ABSTRACT

Title of Dissertation: THREE ESSAYS ON COFFEE MARKETS

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Among the most prominent contributions of agricultural economists to the development field is the analysis of issues in commodity marketing. The topics include the role of competition among market intermediaries in determining marketing margins, analysis of price risks and the theory of commodity price stabilization. This dissertation consists of three essays on coffee markets that provide empirical evidence on three marketing issues widely debated by development practitioners: the impact of domestic policy on producer prices, the relationship between producer prices and competition among traders, and the use of informal risk management tools by farmers.

The first essay evaluates the impact of coffee sector reforms on producer prices in a number of coffee producing countries. With the help of cointegration analysis the essay establishes that the reforms produced a closer relationship between the domestic and world prices. Estimation of an error-correction model reveals that

transmission of price signals from the world market to domestic producers has also improved. However, in some countries there is evidence of asymmetry in the way positive and negative world price changes are transmitted to domestic markets.

The second paper investigates the role of competition in the marketing sector for prices received by growers in India. In the case of Robusta, the empirical evidence is that competition among traders plays an important role in determining prices to growers, while there is no such evidence for Arabica. Membership in a cooperative has a significant impact on prices in some cases. The analysis also points towards the value of education since those with university education receive higher prices. The choice of marketing intermediary has different implications for prices depending on the type of coffee traded.

The third essay concludes that in absence of formal risk hedging instruments risk averse farmers do take actions to reduce income uncertainty: growers that are risk averse are more likely to be members of cooperatives, are less likely to carry over stocks are more likely to default on their loans when prices drop.

THREE ESSAYS ON COFFEE MARKETS

By

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Dedication

To my Dani, my most ambitious project so far, to my mom for always being there for me and to Hernán, for just being.

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Chapter 1: Introduction

1.1 Motivation

Coffee is a major commodity traded internationally which generated US$9,116 billion in global export revenue in 2006 (FAO). Most coffee is grown in developing countries and consumed in the industrialized world. Approximately 17-20 million households in more than 50 nations grow coffee and, by some accounts, as much as 100 million people benefit from coffee trade (Lewin et. al. 2004). Most coffee growers are smallholders with low incomes and high level of exposure to risks. The price received for coffee is perhaps the single most important determinant of coffee growers' welfare. In the past, coffee prices to producers have been regulated by the governments of the coffee producing countries through extensive interventions in coffee marketing and export activities. Price stabilization, although costly and often inefficient, was motivated by the desire of the governments to protect coffee growers' incomes from price fluctuations, but in most cases imposed a large wedge between international prices and local prices paid to growers. When commodity market reforms were introduced with the objective to improve the efficiency of domestic marketing, the share of producer prices in the world market price increased, but at the time producers became more exposed to risks associated with the volatility of international prices.

The drastic decline of international coffee prices in 2001 and 2002 below 60 cents per lb. for Arabica and below 30 cents for Robusta, a 30 year low, had disastrous implications for incomes of smallholder coffee growers across the world. Coffee prices plummeted below production costs, chiefly as the result of global oversupply, causing severe financial losses for coffee farms. Since most coffee farmers are smallholders, the price crash had an immediate and widespread effect on poverty levels, causing devastation in coffee growing communities through the impact on consumption, education and healthcare. The World Bank estimates economic losses for small coffee farmers to be at around US$4.5 billion per year during the crisis (Lewin et. al., 2004). Facing uncertainty regarding future prices and lacking safety nets many growers abandoned plantations and sought other opportunities. Employment in the coffee sector plummeted by more than 50% in some countries (Varangis et. al., 2003). Coffee export revenues also declined in producing countries, with negative consequences for fiscal accounts and balance of payment.

With the coffee price crisis acting as a catalyst, the governments and international community had to come up with strategies for restoring the balance and bringing the coffee industry on a sustainable path. The strategies proposed in response to the crisis relied on increasing the value-added of green coffee through improvements to quality and consistency of coffee, product diversification, both in and out of coffee, the use of differentiated markets (specialty and Geographic Indicators of Origin, organic, fair trade, shade grown etc.), use of supply contracts, standards and certification (Varangis et. al. 2003, Lewin et.al. 2004). However, both the industry and policy makers recognize that revival of prices and tapping into niche markets do not secure sustainability of the sector in the long run, and a broader focus on rural development is needed to provide viable alternatives for on-farm and off-farm income generation.

These survival strategies were discussed in the international community during numerous roundtables, and various initiatives to support producers, both at international and national levels, were launched. These initiatives were based on a growing number of policy discussion papers and qualitative studies that rely on aggregate data and anecdotal evidence to explain the dynamics of producer prices and their implications for coffee growers. The empirical evidence on factors affecting producer prices in the coffee growing countries is scarce.

Motivated by the tremendous importance of prices for the welfare of coffee growers, this thesis focuses on determinants of producer prices and the approaches for dealing with price risks. A number of research questions are addressed. First, what is the relationship between producer prices and the prices of coffee traded internationally? Second, how do the characteristics of domestic marketing affect that relationship? Are there any specific constraints that farmers face that prevent them from extracting full benefits from participation in the global markets? In many countries growers report concerns with increasing market power of traders, constrains in access to market information and high exposure to risk. Third, what is the role of policy and regulation in improving market efficiency? Fourth, what are the sources of income uncertainty and what do farmers do or might do to mitigate risks?

1. 2 Dissertation objectives

This dissertation examines the relationship between farm-gate coffee prices and characteristics of domestic markets and coffee farmers themselves. The objective of this research is to contribute to understanding the determinants of producer prices as well as actions that growers take to protect themselves from price fluctuations. Specifically, the dissertation focuses on two issues that affect functioning of coffee markets and contribute to formation of farm-gate prices: domestic policy and competition among traders. In addition, the use of price risk management tools is analyzed. For each of these topics a different set of questions is addressed, using methodology appropriate to each, as briefly outlined below.

1.2.1 Producer prices and structural reforms

Between late 1980's and mid 1990's most coffee exporting countries implemented reform packages that transformed state-controlled marketing into market-based trading systems. Typically, the reforms contained the following key components: (i) Withdrawal of state trading enterprises from direct marketing; (ii) Allowing entry of private agents into coffee purchasing, domestic marketing and export activities and encouraging competition among traders; (iii) Abandoning guaranteed minimum prices and (iv) Lowering or eliminating export taxes.

