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Have coffee reforms and coffee supply chains affected farmers' income? The case of  
coffee growers in Rwanda

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**Abstract**

Low prices in the international coffee markets have worsened the economic well-being among coffee farmers. In the face of this situation, the Government of Rwanda has introduced coffee sector reforms that aimed to transform the sector in a way that targets the high quality market and moves away from the bulk coffee market. The high quality coffee market has shown consistent growth over time and exhibits price premiums in international market. If these high prices are passed on to farmers who take advantage of the benefits of the new high quality market by selling coffee cherries, access to this new market could help alleviate poverty brought on by low prices in the conventional sector. However, the majority of coffee farmers in Rwanda rely on the conventional market by selling parchment coffee. The present study analyzes the effects of coffee sector reforms in terms of household expenditures, a proxy of income, on farmers selling coffee to two supply chains: parchment coffee channel and coffee cherry channel. Results from the random effects model on the two year panel data indicate that farmers benefited from coffee reforms by increasing their consumption over time. Farmers selling coffee cherries have gained from the coffee sector reforms in comparison to farmers selling parchment coffee. Based on these results, it seems that efforts to promote the production of high quality coffee would improve food security and the overall consumption expenditures of coffee growers.

Key words: Rwanda, market reforms, coffee supply chains, farmers' income

## **1. Introduction**

Studies of the impact of market reforms on smallholder farmers show that households, as producers and consumers, respond by taking advantage of opportunities created by them. They also react to reforms by protecting themselves from their adverse effects. Winters et al. (2004) noted, however, that while market reforms can facilitate poverty reduction, their findings were not conclusive on the exact impact of the reforms either in theory or empirically. The inability to generalize the impact of market reforms on farmers has been explained by the fact that outcomes depend on circumstances that underline the economic conditions of the target population and measures taken to implement the reforms.

In Rwanda, the coffee sector has gone through domestic deregulation since the mid 1990s. The liberalization of coffee policies allowed for instance farmers to choose to grow coffee or not, and liberalized coffee production practices. One specific feature of the Rwandan coffee industry relies on the fact that coffee marketing is not fully liberalized. The Government has been setting minimum prices at the beginning of the coffee season (Boudreaux, 2007). During discussions via focus groups, many coffee farmers state that these minimum prices do not reflect the production costs of coffee farming.

Previous studies (e.g. Bussolo et al., 2007, Deininger et al., 2003) have extensively focused on the supply response caused by high prices as a consequence of market liberalization. The studies have documented the positive response that followed an increase in output prices as a result of market reforms. Although the contextual environment of setting prices does not provide the right signal for a positive supply

response, the reforms might have not provided the right signal for coffee production, but they contributed to farmers' decisions to allocate the already scarce resources in different ways than they were before the reform.

Furthermore, the coffee reforms in Rwanda were implemented during a period of international coffee surplus, which resulted in low prices offered to farmers. A coffee survey conducted in 2002 showed a drop in number of farmers growing coffee. Fifty percent of rural farmers in Rwanda were coffee growers in 1991, compared to 30% in 2002 (Loveridge et al., 2003). The same study found that many farmers were interested in intercropping coffee. Did the crop shifts make farmers better off or worse off? This study aims to fill this empirical gap by analyzing how coffee policy reforms have affected smallholder income through the change over time in household expenditures of selected items with high budget shares. This study assesses whether coffee households have benefited from these reforms.

The coffee market in Rwanda is segmented into parchment coffee destined for the bulk market and cherries that may be used for higher grade coffees. Prices of parchment coffee from the conventional market are not always lower than prices offered by the new coffee cherry market. In a survey conducted as part of this study, farmers were asked whether coffee cherry prices were fair with respect to the counterfactual prices from the parchment coffee market. Many farmers said they were not satisfied with current coffee cherry prices, particularly during the 2007 coffee season when parchment coffee prices were relatively high compared to the years before.

One question for research is whether the effects of coffee reforms on farmers were the same across the two domestic markets. This study also responds to this empirical question.

The Rwandan coffee industry has gone through many transformations. Farmers used to process their coffee and dry it before selling it to traders on a spot market. Many farmers currently have an alternative coffee market where farmers sell coffee cherries to processing plants owned by coffee cooperatives or private investors.

