.

The results of model (2) confirm the previous findings (second column of Table 1.7). They show a significantly higher income for households whose coffee is graded. On the other hand, whilst cooperative membership shows the expected sign (being a member increases cash income), this finding is not significant, even at the 10 percent significance level, after controlling for other factors. In the survey sample, individual grading was conducted by a cooperative society. What this result shows is that the cooperative channel is incidental. Incomes would have been higher for producers that sell through the private buyer or mixed buyer channel as long as their coffee was individually graded and the prices received by producers differentiated by the buyer according to grades.

Other factors that are positively and significantly related to cash income are quantity sold, farm size and use of drying table. Old age and being female are related to lower incomes. In addition,

the village dummies are significant and show that cash incomes in the two villages where coffee is not graded are lower overall than the village where grading takes place.

Grading is likely to have translated into higher cash incomes for coffee by providing an incentive for producers to invest in production practices that enhance quality. The results show that the incomes of coffee producers that use a drying table are higher than those that do not. The use of a drying table is the main quality-enhancing production practice measured in the survey: 68 percent of producers in the sample use a drying table. Most of them are based in Kinyamvuo.[21]

[21] Kinyamvuo is the grading village, but rates of drying table use are reasonable in the other two villages also.

Table 1.7: OLS regression results

Model	**1**		**2**		**3**	
	OLS: without controls		**OLS: with controls**		**OLS: interaction variable**	
Variable	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**
Dummy if member of a cooperative	0.883***	0.11	0.089	0.108	0.105	0.108
Dummy if grades coffee	1.053***	0.089	0.250**	0.113	0.330***	0.118
Age (log)			-0.247**	0.111	-0.205	0.126
Dummy if coffee farmer is female			-0.017	0.079	-0.004	0.078
Quantity of coffee sold (log)			0.222***	0.048	0.219***	0.048
Farm size (log)			0.301***	0.068	0.288***	0.068
Dummy if uses drying table			0.176**	0.081	0.362***	0.122
Dummy for village Masia Mshiri (no village grading)			-0.529***	0.119	-0.516***	0.119
Dummy for village Lole Marera (no village grading)			-1.367***	0.136	-1.378***	0.135
Dummy if illiterate			-0.503***	0.185	-0.539***	0.185
Interaction variable: grading * use of drying table					0.317**	0.157
Constant	13.267***	0.061	13.346***	0.543	13.233***	0.544
No. of observations	356		343		343	
R – squared	0.4575		0.6816		0.6854	

Source: author's own calculations from primary data collected.

An issue that needs to be addressed when considering these results is the potential for endogeneity. More specifically, there is a possibility that the cooperative membership variable is endogenous. Whilst cooperative membership may be a factor that influences the cash income of a coffee producer, it is possible that the producers' income is related to their ability to afford cooperative membership. Cooperative members are expected to pay a subscription fee and are also expected to attend village cooperative meetings and to sell exclusively to the local cooperative society through a contingent contract that involves a deferred payment. This is a combination of actual and opportunity costs that may cause a relationship between wealth and cooperative membership.

In order to test for the presence of endogeneity, the Hausman specification test is used (Hausman, 1978). This test compares the coefficients of the potentially endogenous variable using the OLS and instrumental variable (IV) estimators. If one appreciably differs from the other, it is likely that the variable in question is endogenous.

Where valid instruments exist, the instrumental variable approach is one of the main ways of estimating models with endogenous regressions as they provide consistent estimators. Weak instruments are a particular concern since one of the side effects of IV estimators is the loss of efficiency resulting from the use of fitted values. In order to minimize this loss of efficiency, the instrumental variable needs to be not only exogenous, but also relevant. The relevance condition requires that a strong fit exists between the instrument and the endogenous regressor. When the fit is good, the instrument is said to be strong, and when it is less robust, the instrument is said to be weak.

An instrumental variable is identified from the coffee producers survey, that is related to cooperative membership (the explanatory variable) but that is not directly related to cash income (the dependent variable) that is being tested for validity. The variable measures whether the coffee producer is politically active through his cooperative (for example, by attempting to influence changes in local bylaws, regulations or policies) [22].

[22] It is likely that the village location of the interviewed growers would have been a potential instrumental variable since the absence of cooperative society in a village, or even its location within the village, will influence cooperative membership greatly. The problem with this option, however, is that the village variable is one of the key exogenous control variables in model (2). Excluding it from the list of exogenous variables would make it difficult to control for village-specific effects on cash income, including institutional, leadership, price, infrastructural and geographic effects.