While market liberalization spurred entry of private traders and emergence of new institutions and organizations, its success in terms of improving market efficiency and creating better conditions for growers has been disputable. Some concerns have been raised regarding the emergence of private monopolistic competition in domestic markets and the market power of multinational coffee traders and roasters. The nature of post-reform competition among market intermediaries plays an important role as it influences markups in the sector and thus directly affects the relationship between producer and export prices.

The principal question posed in Chapter 2 is whether the reforms were successful in obtaining the declared goals of raising producer prices and improving price transmission from international markets to the farm gate. To investigate that question, an error-correction model with a structural break is applied to time series data on prices for thirteen countries. Based on this model, short-run price transmission, the speed of adjustment and the share of producer price in the world price are estimated to assess the impact of the structural reforms. In addition, asymmetry of price transmission is tested in both periods to check whether price increases were passed through to producers as fast as price decreases and whether the nature of the asymmetry has changed after the reforms.

1.2.2 Producer prices and domestic marketing

A coffee marketing channel typically consists of several important stages such as collection of coffee at farm-gate or village level; transport; processing; storage; wholesale transaction; and exporting. While each marketing activity is necessary for production of the final good, which is green coffee for export, and therefore generates significant value-added, an issue that potentially could have important implications for the size of the marketing margin is the level of competition among market intermediaries. Each of the marketing stages may be characterized by oligopsonistic competition among marketing agents, especially if entry to the activity is restricted. An issue commonly raised by coffee growers is that the market power of traders, combined with constrained flow of market information in the sector, leave growers at a disadvantage vis-à-vis traders and affects the prices they receive.

Chapter 3 investigates the roles of competition among market intermediaries in determining the spread between export prices of coffee and prices received by growers, utilizing a survey of coffee producers in the state of Karnataka in India. A simple model with oligopsony in the marketing sector is developed and tested to determine the impact of trader competition on producer prices. A number of other factors are considered, such as the type of marketing channel, availability of price information and membership in cooperatives.

1.2.3 Risk aversion and informal risk management

Understanding how prices affect coffee growers requires taking into consideration price volatility and the importance of price risk for producers' welfare. Extensive empirical research shows that farmers are overwhelmingly risk averse, and it is therefore natural to assume that they would benefit from price hedging instruments. However, the implementation of these instruments in coffee growing countries has been slow. One of the reasons is insufficient interest from producers. To better understand the incentives for coffee grower participation in price insurance, two questions are of relevance: First, are coffee growers risk averse, as the empirical and experimental literature involving other smallholder farmers indicates? Second, what type of risk reducing and consumption smoothing strategies do farmers apply in the absence of a formal insurance?

Chapter 4 develops a framework for deriving growers' risk preferences from the responses on maximum premiums that growers would be willing to pay for price insurance. Using the same survey data from Karnataka in India, as in Chapter 3, the relationship between attitude to risk and the use of informal insurance instruments is tested empirically to establish whether risk averse growers resort to self-insurance for risk mitigation or consumption smoothing in the absence of formal insurance.

1.3 Main findings

The main contributions of this thesis are empirical findings establishing: (i) the relationship between producer prices and domestic policy (ii) the relationship between producer prices and characteristics of the marketing sector and (iii) the relationship between risk aversion and risk-mitigating activities of farmers. As such, this dissertation is intended to contribute to the ongoing debate on policies and instruments intended to raise the incomes of coffee growing households.

The principal finding of the *first essay*, based on time series data for selected coffee producing countries, is that in most countries the reforms were successful in raising the ratio of producer price to the world market price and enhancing price transmission from international markets to farm-gate. Producer prices adjust faster to changes in world market prices today than prior to market liberalization, and the effect is stronger in countries where reforms were more far-reaching. However, in some cases asymmetric price transmission is detected, so that in the post-reform period price increases are transmitted slower than price declines.

The main conclusion in the *second essay* is that competition among growers matters for producer prices, but only in the case of Robusta coffee, the most homogeneous of the two types of coffee produced in India. The prices of Arabica coffee appear to be driven more by quality than marketing arrangements. Several other variables affect producer prices: the type of market intermediary, the education level of grower and membership in cooperative.

The *third essay* concludes that risk averse farmers do take some actions to reduce the adverse effects of price volatility on their welfare: growers that are risk averse are more likely to be members of cooperatives, do not usually carry over stocks to reduce exposure to price risk and are more likely to default on their loans when prices drop. However, they do not seem to be more likely to diversify income through off-farm employment and crop diversification that other growers.

1.4 The structure of the dissertation

The structure of this dissertation is as follows. Chapter 2 is an essay on the impact of structural reforms on producer prices relative to international prices. Chapter 3 focuses on the role of competition among traders and other characteristics of domestic marketing in determining prices to growers. Chapter 4 examines the case of price insurance and establishes the relationship between risk aversion and strategies used by the farmers to reduce income risk and smooth consumption. Chapter 5 provides concluding remarks and suggests areas for future research.

Chapter 2: The impact of coffee market reforms on producer prices and price transmission

2.1 Introduction

Coffee growers in developing countries receive a notoriously small share of the export price of green coffee. The spread varies substantially across countries, depending on country specific conditions such as domestic policy affecting production and exporting, the market structure of the marketing sector even when comparing countries with seemingly similar exporting systems. For example, producers in Tanzania received only 42% of the export price of Arabica coffee and 30% of the price for Robusta in 1998/99 (Baffes, 2003), while in Uganda the share of export price accruing to growers of Robusta at the same time was 75% (CRMG, 2002b).