As coffee farmers sell coffee through different channels, the analysis of the effects of coffee sector reforms in terms of household expenditures, a proxy of income, will shed some light about how the reforms affected the economic conditions of coffee farmers. This is particularly important as the current coffee debate concentrates on the emergence of Rwandan specialty coffee and pays less attention to the large population of producers who still sell to the commodity market.

This study forms a new empirical contribution of the analysis of market reforms. The specific features of the Rwandan coffee sector will broaden the existing knowledge of how coffee sector reforms affected farmers. The anticipated results of the study are also important to agricultural policy in other export crop countries. In Rwanda, results may assist the Government in the liberalization of other export crops such as tea. Tea production is the second largest value agricultural commodity of the Rwandan economy.

The outline of this paper is structured as follows. The second section gives the overview of domestic coffee markets in Rwanda. The third section presents the conceptual framework of the study. The fourth section contains the survey design, the description of data and estimation methods. The fifth section discusses the results of the

study. Finally, the sixth part presents the main conclusions of the paper and policy recommendations.

## **2. Overview of domestic coffee markets**

Government policies in the coffee industry have aimed to transform the sector in a way that targets the high quality market and moves away from the bulk coffee market. Rwanda is a small coffee producer. The scale of coffee production and its distance from ports do not provide a competitive advantage in the international commodity market. The high quality market, especially the specialty market, is a growing industry and offers high prices to coffee producers. The quality coffee market is, however, thin and all coffee cannot be sold via this channel.

Reforms in coffee marketing and coffee quality improvement have allowed coffee operators (private investors and coffee cooperatives) to invest in quality enhancing practices such as building processing factories, also known as *washing stations*, to target the growing specialty market. The investment in these facilities did not, however, cover the whole country. A large percentage of growers still process coffee using the pre-reform techniques and sell it to the regular commodity market. The coffee sold in this market is called *parchment coffee*. Parchment coffee is coffee that has gone through preliminary processing stages. In general, farmers selling parchment coffee are located in places where some conditions for building processing plants, such as enough water to process coffee do not exist. Moreover, they may also be located in non-coffee intensive zones where investment in coffee processing is not profitable.

Owners of processing facilities buy raw coffee, which is called *coffee cherries*. Farmers who are selling in the coffee cherry market face a different market structure from

farmers selling parchment coffee. After the liberalization of coffee purchasing, new buyers of coffee cherries (coffee cooperatives and private entrepreneurs) have emerged, leading to a high competition in the raw coffee market in many parts of the country. This resulted in high coffee prices, generally higher than Government mandated prices. Besides a relatively high price compared to the parchment coffee price, coffee cooperatives and private investors offer extension services and sometimes credit to coffee farmers. Farmers who sell parchment coffee do not receive these benefits. These benefits are predicted to have a strong effect in consumption smoothing and reducing poverty (Badiane et al., 99).

A Government coffee agency, named OCIR café, translated into English as the Rwandan Coffee Board but known by its French acronym as “ Office des Cultures Industrielles du Rwanda”, regulates coffee quality standards and marketing. At the beginning of the coffee season, the Government fixes the minimum price for both coffee cherries and parchment coffee that will be paid to farmers. These prices are expressed in Rwandese Francs per kilogram (FRWA/Kg). One kilogram of parchment coffee is obtained from approximately five kilograms of coffee cherries. Farmers who are not selling parchment coffee deliver coffee cherries to a coffee washing station or to a coffee collection center owned by a private processor or a coffee cooperative.

On delivery, farmers get paid immediately or can wait until they have sold enough cherries. Some farmers prefer not to be paid right away for fear that they will not spend the money properly or sometimes for fear that the money will get stolen as there are no rural financial institutions where they can deposit coffee earnings. Processors also deduct outstanding loans the farmers owe them. At the end of coffee season, profitable coffee

cooperatives pay back dividends to members if the cooperative has made profits. Many coffee cooperatives are still paying loans received to build the processing factories and are not able to pay dividends to their members. With respect to owners of private processing facilities, some give bonuses to farmers who have supplied large quantities of coffee cherries during the coffee harvesting season.

Coffee production has been low over the last decade as a result of low coffee prices received by farmers. Growers did not have economic incentives to maintain coffee trees and increase production. Owners of coffee processing factories are therefore struggling to get enough throughputs for their processing needs resulting in high competition in the coffee cherry market and high operating costs.