To test the robustness of this instrument, a standard two-stage least squares estimator (2SLS)[23] IV estimation method is used in addition to two other methods that deliver more robust results when instruments are likely to be weak. These are Fuller's modified limited information maximum likelihood (FULL) and Moreira's conditional likelihood ratio (Moreira's CLR), (Bascle, 2008).

The results of these IV estimations are presented in Table 1.8. The results show that the coefficients of the standard 2SLS instrumental variable estimation and those generated through Moriera's CLR are identical. The latter, however, have slightly larger standard errors. Since Moriera's CLR estimates are not robust in the presence of heteroskedasticity, the heteroskedasticity test results are presented in Table 1.8. These results show the absence of heteroskedasticity, suggesting that the results of Moriera's CLR are fairly robust.[24] This indicates that the instrument is sufficiently relevant. Hence, the estimates generated through Moiera's CLR approach in the Hausman test for endogeneity can be used.

The Hausman test results are presented in Table 1.9. They show that the null hypothesis – that there is no systematic difference in the OLS and IV coefficient estimates – cannot be rejected here. In other words, there are no significant differences between the estimated coefficients of the two models indicating that the cooperative membership variable is most likely to be exogenous. In this situation, the Hausman specification test suggests that the OLS estimates generated with model (2) are valid, and that the findings that were previously described under that model are applicable.

Additionally, it is noted that the variable being tested for endogeneity – cooperative membership – is not statistically significant in the results of OLS model (2). In this case, the instrumented variable results presented in column one are likely to be non-significant, which might cause the Hausman test to show little difference between the OLS and IV estimates. For this reason, the Hausman procedure (including the IV estimates) using model (1) as the OLS estimator is repeated. However, the results of the second Hausman test (in Table 1.9) also show that there is no systematic difference in the OLS and IV coefficient estimates.

[23] The 2SLS estimator is the most efficient estimator when the errors are homoskedastic and independent.
[24] The ivhettest command was used in STATA 10.

Table 1.8: Instrumental variable regression results

Model	**IV: 2 SLS**				**IV: FULL**		**IV: Moriera's CLR**	
	First stage		**Second stage**					
Variable	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**	**Coef.**	**Std. err.**
Dummy if member of a cooperative	0.705	1.047	0.705	1.064	0.387	0.707	0.705	1.064
Dummy if grades coffee	0.300***	0.145	0.299**	0.147	0.273***	0.126	0.300***	0.147
Age (log)	-0.215	0.142	-0.215	0.144	-0.233*	0.131	-0.215	0.144
Dummy if coffee farmer is female	-0.008	0.083	-0.008	0.085	-0.013	0.080	-0.008	0.085
Quantity of coffee sold (log)	0.195***	0.068	0.195***	0.069	0.209***	0.057	0.195***	0.068
Farm size (log)	0.291***	0.073	0.291***	0.074	0.297***	0.069	0.291***	0.074
Dummy if uses drying table	0.128	0.116	0.128	0.118	0.153	0.097	0.128	0.118
Dummy for village Masia Mshiri (no village grading)	-0.467***	0.198	-0.467**	0.201	-0.472***	0.191	-0.467***	0.201
Dummy for village Lole Marera (no village grading)	-0.454***	0.175	-0.454***	0.178	-0.492***	0.145	-0.454***	0.178
Dummy if illiterate	-1.038**	0.572	-1.038*	0.581	-1.207***	0.396	-1.038**	0.581
Constant	13.335***	0.561	13.335***	0.570	13.342***	0.541	13.335***	0.570
No. of observations		342		342		342		342
R - squared		0.6509		0.6509		0.6746		0.6509
First-stage F-statistics		15.26				3.84		64.63
First-stage P-value		0				0.051		0
Moreira's CLR (confidence regions)							(-inf, 2.81)	(444.64, +inf)
p-value in parentheses								0.4882
Pagan – Hall test for heteroskedasticity								
Chi-sq (10) test statistic						15.282		
P – value						0.1221		

Source: author's own calculations from primary data collected.