The governments of developing countries are known for intervening intensively in their agricultural markets for two main reasons. One is revenue collection, since agriculture, often being the largest sector of the economy in terms of employment and exports, represents a convenient base for taxation. Another reason is the desire of governments to reduce producer price volatility to reduce price risks to producers that depend on exportable commodities for their livelihood and to manage food price risks for consumers. For their impact on producer welfare the stabilization schemes are in general regarded as unsuccessful. Varangis et. al. (2002) summarize the findings in the literature on reasons for failure of these schemes. The cost of reduced volatility seemed too high, given that the administered prices usually were far below the certainty equivalent that would be accepted by farmers (see for example

McIntire and Varangis, 1999). Moreover, the implementation of stabilization policies was delegated to inefficient, overstaffed and often corrupt marketing boards. Apart from price stabilization through administered minimum prices and maintaining buffer stocks (the instruments of stabilization in developing countries are discussed in Claessens and Duncan,1993), these marketing boards were typically directly involved in domestic marketing of commodities, controlling purchasing as well as exporting, in effect acting as a state monopsony vis-à-vis producers.

Faced with costly and inefficient marketing systems and growing pressures from international donors to reforms agricultural commodity markets, most coffee-growing countries in Sub-Saharan Africa and Latin America implemented substantial liberalization of the coffee sector beginning in the mid-1980s, dissolving marketing boards and allowing private agents to operate as traders and exporters (for selected case studies that include coffee see Akiyama et.al., 2001). The pace and scope of the reforms varied across countries. Most countries liberalized coffee markets in late 1980s or early 1990s by lowering export taxes and replacing state-controlled marketing systems with markets run by private agents. The key objectives were introduction of more efficient markets, lower marketing margins and higher producer prices.

This paper investigates whether the reforms were successful in raising the ratio of producer price to the international price of coffee and whether they improved the transmission of price signals from the world to domestic markets. An error-correction model is specified to account for the dynamic nature of price adjustment. Short-run price transmission, the speed of adjustment and the equilibrium producer price share are estimated before and after the reforms. Asymmetric price transmission is tested in both periods to check whether price increases are passed through to producers as fast as price decreases and whether the nature of the asymmetry has changed after the reforms.

2.2 Empirical literature on price transmission

Several papers investigate the responsiveness of domestic prices in developing countries to fluctuations in international commodity prices. The evidence of the relationship between world market prices and domestic prices has been mixed. The estimates of the elasticity of transmission from border to domestic markets seem to be highly sensitive to the methodology applied.

Hazell et. al. (1990) examine whether the volatility in the world market prices has been passed through to producer prices in developing countries. The authors test whether price instability has increased over time and whether fluctuations in domestic markets followed the variability of the world prices. They find that world market prices indeed grew more volatile over time, but that price variation was explained more by declining average prices than by variability around trend. The fluctuations in world market prices were in general transmitted to countries' export unit values, but not to producer prices, since the real exchange rates and government intervention in agriculture played a buffering role.

Mundlak and Larson (1992) estimate a direct relationship between domestic and world market prices. Their estimates of price transmission elasticities for 58 countries reveal almost perfect price transmission. Cross-commodity OLS for each country independently as well as between-commodity and within-commodity regressions suggest that for most countries the elasticity of transmission is close to unity. Separate estimations are carried out for wheat, coffee and cocoa. Price transmissions in those markets are found to be lower than those obtained from the pool of commodities, indicating imperfections of transmission in these particular markets.

A different approach to estimating a relationship between two price time series is the error-correction model. Unlike the static framework, the error-correction model includes a dynamic component, which captures the effect of adjustment of the dependent variable when it deviates from its long-term equilibrium level. This approach is taken by Quiroz and Soto (1995), and their results differ substantially from the ones obtained by Mundlak and Larson. Their conclusion is that the vast majority of cases the international price signals are transmitted very poorly to domestic markets or are not transmitted at all.

Baffes and Gardner (2003) also use the error-correction model to estimate the responsiveness of domestic prices to fluctuations in the global markets. The authors analyze price transmission for 10 commodities on a country-by-country basis for the period mid 1970s to mid 1990s. Again, estimation of price adjustment suggests that changes in the world prices account for only a small share of the variation in domestic prices. The authors also assess whether policy reforms under the structural adjustment programs improved price transmission. Structural breaks are introduced corresponding to the years of substantial market reforms. The results indicate that in most countries the reforms had very limited effect on price transmission.

Morisset (1997) examines the growing spread between world and domestic commodity prices in the consuming countries and evaluates the losses to developing countries caused by this spread. He finds that the gap has widened over time because of the asymmetric response of consumer prices to movements in the world prices. Throughout the period examined, the increases in the world prices have been passed through to consumers more fully than price decreases, causing a loss of over $100 billion a year in export earnings for developing countries. Coffee is the sector which is characterized by the greatest price asymmetry. Apart from fuels, coffee is also the commodity which bears the greatest losses associated with the increasing price spread between the world prices and the domestic consumer prices.

This paper focuses exclusively on the coffee sector and measures the responsiveness of domestic producer prices to the international prices. The assumption is that exporting countries act as price takers on the world market. This is a reasonable assumption in the period following the collapse of the International Coffee Agreement (ICA) in 1989. However, even during the ICA regulatory system, which was designed to sustain collusion among coffee producing countries, the difficulties associated with negotiating and insuring compliance with the agreements implied meant that the countries were not able to collude perfectly. Karp and Perloff (1993) test the price-taking hypothesis in the case of Brazil and Colombia, the two largest exporters of that time. Using a dynamic feedback oligopoly model the authors conclude that Brazil and Colombia were closer to price taking than to collusion.

The essay follows the dynamic approach adopted by Quiroz and Soto (1995) and Baffes and Gardner (2003) and introduces asymmetric price transmission. The principal question addressed is whether the reform processes in the coffee producing countries resulted in a closer relationship between the world market prices and the internal prices paid to growers. The error-correction model allows estimation of short-run price transmission, the speed of adjustment and the share of the domestic price before and after the reforms. In addition, the paper tests for the existence of asymmetric responses to world price increases and decreases. If prior to liberalization neither price increases nor price decreases were fully transmitted to producers, an interesting question is whether the reforms affected the transmission of the upward and downward price movements equally.