To acquire more cherries, buyers have adopted incentive mechanisms that attract farmers to sell to their factories. Before and during the harvest season, cooperatives and private processors offer market incentives to their members and farmers who are supplying coffee cherries to their processing factories. These incentives include consumption credit in cash or in kind, school loans, input loans such as fertilizers, extension services, etc. Moreover, coffee cooperatives use an open membership policy that accept new applications of new members and farmers can still sell coffee cherries through the cooperative without being a member. These incentives contribute in improving coffee production and respond to the cash constraints of farmers. The high competition of coffee cherries in some areas has also resulted in high prices offered to farmers. These prices are sometimes higher than the minimum Government mandated prices.

### 3. Conceptual framework

This study examines the effects of coffee policy changes on farmers selling coffee to two domestic markets: the coffee cherry market and the parchment coffee market. The outcome variables of interest are adjusted total annual expenditures per adult equivalent and annual food expenditures per adult equivalent, during the 2001 and 2007 coffee seasons.

This study makes use of a general program evaluation model (Ravallion, 2005). Let  $Y_c$  represent the per adult equivalent of household expenditures of a farmer selling coffee cherries to a cooperative or a private entrepreneur that processes coffee through the washing station.  $Y_p$  represents per adult equivalent of household expenditures of a farmer who processes coffee himself and sells parchment coffee. The outcome variable of farmers selling coffee cherries can be specified as:

$Y_{ci} = X_i\beta_c + U_i$  (1) where  $X_i$  is a vector of determinants of household expenditures. These are observable characteristics affecting the outcome variables, the subscript  $i$  denotes the farmer in question,  $\beta$  is a vector of parameters,  $U_i$  is the error term.

Similarly, the outcome variable of farmers selling parchment coffee can be specified as:

$$Y_{pi} = X_i \beta_p + U_{pi} \quad (2)$$

The expected gain from selling coffee cherries instead of parchment coffee is denoted by

$$E(\Delta) = E(Y_{ci} - Y_{pi}). \quad (3)$$

Farmers are expecting to sell coffee cherries instead of parchment coffee if the expected gain from selling the raw coffee, net of costs of dealing with the coffee cherry market, exceeds zero. The net gain, except coffee production cost, can be defined as

$$I_i = (E(\Delta) - \text{cost of selling to coffee processors}).$$

$= Z_i \alpha + \varepsilon_i$  (4) where  $Z$  is a vector representing factors of selling to the coffee cherry market,  $\alpha$  is a vector of parameters,  $\varepsilon$  is the error term.  $I$  is unobserved and it is assumed farmers will sell to the coffee cherry market if  $I_i > 0$ . What we observe is whether a grower has sold coffee cherries, denoted in this framework as ( $T_i = 1$ ) or has sold parchment coffee, denoted here as ( $T_i = 0$ ).

Assuming coffee reforms have affected household expenditures through equations (1) and (2), the model of effects of coffee reforms can be rewritten as:

$$Y_i = X_i \beta + \gamma T_i + U_i . \quad (5)$$

The effect of the type of the coffee market on the dependent variable is measured through  $\gamma$ . The dummy variable of the choice of the domestic market is treated as exogenous as the decision to sell either coffee cherries or parchment coffee is not based on individual selection (equation (4)). There has been a strong publicity of encouraging farmers to sell coffee cherries unless there is no processing facility nearby. The number of farmers who are not responding to this call is very minimal. Farmers who sell coffee cherries receive cash most of the time right away and do not have to process their coffee like farmers who sell parchment coffee. These conditions make farmers more attracted by the coffee cherry market. The proximity of the farmer to a processing facility will be the sole determinant in the farmer's choice of where to sell his/her coffee. Using the conceptual analysis, the exogeneity assumption of the market choice variable means that  $\text{Cov}(u_i, \varepsilon_i) = 0$ .

## **4. Data and estimation methods**

### **4.1 Survey design**

The survey was conducted via a panel data set of 264 households of coffee growers. Coffee growers were identified from the Livelihood Conditions Survey conducted by the Ministry of Finance and Economic Planning in 2001. From the 2001 random sample, farmers who grew coffee at that time were selected. The study did not revisit all coffee growers that were respondents in the 2001 survey due to limited financial resources. Only clusters with more than 3 coffee growers were identified and included in the 2007 coffee survey.