Table 1.9: Hausman specification tests for endogeneity

	1				2			
	OLS Model (2) - Coefficients				**OLS Model (1) - Coefficients**			
	IV	**OLS**	**Difference**	**S.E.**	**IV**	**OLS**	**Difference**	**S.E.**
Dummy if member of a cooperative	0.7054	0.0893	0.6161	1.0088	2.5283	0.8835	1.6447	0.9026
Dummy if grades coffee	0.2148	0.2483	0.0335	0.0562	0.6165	1.0531	0.4366	0.2408
Age (log)	-0.0080	-0.0171	0.0091	0.0167				
Dummy if coffee farmer is female	-0.2996	-0.2468	-0.0528	0.0855				
Quantity of coffee sold (log)	0.1952	0.2224	-0.0271	0.0446				
Farm size (log)	0.2908	0.3007	-0.0099	0.0205				
Dummy if uses drying table	0.1284	0.1759	0.0475	0.0782				
Dummy if illiterate	-0.4675	-0.5032	0.0357	0.0518				
Dummy for village Masia Mshiri (no village grading)	-0.4543	-0.5286	0.0744	0.1209				
Dummy for village Lole Marera (no village grading)	-1.0377	-1.3673	0.3296	0.5377				
Chi-sq test statistic	0.67				3.53			
P – value	0.7140				0.1708			

Source: author's own calculations from primary data collected.

Having established that endogeneity is not a cause for concern, other factors that are not accounted for in the analysis that may be causing the observed outcomes are considered. The main potential factor identified is the gender of the coffee survey enumerators. The enumerator team was composed of one female and two males. The female enumerator was positioned in Kinyamvuo village, the grading village where the highest levels of income were recorded. Since the majority of respondents were male, they might have been motivated by the gender of the female interviewer to inflate their cash income. In fact, all three enumerators indicated that many respondents showed some discomfort in answering questions about their household's economic status.[25] To test for the possibility of this bias, the possibility that the response of the male respondents in Kinyamvuo village differed considerably from the responses of the female respondents is examined. Male respondents reported an average income of Tsh 861,345, whilst the female respondents reported an average income of Tsh 836,081. Since the difference between the cash incomes reported by male and female respondents is minimal, the analysis concludes that the gender of the enumerator did not bias the responses of coffee producers in the grading village.

Next, the dynamics between grading, production practices and contract type are examined. Table 1.5 showed previously that coffee producers in the sample who sell through the cooperative marketing channel tend to have higher levels of input use (mostly fertilizer and pesticide) and productivity, leading to higher cash incomes. Of this group, producers who sell through the grading cooperative channel invest the most in quality-enhancing practices, such as the use of drying tables. And even though they have the same level of input use as the non-grading cooperative sellers, they have a significantly higher level of productivity. In order to explore the link between better production practices (use of drying table) and the attainment of higher grades of coffee, Table 1.10 isolates the coffee producers who sell to the grading cooperative. Of those attaining the higher grade (P1), 82 percent used drying tables, indicating that it is an important practice for achieving quality (Table 1.11). It is likely that their investments in increased productivity and higher quality outputs are the driving factors behind their higher grades of coffee and levels of cash income. Being able to realize the gains from higher quality output through grading may be the key incentive that stimulated the coffee producers of the Kinyamvuo village to achieve these significant results.

[25] To alleviate this problem, the relevant section of the survey (which initially was at the start of the questionnaire) was transferred to the end of the questionnaire after piloting, in order to allow the enumerator to establish trust and comfort with the respondents before asking them to disclose information about their wealth and income.

Table 1.10: Production practices by buying channel

	Private buyer	Mixed buyers	Cooperative no grading	Cooperative grading
Farm size	0.88	1.12	1.27	1.53
Quantity harvested (kg)	50	74	71	127
Productivity (kg per acre)	63	67	62	97
No. of inputs used (percent)				
One-input	96	70	38	37
Two-or-more-inputs	4	30	62	63
Use of drying table (percent)				
Yes	43	63	66	80
No	57	37	34	20

Source: author's own calculations from primary data collected.

Table 1.11: Effect of use of drying tables on grade achieved

	Use of drying table	
	Yes	No
Grade - P1	82%	18%
Grade - P2/3	50%	50%

Source: author's own calculations from primary data collected.

This effect is further explored by including an interaction variable to model (2), to get an indication of whether the difference in income between those who do and those who do not grade varies with use of drying table:

$$log\gamma_i = \alpha G_i + \beta C_i + \sum \delta log X_i + \sigma I_i + \mu_i \quad (4)$$

Where I_i is an interaction variable between grading and use of drying table. In this way, it can be determined whether good production practices (proxied by use of drying table) are identified and rewarded through the grading process. The results presented in the third column in Table 1.7 show that the interaction variable is positive and highly significant, indicating that the grading mechanism is effective in making a link between higher quality coffee and cash income.[26]

[26] The coefficients and significance levels of the other variables have remained mostly similar to previous results.

1.4 If grading is good, why doesn't it happen?

Surprisingly, coffee grading at the village, when the primary transaction takes place between buyers and sellers, is mandated by the Coffee Regulations. The Tanzania Coffee Board has instituted detailed village grading criteria in the coffee regulations. But they confirmed in the interviews with them that grading is not generally applied on the ground (Table 1.12), and that their capacity to enforce the mechanism is prohibitively low.