2.3 The extent of coffee market reforms

Each coffee producing country followed its own distinct liberalization path. The degree of liberalization, the timing and the sequencing of the reforms were different in each country, producing different outcomes in each case. The main components of the reforms by country are summarized in Table 2.1. Four types of countries can be identified. In many countries the reforms covered the full range of measures: complete withdrawal of the state from marketing, facilitation of entry of private traders, abolishment of minimum prices, lowering of export taxes and simplification of procedures for firm registration and licensing. This category includes Brazil, Mexico, India, Uganda, Madagascar, Togo and Cameroon.

The second group includes countries where some reforms took place, but the government retains some power over marketing, and the sector continues to be heavily regulated. In Kenya and Tanzania the parastatal organizations are not officially involved in marketing, but mandatory auctions are still in place, under which no coffee can legally be traded outside the system. The Coffee Board of Kenya (CBK) remains highly influential, but the Kenya Coffee Growers and Employers Association (KCGEA) has called for its dissolution, demanding direct marketing of coffee by the growers to be permitted (East African Standard, 2003). In Tanzania, a large proportion of coffee is marketed by cooperative unions which maintain close ties to the Coffee Board and enjoy special privileges. The licensing procedures for coffee traders are restrictive and in 2000/2001 the Coffee Board revoked the buying licenses of private traders, effectively handing the monopsony power to the unions (Baffes, 2003).

In other countries, such as Ethiopia, Angola and Central African Republic, internal marketing is liberalized, but the government continues to exert control over producer prices. The Angolan National Coffee Institute announces the minimum prices to producers at the beginning of each season. In Ethiopia the minimum export differentials are set daily, but there is no floor producer price. In Central African Republic there are centrally controlled indicative prices that are used as the basis for negotiations.

Finally, in the case of Colombia, the reforms of the coffee sector were very limited. The Federación Nacional de Cafeteros (FNC) continues to be the most powerful player on the market, controlling both domestic marketing and exporting and fixing grower prices and marketing margins. However, Colombia is a special case where producers themselves regulate the market, without direct involvement of the state.

The content and achievements of market liberalization in each country are described in more detail in Appendix 2.A. To get a preliminary idea of how the reforms affected producer prices, the shares of the domestic prices in the world prices before and after the reforms are shown in Figure 2.1. As expected, in almost all countries the producer price share increased after the reforms. The only exception is Tanzania, where the price share for Arabica coffee decreased slightly. This could potentially be due to the fact that the quality of the Tanzanian coffee has been decreasing in recent years. The data on coffee export by coffee grade in Ponte (2001) shows that the quality has been declining steadily since 1995/1996. In all other countries the share of producer price increased substantially, in particular in Brazil, Ethiopia, Kenya, Mexico, Madagascar and Uganda.

2.4 Methodology

To test for cointegration between producer prices and world prices, an error-correction specification is used, following Engle and Granger (1987). Error-correction models incorporate dynamic elements into estimation of price transmission, allowing producer prices to adjust to their long-term equilibrium following a change in the world price.

Consider an autoregressive distributed lag model ARDL(1,1), which includes the lagged values of the producer price and the world price as independent variables.

$$p_t^d = \alpha + \beta_1 p_t^w + \beta_2 p_{t-1}^d + \beta_3 p_{t-1}^w + \varepsilon_t \qquad (2.1)$$

This can be rearranged to yield an error-correction specification

$$p_t^d - p_{t-1}^d = \alpha + \delta(p_t^w - p_{t-1}^w) + \theta(p_{t-1}^d - \gamma p_{t-1}^w) + \varepsilon_t \qquad (2.2)$$

where $\delta = \beta_1$, $\theta = -(1-\beta_2)$ and $\gamma = \dfrac{\beta_1 + \beta_3}{1-\beta_2}$.

Equation (2.2) describes the variation of producer price p^d in terms of an immediate reaction δ to a change in the world price p^w and adjustment to its own long-term equilibrium γp^w, captured by the error-correction term θ.

To insure that error-correction model is appropriate, I first check whether the time series used in the estimation are stationary. The stationarity properties of prices (both levels and first differences) are tested using the Augmented Dickey-Fuller procedure (ADF). In each case the hypothesis tested is that the time series follow a nonstationary process with a unit root. Rejecting the null hypothesis allows treating the time series as stationary. In addition, the existence of a long-term cointegrating relationship between the world and the producer prices is tested, in order to check the validity of the error-correction part of equation (2.2).

The long-term cointegration between prices can be estimated by OLS:

$$p_t^d = \gamma p_t^w + u_t \tag{2.3}$$

Three OLS regressions are estimated: separate regressions before and after the reforms based on (2.3) and a pooled regression with a structural break:

$$p_t^d = \gamma_1 p_t^w D_t^{ref} + \gamma_2 p_t^w (1 - D_t^{ref}) + v_t \tag{2.4}$$

where D_t^{ref} is the policy dummy:

$$D_t^{ref} = \begin{cases} 0 & \textit{if } t \textit{ is a year before the reforms} \\ 1 & \textit{if } t \textit{ is a year after the reforms} \end{cases}$$

Note that the constant is restricted to be zero, so that the γ_s can be interpreted directly as share of producer price in the world price[1]. In each case an ADF test on the residuals is performed to determine whether the OLS results adequately describe the cointegrating relationship between p^d and p^w.

The residuals from (2.4) are used to estimate the error-correction model with a structural break for each country, based on (2.2). To test for asymmetric price transmission another dummy variable is defined, showing whether the world price increased or decreased:

$$D_t^{\Delta} = \begin{cases} 0 & if\ \Delta p_t^w < 0 \\ 1 & if\ \Delta p_t^w \geq 0 \end{cases}$$

where $\Delta p_t^w = p_t^w - p_{t-1}^w$.

Both the policy dummy D_t^{ref} and the dummy for price increase/decrease D_t^{Δ} are used in the error-correction model. D_t^{ref} is interacted with all the independent variables, and D_t^{Δ} is interacted with the short-run elasticity of transmission δ to test for the presence of asymmetric short-run price transmission. The estimated error-correction model is thus

$$\begin{aligned} \Delta p_t^d &= \delta_1 \Delta p_t^w D_t^{ref} D_t^{\Delta} + \delta_2 \Delta p_t^w D_t^{ref} (1 - D_t^{\Delta}) + \delta_3 \Delta p_t^w (1 - D_t^{ref}) D_t^{\Delta} + \\ &+ \delta_4 \Delta p_t^w (1 - D_t^{ref})(1 - D_t^{\Delta}) + \theta_1 \hat{v}_{t-1} D_t^{ref} + \theta_2 \hat{v}_{t-1} (1 - D_t^{ref}) + \varepsilon_t \end{aligned} \tag{2.5}$$

where $\Delta p_t^d = p_t^d - p_{t-1}^d$. The δs describe the short-term responsiveness of producer prices to world price increases and decreases before and after the reforms. The θs are the parameters capturing the pre- and post-reform speed of adjustment to the long-term equilibrium in producer prices.