In 2001, farmers were visited for 16 days whereas in 2007, the same households were visited for 10 days but adjustments were made consistently while constructing variables for use during data analysis. The 2001 random sample forms the baseline sample and characterizes the conditions that prevailed before the major coffee reforms because in 2001, farmers were mostly selling parchment coffee. Farmers started selling coffee cherries in 2002 when private investment in coffee processing facilities started as a response to coffee policy changes. One of the weaknesses of this sample is its size. The 2001 survey included less than 10% of coffee growers and these were scattered all over the country. The desire to evaluate the effects of coffee reforms between 2001, the ex-ante policy period, and 2007, the ex-post policy period, combined with limited resources to revisit all coffee growers sampled in the 2001 survey explain the small sample size.

The coffee household survey included three categories of growers: First are those belonging to coffee cooperatives and whose coffee cherries are supplied to the cooperative for processing and marketing. Second are those who sell their coffee cherries

to a private processor that owns and operates a coffee processing plant. Third are producers who sell parchment coffee to the traditional market. The first two groups are considered treatment groups. Third are producers who sell parchment coffee to the traditional market. This last category is a controlled group.

After cleaning the data set, a final random sample of 252 households was obtained for further analysis. Table 1 gives the distribution of coffee respondents by province and coffee channels.

**Table 1. Distribution of coffee respondents across coffee channels and provinces, 2007 survey**

	Name of the province				<b>Total</b>
	<b>East</b>	<b>North</b>	<b>South</b>	<b>West</b>	
Number of respondents selling parchment coffee per province	2	8	51	43	104
Number of respondents selling coffee cherries per province	24	17	36	71	148
Total number of respondents by province	26	25	87	114	252

Source: Author's calculations

Table 1 show that coffee is mainly produced in the Southern and Western provinces. The table also implies that coffee processing facilities are not widespread all over the country given the large number of farmers who are selling parchment coffee.

## **4.2. Description of data**

The data include outcome variables of interest, which are the adjusted annual food and total household expenditures per adult equivalent, and some explanatory variables, which are determinants of household expenditures of coffee farmers.

### **Dependent variable**

The dependent variables of the analysis are the yearly adult equivalent of food and total household expenditures of survey respondents in 2001 and 2007. The dependent variables are expressed in constant prices. The adult equivalent expenditure is preferred as a proxy of income because it helps correct for the age and gender distribution within the household. To be consistent with previous poverty analysis in Rwanda and to accommodate potential discontinuous or sign changing relationships, another candidate of the dependent variable can be constructed by dividing the yearly adult equivalent of expenditures into consumption quintiles. However, due to limitations associated with a small sample size, data analysis did not make use of consumption quintiles. The following section discusses how the dependent variable was constructed.

The annual food and total household expenditure per adult equivalent were constructed based on household consumption data. The consumption data of the coffee survey is the short version of the 2001 survey. The financial limitations precluded use of the long questionnaire employed by the 2001 household living standards survey. To reduce survey length, the coffee expenditure questionnaire was reduced by making use of data from the 2001 survey to select food and non-food items that have the highest budget shares. Twenty food items and ten non-food items that represent more than 75% of total household expenditures were selected. The food items include the main products

purchased, home grown and auto-consumed commodities. Appendices 1 and 2 give the types of items and their respective budget shares.

Household expenditure is the value of household consumption, including both market purchases and imputations for consumption obtained from non-market sources, in particular the consumption of own- produced food. The consumption calculations exclude purchases of durable goods and exceptional or one time expenses such as wedding expenses. The components of the household expenditure variable are explained in table 2.

The consumption data were collected over a variety of recall periods. The recall periods were two days in the case of food items, consumption of owned produced food and frequently purchased non-food items. During each visit, enumerators collected information on values of purchases or consumption since the last visit. Although coffee farmers were visited five times in 2007 and seven times in 2001, the computations of household expenditure were adjusted accordingly. For less frequently consumed products such as shoes, clothing and medicine, long recall periods (expenditures of last month, last year) were used.

Expenditures were expressed on annual basis by annualizing the data relating to shorter recall periods. The same procedure was used to compute the values of non-purchased items. The use of short recall periods in the surveys for frequent purchases means that there will be seasonal effects depending on when a specific household was surveyed. However, based on the sample design, this should not affect sample means for groups of households and alter the results. Total household consumption expenditure was calculated as the sum of all of its components after the replacement of outliers.