Table 1.12: Coffee grading by village

	Village		
	Kinyamvuo (grading village)	Lole-Marera	Masia-Mshiri
Coffee graded			
Yes	91%	11%	12%
No	9%	89%	88%

Source: author's own calculations from primary data collected.

It is likely that the real deterrent to village grading is not the visual inspection itself, which is a fairly simple low transaction cost exercise, but the application of price differentiation and the payment of quality premiums because buyers make purchasing decisions based on their expected payoff. In the short term, any high quality coffee procured at the price of low or medium quality goods represents a bonus for the buyer – an information rent. Hence, in a context where grading is not enforced, buyers enter the market without an incentive for grading. In the long term, the lack of incentives to coffee producers creates the conditions for the under provision of quality in the market.

1.5 Concluding remarks

Despite some early gains in the post-liberalization period, the performance of Tanzania's coffee sector has failed to meet expectations. Both quality and production show a declining trend. But most concerning from a poverty perspective is that the producer price share for Tanzanian coffee producers is lower than in most other coffee-producing countries, inevitably affecting their overall income.

The analysis of grading in this paper showed that when the proper marketing arrangements and incentives are in place, markets can work better for both coffee producers and coffee buyers. Individual grading contracts can increase the incomes of otherwise poor producers who rely on

their annual coffee crop to sustain the household, and can create a virtuous cycle that leads to a market that reinforces investments in better production and processing practices. Yet this is not the case for Tanzania's coffee market, where such grading contracts are largely absent. No producer-specific premiums or incentives are delivered through the prevalent spot and group contingent contracts. Moreover, although the *de jure* regulations require buyers to apply the village grading arrangement, the *de facto* reality is that they stand to maximize their payoffs and to extract rents by avoiding them.

From the perspective of the coffee buyer, the coffee market accommodates demand for both high and low quality coffee. High quality coffees are sold as premium products, whilst lower quality Arabica coffee may be used as filler in coffee blends for less refined segments of the international market. This may in turn cause coffee buyers to develop a segmented buying strategy. They would need to procure low quality coffee at the lowest cost possible through marketing channels such as the one described in this case study. In this segment of their market, the coffee buyer might not have an interest in fostering the supply of high quality coffee, as long as they can source it from other channels. These other channels include large private coffee estates or other coffee-producing regions and countries.

The winners and losers from these contractual arrangements, and the associated market failure, are evident. While coffee producers lose out on income and incentives, coffee buyers earn premium rents in the short term. The third party in this scenario is the regulatory bodies, which have failed to mitigate negative outcomes for producers.

Annex 1 *Coefficients of correlation table*

Variable description	Mean	Std. Err.	Min-Max		Female	Literate	Uses a drying table	Weighted asset index	Farm size (acres)	Quantity sold (kg)	Cash income (Tsh)	Age	Has held an official position	Coop member	Grades coffee	Village (Kinya - mvuo)	Influences through association
Female	27%	0.022	0	1	1												
Literate	97%	0.009	0	1	0.0268	1											
Uses a drying table	68%	0.023	0	1	0.1268	-0.0509	1										
Weighted asset index	4.16	0.12	0	14	-0.0580	-0.0619	-0.1725	1									
Farm size (acres)	1.28	0.05	0.25	6	-0.0962	0.0544	-0.2073	0.1011	1								
Quantity sold (kg)	96	5.40	2	700	-0.0703	-0.0069	-0.3681	0.2930	0.5017	1							
Cash income (Tsh)	505,085	34,545	0	4,800,000	-0.1575	0.0200	-0.3610	0.2131	0.4734	0.5333	1						
Age	48	0.75	19	85	-0.2228	0.2375*	-0.1020	-0.0902	0.2645	0.1247	0.2495	1					
Has held an official position	20%	0.020	0	1	-0.0568	0.0638	-0.0971	-0.0978	0.1258	0.0476	0.2078	0.1578	1				
Cooperative member	80%	0.020	0	1	0.1379	-0.0692	0.2834	-0.0560	-0.2381	-0.3108	-0.4956	-0.1779	-0.1659	1			
Grades coffee	43%	0.025	0	1	0.0629	-0.1238*	0.1905	-0.1650	-0.2374	-0.3568	-0.5988	-0.2466	-0.2552	0.2827	1		
Village (Kinya - mvuo)	39%	0.024	0	2	0.1417	-0.1547*	0.2917	-0.0094	-0.2892	-0.3383	-0.7443	-0.3179	-0.3453	0.5490	0.6866	1	
Influences through association	85%	0.017	0	1	0.1012	0.0434	0.0848	-0.0531	-0.0681	-0.1002	-0.1396	-0.0485	-0.0384	0.0946	0.1495	0.1569	1

Source: author's own calculations from primary data collected.