[1] In most cases the constant was not significantly different from zero.

The estimated coefficients can be used to calculate how long it will take the producer prices to fully adjust to a one-time change in the world price. The degree of adjustment of the producer price relative to full adjustment n periods after the change in the world price equals

$$m_n = 1 - \frac{(\gamma - \delta)(1+\theta)^n}{\gamma} \quad (2.6)$$

For derivation see Appendix 2.B.

2.5 Data

The data for this investigation are monthly world market prices and prices paid to producers in 13 coffee exporting countries from 1976 to 2004 or 2005 (data availability for recent years varies by country), in US cents per pound. The data are collected by the International Coffee Organization (ICO). Prices paid to growers are the farm-gate prices reported to ICO by the national coffee authorities and constitute the average of all grades purchased from the farmers. The exchange rates used by the ICO to convert the prices in local currencies to US cents are the monthly average exchange rates published by the IMF.

Prices received by the exporting countries for their coffee on the world market vary depending on the coffee type exported. The ”indicator prices” are calculated by the ICO on the basis of the daily spot prices of the relevant types coffee traded in the New York and Bremen/Hamburg markets. The ICO prices distinguish between four main groups of coffee: Robusta coffee and three types of Arabica coffee (Colombian milds, Brazilian milds and other milds). The main exporters of each type of coffee are shown in Table 2.2. In the country-by-country analysis the world market price corresponds to the coffee type exported.

2. 6 Estimation results

The results of the stationarity tests are reported in Table 2.3. For twelve out of seventeen prices the ADF test does not reject the null hypothesis that the price time series follow a unit root process at 5% significance. However, when first differences of prices are used, the unit root hypothesis is rejected at 1% level for all countries. This leads us to conclusion that price differences can be used in the error-correction model.

The error terms from regressing domestic prices on international prices are also tested for unit-root, and the results are presented in Table 2.4. Only for India the hypothesis of no cointegration before the reforms is rejected at 5%, which is consistent with the prediction that in regulated markets the relationship between producer prices and global prices is weak. Given the high degree of government intervention in the sector prior to liberalization we can expect the domestic prices to be driven by policy decisions, rather than by the world market prices. After the reforms cointegration is detected (at 5% significance) in all countries except Brazil, Mexico, Uganda and Central African Republic. In the pooled sample with structural breaks the null of no cointgration is rejected at 5% significance for all countries except Togo and Cameroon. It is interesting to note that in these countries a cointegrating relationship was found in the period after the reforms.

The estimates of pre- and post-liberalization producer price shares are reported in Table 2.5, together with the results from estimation of the error-correction model based on equation (2.5). In nearly all countries the reforms significantly increased the share of producer prices in the world market price. For example, in Uganda the share in the world market price increased from 31% to 88% and in Ethiopia it grew from 35% to 72% In Brazil the share of producer prices for Arabica increased from 43% to 81%. Similarly, in India Arabica growers received around 54% of the world price earlier, and the share has increased to 70%. The only exception is Tanzania, where the price share decreased from 56% to 51%. All changes are significant at 1% significance level.

Short-term transmission has either remained unchanged or improved in all cases, most notably in Kenya, Uganda and India, where prior to the reforms price transmission was close to zero and increased considerably following the liberalization, with the difference significant at 1% level. Post-liberalization transmission varies across countries and in some cases, as in Kenya, is very high, implying that domestic prices adjust almost immediately to the new equilibrium. Asymmetric short-run price transmission did not seem to be a big issue at play, but there are a few interesting cases. In Kenya, the transmission of both price increases and price decreases changed from zero to positive values after liberalization, but the negative price changes are now transmitted faster to growers than the positive changes, with the change significant at 1% level. While farm-gate prices only increase by 41 cents as world prices go up 1 dollar, price decreases are passed through one to one, placing the full burden of falling coffee prices on growers. In Madagascar, price transmission improved for price decreases, but price increases are passed through with a negative sign after the reforms, leading to a surprising conclusion that producer prices fall in the short-run in both cases – when the world market price increases and when it decreases. Note, however, that in these two cases the R-squared was very low: only 7% and 8% of the producer price variation is explained by the model. A similar situation is observed in post-reform Cameroon, where no short-term transmission of price decreases was found, but price increases lead to immediate downward changes in producer prices. In the extreme case of Angola, there was virtually no price transmission prior to liberalization since prices were fixed, however in 1991 price plummeted, and the short-term price transmission for negative price changes in the post-reform period is 1.59. In Brazil, on the other hand, price transmission was significantly higher for price increases than price decreases before the reforms, and today there is no difference in transmission.

To better understand how the transmission of price decreases changed relative to the transmission of price increases, a measure of the net change is constructed and presented in Table 2.5. In five out of nine countries, for which the error-correction model was estimated, the transmission of price decreases went up by more than the transmission of price increases. The countries for which this effect is significant at 5% are Kenya, Madagascar, Cameroon, Central African Republic and Brazil. This simple calculation of the relative changes shows that the impact of the reforms was asymmetric in some countries.

The speed of adjustment improved significantly, at either 1% or 5% level, in eight out of thirteen cases, increasing from close to zero to around 0.2 in Colombia, Ethiopia, Kenya, Tanzania and Uganda. It did not improve significantly in Brazil or in Mexico.