Household food consumption was also computed as an alternative measure of living standards. Poor households tend to spend more on food than on other goods.

Moreover, data information on food prices made possible the computation of the food price indices across provinces and over time. The food price indexes were used to express food expenditures in constant terms. The price information on non-food items was not available. Average provincial consumer price indices were used to adjust household expenditures on non-food consumption for inflation. The average provincial index is, however, not ideal for adjusting prices because there are price variations across the different provinces of Rwanda. Due to the lack of price information on non-food items across different markets, the provincial index was the best option to approximate inflation. The availability and the high quality of food price data provide another reason to use annual food expenditures per adult equivalent as a separate dependent variable.

Furthermore, adjustments for differences across households in the prices they face and on the size and composition of households were made to get a standard measure of total annual household expenditure (and annual household food consumption) per adult equivalent that can be comparable across households. Appendix 3 gives the scaling table that adjusts the needs of members of the household depending on their age and their sex. The same scale was used in previous poverty studies in Rwanda.

The total household expenditure was computed from 20 food products and ten non-food products. These items formed respectively 60% and 50% of average expenditures on food and non-food products according to the findings from the household expenditure survey conducted in 2006. These budget shares were assumed to be the same in 2001, when another household expenditure survey was conducted and, in

2007, which is the year of the coffee study. The analysis has assumed that the trend in budget shares did not vary between the two surveys that constitute the panel coffee data.

The outcome variables chosen for this study are assumed to be a function of the marketing channel used by farmers to sell coffee and a set of other explanatory variables. Among them are household-specific characteristics such as years of formal education completed, age and the type of the main activity of the head of the household. Other data collected are the farm size and the number of working males and females in the household, which provides the labor availability of the household. The next section describes some explanatory variables and their hypothesized effects.

### **Choice of the marketing channel**

The price and other benefits received by a farmer are a function of the choice of the marketing channel. Farmers selling parchment coffee receive the minimum mandated price offered by coffee traders. Farmers selling coffee cherries can choose between selling to a private or a cooperatively owned processor. Generally, farmers are often committed to sell to one processing factory because it is the only one that is nearby. In some locations, two or more washing stations are competing in the same village so farmers have to choose the washing station to which they will sell coffee cherries.

The choice of selling either coffee cherries or parchment coffee is not controlled by farmers. Coffee households that live near coffee processing facilities sell coffee cherries and get paid relatively high prices. They receive other associated benefits mentioned before and save the processing time by selling coffee cherries. Coffee growers who sell parchment coffee live in places where processing facilities do not exist. The choice of the market channel by the farmer is therefore exogenous. It is expected that

farmers selling coffee cherries are experiencing high food and total expenditures per adult equivalent.

**Table 2. Components of the household expenditure variable**

Category	Additional information
Purchases of food	Data on purchases of 20 food items, based on patterns of spending over a period of 8 days for both 2001 and 2007 surveys
Consumption of owned produced food	The valuations of owned produced and consumed commodities were provided by respondents at prices they could be sold. Information was gathered for 19 home-grown crops.
Expenditure on purchased non-food items	Expenditure on infrequently purchased non-food items based on pattern over the last twelve months
	Expenditure on monthly purchased non-food items and services
	Expenditure on frequently purchased non-food items based on pattern in several short recall periods of two days for a total number of 8 days
Expenditure on health and education	Expenditure on education
	Expenditure on health consultations
	Expenditure on pre-natal care
	Expenditure on post natal care
Expenditure on transfers	Money or in-kind items given away or received

## **Education**

The production of high quality coffee requires farmers to adjust to the new requirements of the specialty market. Numerous studies have found that farmers' education plays a big role in the adoption of new agricultural practices (Zbinden and Lee, 2005). In this study, it is expected that the education levels of the heads of the households will increase their ability to respond to opportunities created by coffee reforms. Similarly, experience in coffee production that is captured by the age of the head of the household can help coffee households adjust positively to the coffee sector reforms.