References

1. Alexander, C., R.E. Goodhue and G. C. Rausser (2007) 'Do incentives for quality matter?', *Journal of Agricultural and Applied Economics*, 39, 1–15.
2. Baffes, J. (2004) 'Tanzania's coffee sector: constraints and challenges in a global environment'. *World Bank Brief* 31050. Washington, DC.
3. Bascle, G. (2008) 'Controlling for endogeneity with instrumental variables in strategic management research'. *Strategic Organization* 6 (3), 285-327.
4. Bolwig, S. (2012) 'Poverty and Gender Effects of Smallholder Organic Contract Farming in Uganda', *IFPRI Uganda Strategy Support Program Working Paper* No. 8, International Food Policy Research Institute.
5. Bull, C., A. Schotter and K. Weigelt (1987) 'Tournaments and piece rates: An experimental study', Journal *of Political Economy,* 95, 1–33.
6. Fafchamps, M.and Minten, B. (2001) 'Property Rights in a Flea Market Economy', *Economic Development and Cultural Change*, Vol. 49, No. 2, pp. 229-267.
7. Fafchamps, M., R. Vargas-Hill and B. Minten (2006) 'Quality control in non-staple food markets: Evidence from India'. *ESRC Global Poverty Research Group Working Series* 057, Oxford.
8. Goodhue, R.E., S. Mohapatra and G.C. Rausser (2010) 'Interactions between incentive instruments: Contracts and quality in processing tomatoes', *American Journal of Agricultural Economics,* 92, 1283–1293.
9. Goodhue, R. E. (2011) 'Food Quality: The Design of Incentive Contracts', *Annual Review of Resource Economics,* Vol. 3, Issue 1, pp. 119-140.
10. Grosh, B. (1994) 'Contract Farming in Africa: an Application of the New Institutional Economics.' *Journal of African Economies* 3 (2): 231-261.
11. Hausman, J. (1978) 'Specification tests in econometrics.' *Econometrica* 46(6), 1251-72.
12. Heckman, J. J. (1979) 'Sample selection bias as a specification error'. *Econometrica* 47(1), 153-61.
13. Key, N. and D. Runsten(1999) 'Contract farming, smallholders, and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production', *World Development*, 27, 381–401.
14. Krivonos, E. (2004) 'The impact of coffee market reforms on producer prices and price transmission'. *Policy Research Working Paper Series* 3358, The World Bank, Washington DC.
15. Little, P., and M. Watts, eds. (1994) 'Living Under Contract: Contract Farming and Agrarian Transformation in Sub-Saharan Africa' Madison, Wis.: University of Wisconsin Press.
16. Milgrom, P and J. Roberts (1992) '*Economics, Organizations and Management'*, Prentice Hall, Englewood Cliffs.

17. Minot, N., and D. Roy (2006) 'Impact of High-Value Agriculture and Modern Marketing Channels on Poverty: An Analytical Framework' Mimeo. Markets, Trade, and Institutions Division, International Food Policy Research Institute, Washington, D.C.
18. Miyata, S., N. Minot and D. Hu (2007) 'Impact of contract farming on income: Linking small farmers, packers, and supermarket in China', *IFPRI discussion papers* 742, International Food Policy Research Institute (IFPRI).
19. Ponte, S. (2004) 'The politics of ownership: Tanzanian coffee policy in the age of liberal reformism'. *African Affairs* 103(413), 615-633.
20. Rosen, S. (1992) 'Contracts and the Market for Executives' in Werin, L. and H. Wijkander (eds.), *Contract Economics*. Basil Blackwell, Cambridge, Mass.
21. Saenger, C., M. Qaim, M. Torero and A. Viceisza (2012) 'Contract farming and smallholder incentives to produce high quality: experimental evidence from the Vietnamese dairy sector', Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012.
22. Warning, M., and N. 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.
23. Williamson, O. (1975) *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York.
24. Williamson, O. (1985) *The Economic Institutions of Capitalism*, N.Y., Free Press.
25. Winter-Nelson, A. and A. Temu (2002) 'Institutional adjustment and transaction costs: product and inputs markets in the Tanzanian coffee system'. *World Development* 30(4), 561–574.
26. Wu, S. and B. Roe (2005) 'Behavioral and welfare effects of tournaments and fixed performance contracts: Some experimental evidence', *American Journal of Agricultural Economics* 87, 130–146.