To understand how the reforms affected the speed at which domestic prices react to changes in the world price, it is useful to calculate the degree of adjustment of producer prices to a one-time change in the price at the world market. Appendix 2.B shows how this parameter is derived. The results for adjustment 6 and 12 months after the change in the world price are reported in Table 2.6. In all countries without asymmetry in transmission coffee prices adjust faster to changes in the world market price after the structural reforms than they did before. In most countries, prior to the reforms less than 50% of price adjustment took place in the first six months. In the post-reform period, the adjustment rate after six months is over 80%. In Mexico the adjustment rate did not change as much as in other countries.

In most cases where asymmetric price transmission was detected price decreases are transmitted faster today than before liberalization, with the result significant at 5% level, however the evidence for price increases is mixed. In Brazil, Angola and Kenya most of the price increase is transmitted after six months, and the asymmetry between positive and negative price changes is not that strong. However, in Madagascar and Central African Republic the differences are sizable, and in Cameroon no price increases are passed on to domestic producers at all.

2. 7 Discussion

In eleven out of thirteen countries investigated, grower prices were integrated with the world market price in the long run. Following the reforms, short-run transmission improved in all countries and eight countries experienced an increase in the speed of transmission. In all countries except Tanzania the share of grower price in the world market price increased substantially.

In general, the largest impact of the reforms was detected in countries where the liberalization was complete, leading to full withdrawal of state-trading enterprises from marketing, significantly simplified procedures for export licensing and entry of private traders. The following countries are in this category: Brazil, Kenya, Mexico, India, Uganda, Madagascar, Togo and Cameroon. For example, in Uganda the liberalization process covered the whole marketing chain from farm purchasing to export. Traders are now free to negotiate their own overseas contracts, and payments are passed quickly to coffee growers. The result is almost tripling of the producer price share and large and significant improvement in the immediate transmission of the world market signals. Less striking but equally important results were achieved in India and Brazil: Both countries underwent substantial reforms involving a switch from state trading to a market-based system. Important results were achieved in Kenya and Ethiopia as well, although in these countries the reforms were more limited. In Mexico, where the starting point was a less restrictive system, the reforms increased the share of grower prices, but did not influence the speed of adjustment significantly.

In other countries several important reforms took place, but they were less far-reaching or happened more gradually than in the cases described above. These include Colombia, Ethiopia, Tanzania, Angola and Central African Republic. In Tanzania, cooperative unions, which were controlled by the coffee board prior to the reforms, still account for a large share of trade. The Tanzania Coffee Board runs the obligatory coffee auction and direct exports are not allowed. The coffee sales taxes are quite high and their structure is complicated. The taxes have been increasing in the last couple of years. All these factors could have an impact on the reform outcome. Tanzania is the only country in the sample where the share of grower prices in world market prices didn't increase following the liberalization. In Colombia, prices continue to be administered, which could explain some of the remaining rigidity in price adjustment and lower share of producer prices. While in Kenya, Uganda and Mexico the producer price share is close to 90% in the post-reform period, in Colombia and Ethiopia producers capture approximately 70% of the world price.

In a number of African countries (Madagascar, Togo, Cameroon and the Central African Republic) the model fit is rather poor, explaining less than 10% of the variation in producer price changes. This is likely to be related to the fact that there are other leading determinants of agricultural prices in these countries, not accounted for by the model. There are certain disruptive factors at the national level, such as wars and political unrest that are likely to have much larger implications for the economy and therefore producer prices, than world market prices. Thus, the political crisis in Madagascar in 2002 had severely affected economic activity and caused an almost complete shutdown of the export processing sector. Because of marketing difficulties, farm gate prices dropped (IMF, 2002). In Central African Republic the continuous political conflict and unrest since 1990's have had severe implications for the economy. Similarly, economic crisis has been pertinent in Cameroon from the mid-1980s to the early 2000s.

2. 8 Conclusions

With the help of cointegration analysis and an error-correction model, this article examined price transmission from the world coffee market to producers in coffee-growing countries before and after structural reforms in the coffee sector. In addition, the impact of policy changes on the share of grower prices in world prices was estimated. The results show that the share of producer prices in the world price has increased substantially in all countries except one. There is closer cointegration between the domestic and world markets today than prior to the reforms, and the transmission of world price signals has improved in most cases.

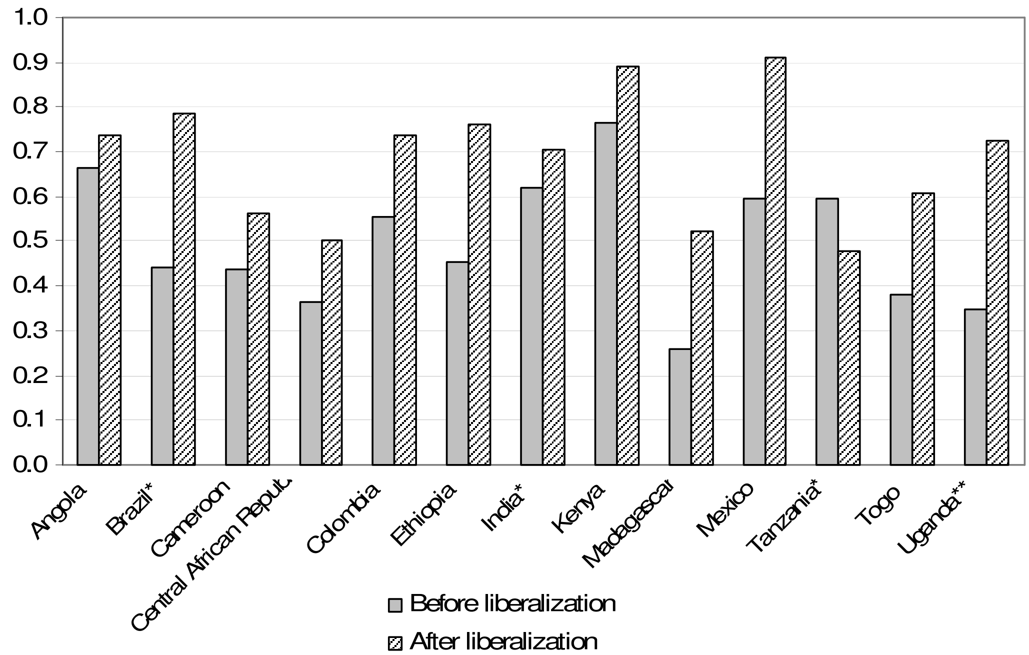
The case of Tanzania demonstrates that the impact of the liberalization process on producer prices seems to be limited if reforms are incomplete. Continued regulation of the sector and barriers to entry of new traders curtail competition and keep producer prices at a low level relative to the world price.