## **Employment**

Access to multiple income generating activities can have positive effects on households' income. In particular, the main occupation of the head of the household has a greater impact on household expenditures as the head of the household is supposed to meet the needs of the household. Agricultural production is the main household activity for the majority of farmers in Rwanda. Farming is more important among the poor where it accounts for more than 90%, and the majority of households do not have other employment alternative. In 2001, only about 4.7% of Rwandan farmers were engaged in secondary activities (NISR, 2002). Using the panel data, the number of household members engaged in secondary occupations has increased over time.

## **Land assets**

Farmers with large farms are expected to be more flexible in land use (Chambers and Foster, 1983). They are also able to cope with risks associated with market reforms and adoption of technology (Nowak, 87). Farmers with large pieces of land can therefore better adjust resources allocated to coffee production with respect to other crop

enterprises. Thus, we expect the size of land of coffee household to have a positive impact on household income.

### **Labor availability**

The coffee reforms introduced by the Government of Rwanda aimed to target the quality coffee market. Coffee production, and in particular coffee harvesting, is labor intensive. Careful harvesting is required to produce a high quality coffee. Farmers must harvest only ripe cherries, otherwise picking green coffee leads to a bitter coffee taste. Moreover, harvesting overripe coffee produces an inferior quality (Clever, 95). Coffee households with enough labor availability are expected to meet the challenges of coffee production and in particular be able to produce coffee cherries of high quality. In this study the number of working men and women per adult equivalent were taken as a variable representing labor availability.

### **Altitude**

A coffee investor takes into account the altitude at which the coffee is grown when they decide where to build a coffee processing plant because the quality of coffee produced is a function of the coffee growing altitude. High altitude leads to good quality coffee (Bacon, 2005).

Coffee growing zones with a high altitude give an incentive for coffee investors to install processing plants in these areas. Farmers who live in these places are therefore expected to benefit from the presence of the processing facilities through high prices leading to greater household expenditures. Investors will also expect a high return from their investment which can be translated into more benefits offered to farmers supplying coffee. Finally, including altitude will somehow account for differences in agriculture

potential that shapes farmers' resource allocation across different crops. Summary statistics for the variables included in regressions analysis are given in table 4.

**Table 4. Summary statistics**

Variable	Description	Mean	SD
totanequ	Annual total household expenditures per adult equivalent (in FRWA)	63869.37	51207.42
foodadeq	Annual food household expenditures per adult equivalent (in FRWA)	49428.09	44195.36
treatdum	Domestic coffee channel: coffee cherries (1) and parchment coffee (0))	.5873016	.4928086
yeardummy	Pre-reform period as 0 and post-reform period as 1	.5	.5004968
labormen	Ratio of total number of working males /total number of adult equivalents	.3173293	.2274542
laborwom	Ratio of total number of working females/total number of adult equivalents	.3950342	.2141279
labratim	Ratio of number of working males/number of working females	.9146164	.7983707
ocuhead	Main occupation of the head of the household	611.7579	71.0979
sexhead1	Sex of the head of the household (1/2)	1.251984	.4345835
landpequ	Total land size (in acres) per adult equivalent	.2159617	.4433655
agehead1	Age of the head of the household	50.1131	14.75004
agesquar	Age squared of the head of household	2728.454	1541.858
headclas	Highest grade level completed by the head of the household	12.68056	3.95038
headdipl	Highest diploma/certificate of the head of the household	81.76389	37.26907

#### 4.3. Estimation methods

To estimate the effects of coffee policy reforms on farmers' income; pooled OLS results on the two years are compared with results from the random effects model. One can use the Hausman test to choose between random effects or fixed effects estimates. However, since the choice of the domestic market, the key explanatory variable of the study, is constant over time, we cannot use the fixed effects model to estimate the effects of the choice of the domestic market, a proxy of the coffee sector reforms, on household expenditures per adult equivalent.

Although pooled cross sections can be useful for policy analysis, particularly in the presence of a small sample size like in the current study, the random effects model is

preferred to pooled OLS because random effect estimates are more efficient (Wooldridge, 2002). The random effects model relies, however, on a strong assumption that the unobserved effect embodied in the error term of the per adult equivalent household expenditure equation is uncorrelated with all explanatory variables (Wooldridge, 2002).

## **5. Results and discussions**

Results of the regression analysis (based on random effects on panel data and OLS on pooled data for the two years) are presented in table 5 and table 6. Using the random effects models, the effects of coffee sector reforms, measured by the annual food and total household expenditures per adult equivalent, in constant prices, are positively significant for farmers selling coffee cherries compared to farmers selling parchment coffee. Coffee marketing through the coffee cherry channel increases the average annual food expenditures per adult equivalent by 15% compared to selling to the traditional parchment coffee. Similarly, selling coffee cherries improves the total annual expenditures per adult equivalent by 17% compared to selling parchment coffee.

When controlling for the effects of the type of the domestic coffee channels, the results show that average annual food expenditures per adult equivalent improved over time for all coffee households but the coefficient is not significant. However, the aggregate effects of coffee reforms measured by total annual expenditures per adult equivalent have significantly increased over time. Coffee growers have improved the overall household expenditure by 13% in 2007 compared to the period before the reforms. This indicates that even farmers who are still selling to the traditional coffee market have benefited from the reforms. The removal of policies which obliged farmers to grow coffee has allowed farmers to efficiently allocate the limited resources and consequently

improved their economic well-being. Furthermore, food consumption and total expenditures are significantly higher among households with larger property of land. Access to an additional acre of land per adult equivalent leads to an increase of 28% and 29% in annual food household expenditures and total household expenditures per adult equivalent respectively.

**Table 5. Random effects and Pooled OLS Estimators of the food expenditure equation**

<b>Dependent variable: log (annual food household expenditure per adult equivalent)</b>				
<b>Independent variable</b>	<b>Pooled OLS</b>		<b>Random Effects</b>	
	<b>Coefficients</b>	<b>Corrected standard errors</b>	<b>Coefficients</b>	<b>Corrected standard errors</b>
treatdum	.1548557*	.0877523	.1547177*	.0924133
yeardumy	.063872	.0818068	.0614606	.0774748
labormen	.6168032***	.2263853	.6042063***	.2312937
laborwom	.2511315	.2362194	.2352135	.2352135
labratim	.0582563	.0767703	.0541856	.077534
ocuhead	.0003943	.0005602	.0003347	.0005666
sexhead1	.0431444	.0969144	.0418732	.1007099
landpequ	.2856251***	.0904658	.2824864***	.0953605
agehead1	-.0310165*	.0162341	-.0306027*	.0166361
agesquar	.0002643*	.0001555	.0002629*	.0001595
headclas	.0085966	.0132421	.0098824	.0134791
headdipl	.0002428	.0011362	.0002562	.0011467

\* Significant at P = 0.10; \*\* Significant at P = 0.05; \*\*\*Significant at P = 0.01

The results also showed that households with a high number of male members experienced high expenditures. The coefficient on the total number of men per adult equivalent is positive and significant at the 5% level. The coefficient on the number of women per adult equivalent is not significant in the food expenditure regression but is slightly significant for the overall expenditure equation. This can be a sign of underemployment particularly for women. For many households in Rwanda, poverty is associated with having too much labor (NISR, 2002).

**Table 6. Random effects and Pooled OLS Estimators of the total expenditure equation**

<b>Dependent variable: log (total annual household expenditure per adult equivalent)</b>				
<b>Independent variable</b>	<b>Pooled OLS</b>		<b>Random Effects</b>	
	<b>Coefficients</b>	<b>Corrected standard errors</b>	<b>Coefficients</b>	<b>Corrected standard errors</b>
treatdum	.1353867*	.0785979	.166871*	.0918988
yeardumy	.1526863*	.0857129	.1253928 *	.0709113
labormen	.6168032***	.2263853	.6544827***	.1939086
laborwom	.4350352**	.2138725	.426781*	.2121634
labratim	.0500687	.07414	.0433307	.075795
ocuhead	.0000711	.0004347	-4.83e-06	.0004406
sexhead1	.0471617	.0979077	.0486115	.1031602
landpequ	.3066008***	.1130617	.2939627***	.1185343
agehead1	-.0281425	.0151967	-.0275574*	.0158334
agesquar	.0002275	.0001517	.0002255	.0001588
headclas	.0201654*	.0104712	.0191707*	.0107443
headdipl	.000086	.0011097	-.0000739	.0011086

\* Significant at P = 0.10; \*\* Significant at P = 0.5; \*\*\*Significant at P = 0.01

The regression findings on employment variables indicate that opportunities for income generating activities are likely high for men in rural Rwanda. Investment in coffee processing that followed coffee reforms in Rwanda have created employment opportunities. Owners of coffee processing plants hire a large number of people during the coffee season. The employment opportunities created by coffee reforms seem, however, to favor males over females.