It should be noted that greater price transmission of world market prices does not necessarily makes coffee growers better off. In fact, since coffee prices plummeted between 2000 and 2003, causing losses and severe financial hardships for coffee farmers, producers would most likely have preferred price stabilization to a free market system. Moreover, this study shows that in some cases the impact of the reforms on price transmission has been asymmetric and therefore growers now bear the full costs of price falls, while transmission of the positive price signals has not changed much. As the result, farmers are now fully exposed to price risks.

However, continued interventions in marketing and price stabilization are neither sustainable nor desirable in the long run. First, they place a heavy burden on public finances. Bailing out farmers at the time of prolonged crisis requires significant resources which most coffee-growing countries lack. Second, government policies affecting agricultural markets can also pose significant risks to producers, as policy formulation is not always transparent and foreseeable.

An alternative to approach could be development of market-based instruments for management of coffee price risks. For example, growers could be given opportunity to hedge with futures and option contracts or buy a price insurance based on these derivatives. This approach is supported by the World Bank (Varangis and Larson, 1996; Varangis et.al. 2003; World Bank 2005), which helped set up a number of pilot price risk management schemes in coffee growing countries.

Figure 2.1 The ratio of producer price to world price



* Arabica coffee; ** Robusta coffee

Source: International Coffee Organization

Table 2.1 Structural reforms in the coffee sector

Country	Reform year	Change in the role of the parastal agency	Post-reform policy		
			Price control	Domestic marketing	Exporting
Brazil	1990	From price stabilization to industry supervision	None	Liberalized	Liberalized
Ethiopia	1992	From state trading to industry supervision; mandatory auction	Minimum export differentials	Partly done by ECPE	Partly done by ECEE
Kenya	1993	Producer-dominated, reforms limited; mandatory auction	None	Liberalized	Liberalized
Tanzania	1994	From state trading to industry supervision; mandatory auction	None	Liberalized, but licensing is restrictive	Liberalized, but licensing is restrictive
Colombia	1995	Producer-dominated, reforms limited	Administered prices	Partly done by the FNC	Partly done by the FNC
Mexico	1993	From state trading to industry supervision	None	Liberalized	Liberalized
India	1996	From state trading to industry supervision	None	Liberalized	Liberalized
Uganda	1992	From state trading to industry supervision	None	Liberalized	Liberalized
Madagascar	1988	From state trading to industry supervision	None	Liberalized	Liberalized
Togo	1996	From state trading to industry supervision	None	Liberalized	Liberalized
Angola	1991	From state trading to industry supervision	Minimum prices	Liberalized	Liberalized
Cameroon	1994	From state trading to industry supervision	None	Liberalized	Liberalized
Central African Republic	1991	From state trading to industry supervision	Indicative prices	Liberalized	Liberalized

Table 2.2 Coffee exports by country, shares (quantity)

August 2006 to September 2007

Colombian Milds	**12.6%**	**Robustas**	**34.6%**
Colombia	11.6%	Vietnam	18.5%
Kenya	0.5%	Indonesia	4.2%
Tanzania	0.5%	Côte D'Ivoire	2.7%
Other	0.003%	Brazil	1.6%
		Uganda	1.3%
Other Milds	**21.7%**	India	2.0%
Guatemala	3.8%	Cameroon	0.6%
Peru	3.7%	Togo	0.2%
Honduras	3.3%	Madagascar	0.1%
Mexico	3.0%	Central African Republic	0.1%
India	2.0%	Other	3.3%
Other	5.8%		
Brazilian Naturals	**31.1%**		
Brazil	24.8%		
Ethiopia	3.1%		
Indonesia	1.0%		
Other	2.2%		
TOTAL			**100%**

Source: International Coffee Organization

Table 2.3 Stationarity of the producer and the world prices

Augmented Dickey-Fuller Test (without trend)[1]

Annual prices 1976-2005	ADF statistic			
	Price level		First differences	
ICO indicator prices				
Brazilian naturals	-2.49		-6.71	***
Colombian milds	-2.54		-8.21	***
Other mild arabica	-2.89	**	-7.56	***
Robustas	-2.16		-8.00	***
Producer prices				
Brazil arabica	-3.09	**	-8.41	***
Ethiopia arabica	-3.04	**	-8.46	***
Kenya arabica	-2.50		-9.26	***
Tanzania arabica	-2.68	*	-7.43	***
Colombia arabica	-2.67	*	-6.96	***
India arabica	-3.11	**	-7.27	***
Mexico arabica	-2.61	*	-7.14	***
Uganda robusta	-2.75	*	-8.66	***
Madagascar robusta	-1.96		-8.22	***
Togo robusta	-2.52		-6.45	***
Angola robusta	-4.57	***	-10.38	***
Cameroon robusta	-1.89		-7.53	***
Central African Republic robusta	-2.09		-6.86	***

* Null of unit root rejected at 10% significance, ** 5% significance, *** 1% significance[1] ; 6 months lag

Table 2.4 Cointegration between domestic and world prices
Augmented Dickey-Fuller Test (without trend)[1]

Annual prices 1976-2005	Reform year	ADF statistic					
		Before		After		With structural break	
Brazil Arabica	1990	-2.53		-2.43		-3.99	***
Ethiopia Arabica	1992	-2.32		-3.94	***	-4.41	***
Kenya Arabica	1993	-2.60	*	-4.62	***	-5.26	***
Tanzania Arabica	1994	-2.80	*	-2.95	**	-3.78	***
Colombia Arabica	1995	-2.40		-3.71	***	-3.27	**
India Arabica	1996	-3.05	**	-3.13	**	-3.79	***
Mexico Arabica	1993	-2.60	*	-2.43		-3.35	**
Uganda Robusta	1992	-2.76	*	-2.11		-3.61	***
Madagascar Robusta	1988	-2.46	*	-3.57	***	-4.59	***
Togo Robusta	1996	-1.74		-4.84	***	-2.72	*
Angola Robusta	1991	-0.97		-5.57	***	-4.92	***
Cameroon Robusta	1995	-2.34		-3.39	**	-2.77	*
Central African Republic Robusta	1991	-1.77		-2.87	*	-2.97	**