## **6. Conclusion**

The findings of the study show that farmers benefited from coffee reforms by increasing their consumption. Farmers selling coffee cherries have gained from the coffee sector reforms in comparison to farmers selling parchment coffee. The results of this study suggest that the Government policy of promoting the production of high quality coffee has improved food security and the overall consumption expenditures of coffee growers. The Government has recently removed the export tax to owners of processing facilities. These tax incentives will allow coffee investors to expand coffee processing in areas that are still selling parchment coffee. Credit incentives to enhance investment in building new processing plants could be fostered. Policies that aim to increase the number of farmers selling coffee cherries can therefore improve the economic conditions of coffee growers.

To motivate the production of high quality coffee, decision makers need to take into consideration other spillover effects that come with investing in coffee processing. Owners of processing facilities offer jobs to a large number of people. The results of the study showed that the presence of more active males than females in a household is associated with high expenditures. The underlying causes of this situation are unknown,

but might possibly be due to more focus on lower value staple crops such as sweet potatoes. A study on the type of the job and skills required to undertake the tasks in coffee processing can shed some light on why females tend to have less employment opportunities than men.

Households with access to more land are better off than others. Small-scale farmers who cannot produce enough food that meet their needs and increase coffee production need to get access to other income generating activities to improve their well-being. Policies that aim to create opportunities in non-farm employment can benefit a large proportion of coffee producers in Rwanda.

The minimum price setting needs to be reviewed. Results from focus groups of growers found that some farmers felt that the minimum prices fixed by the Government of Rwanda do not reflect coffee production costs. As coffee investors improve quality coffee and establish strong marketing contracts with international coffee buyers, the Government can still play a regulatory role in terms of quality standards but let farm gate prices be determined by market forces.

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### Appendix 1. Food Consumption Budget Shares

	Item	Share of food purchases	Share of own-consumption	Total share
1	Dried beans	7.89%	7.62%	15.51%
2	Sweet potatoes	3.69%	10.08%	13.77%
3	Potatoes	4.59%	4.41%	8.99%
4	Cooking banana	1.35%	4.93%	6.28%
5	Cassava root	0.90%	2.02%	2.92%
6	Local beer banana	1.44%	0.83%	2.27%
7	Salt	1.90%		1.90%
8	Palm oil	1.76%	0.00%	1.76%
9	Sorghum juice	1.20%	0.55%	1.75%
10	Corn cob	0.24%	1.15%	1.39%
11	Locally grown rice	1.38%		1.38%
12	Tomatoes	1.04%	0.26%	1.30%
13	Banana beer	0.22%	1.07%	1.29%
14	Kernel corn	0.78%	0.48%	1.26%
15	Sorghum grain	1.11%	0.14%	1.26%
16	Local beer sorghum	0.84%	0.22%	1.06%
17	Peanut oil	0.85%	0.00%	0.85%
18	Local banana juice	0.15%	0.58%	0.73%

Source: Calculated by the author from the 2001 household expenditure survey

## Appendix 2. Non-Food Consumption Budget Shares

	Item	Budget share
1	Transfers	8.50%
2	Finished garments	6.97%
3	Education expenses	6.46%
4	Laundry soap	6.00%
5	Cloth	4.67%
6	Energy expenses (Gaz- Kerosine )	3.88%
7	Hair cut expenses	3.43%
8	Shoes	3.32%
9	Transport expenses	2.43%
10	Health expenses	2.43%

Source: Calculated by the author from the 2001 household expenditure survey

### Appendix 3. Scaling parameters for the computation of adult equivalents

Age	Sex	Parameter
>=70	both	0.7
>=60 & <=69	both	0.8
>=50 & <=59	both	0.9
>=40 & <=49	both	0.95
>=20 & <=39	both	1
>=16 & <=19	female	1.05
>=16 & <=19	male	1.02
>=13 & <=15	female	1.13
>=13 & <=15	male	0.97
>=10 & <=12	female	1.08
>=10 & <=12	male	0.97
>=7 & <=9	both	0.91
>=4 & <=6	both	0.76
>=1 & <=3	both	0.56
<1	both	0.41

Source: National Institute of Statistics of Rwanda (NISR), 2002