* Null of unit root rejected at 10% significance; ** 5% significance; *** 1% significance; 6 months lag

Table 2.5 Error-correction model with asymmetric price transmission

Estimation results for (2.5)

			Brazil	Ethiopia	Kenya	Tanzania	Colombia	Mexico	India
Type of coffee			Brazilian natural	Brazilian natural	Colombian mild	Colombian mild	Colombian mild	Other milds	Other milds
Reform year			1990	1992	1993	1994	1995	1993	1996
Short-term transmission	price decreases	Before reforms (δ1)	0.31 ***	0.10 *	0.18	0.06	0.01	0.11	0.06
		After reforms (δ3)	0.79 ***	0.45 ***	1.05 ***	0.08	0.31 ***	0.32 **	0.49 ***
		Change significant	Yes ***	Yes ***	Yes ***	No	Yes ***	No	Yes ***
	price increases	Before reforms (δ2)	0.54 ***	0.13 ***	0.08	0.02	0.06 **	0.21 **	0.05
		After reforms (δ4)	0.77 ***	0.44 ***	0.41 ***	0.17 ***	0.32 ***	0.59 ***	0.46 ***
		Change significant	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***
Asymmetric price transmission significant		Before reforms	Yes+ ***	No	No	No	No	No	No
		After reforms	No	No	Yes- ***	No	No	No	No
Net change in the short-term transmission[1)]			0.25 **	0.04	0.54 **	-0.13	0.04	-0.17	0.02
Speed of adjustment		Before reforms (θ1)	0.11 ***	0.01	0.08 *	0.03	0.05 ***	0.17 ***	0.07 ***
		After reforms (θ1)	0.14 ***	0.17 ***	0.22 ***	0.20 ***	0.27 ***	0.14 ***	0.18 ***
		Change significant	No	Yes ***	Yes ***	Yes ***	Yes ***	No	No
Target share of world price		Before reforms (γ1)	0.43 ***	0.35 ***	0.78 ***	0.56 ***	0.48 ***	0.54 ***	0.54 ***
		After reforms (γ1)	0.81 ***	0.72 ***	0.92 ***	0.51 ***	0.70 ***	0.90 ***	0.70 ***
		Change significant	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***
Observations			355	355	346	354	359	344	359
R-squared			0.52	0.19	0.25	0.11	0.37	0.19	0.24

* significant at 10%
** significant at 5%
*** significant at 1%
Yes+ (Yes-) means that short-run transmission is significantly higher (lower) for price increases than for price decreases
1) Change in the transmission of price decreases net of change in the transmission of price increases, $(\delta_3 - \delta_1) - (\delta_4 - \delta_2)$

Table 2.5 (continued) Error-correction model with asymmetric price transmission

			Uganda	Madagascar	Togo	Angola	Cameroon	Central African Republic
Type of coffee			Robusta	Robusta	Robusta	Robusta	Robusta	Robusta
Reform year			1992	1988	1996	1991	1995	1991
Short-term transmission	price decreases	Before reforms (δ1)	0.02	0.01	-0.04	-0.02	-0.04	-0.03
		After reforms (δ3)	0.77 ***	0.14 **	0.29 ***	1.59 *	0.03	0.16 ***
		Change significant	Yes ***	Yes *	Yes ***	Yes *	No	Yes ***
	price increases	Before reforms (δ2)	-0.02	0.00	0.01	0.01	0.01	0.01
		After reforms (δ4)	0.73 ***	-0.12 **	0.19 *	-0.34	-0.28 **	0.03
		Change significant	Yes ***	Yes *	No	Yes	Yes **	No
Asymmetric price transmission significant		Before reforms	No	No	No	No	No	No
		After reforms	No	Yes- ***	No	Yes- *	Yes- **	Yes- **
Net change in the short-term transmission[1)]			0.00	0.25 **	0.16	1.95 *	0.36 **	0.17 **
Speed of adjustment		Before reforms (θ1)	0.08 ***	0.04	0.03 **	0.01	0.05 ***	0.02 *
		After reforms (θ1)	0.19 ***	0.09 ***	0.16 ***	0.57 ***	0.07 *	0.10 ***
		Change significant	Yes **	No	Yes ***	Yes ***	No	Yes ***
Target share of world price		Before reforms (γ1)	0.31 ***	0.23 ***	0.28 ***	0.46 ***	0.35 ***	0.28 ***
		After reforms (γ1)	0.88 ***	0.48 ***	0.63 ***	0.72 ***	0.49 ***	0.44 ***
		Change significant	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***
Observations			359	350	355	352	326	337
R-squared			0.23	0.07	0.09	0.28	0.08	0.09

* significant at 10%
** significant at 5%
*** significant at 1%
Yes+ (Yes-) means that short-run transmission is significantly higher (lower) for price increases than for price decreases
1) Change in the transmission of price decreases net of change in the transmission of price increases, $(\delta_3 - \delta_1) - (\delta_4 - \delta_2)$

Table 2.6 Adjustment to a one-time change in the world price

Countries with no price transmission asymmetry

Country	Type of coffee	Before reforms		After reforms	
		6 months	12 months	6 months	12 months
Ethiopia	Brazilian natural	36%	39%	88%	96%
Tanzania	Colombian mild	22%	35%	80%	95%
Colombia	Colombian mild	35%	53%	92%	99%
India	Other milds	43%	63%	89%	97%
Mexico	Other milds	77%	93%	84%	94%
Uganda	Robusta	40%	64%	96%	99%
Togo	Robusta	13%	28%	78%	92%

Countries with price transmission asymmetry

Country	Type of coffee	Before reforms		After reforms	
		price decrease	price increase	price decrease	price increase
Brazil	Brazilian natural	86%	112%	99%	98%
Kenya	Colombian mild	54%	46%	103%	88%
Madagascar	Robusta	24%	21%	60%	29%
Angola	Robusta	1%	5%	101%	99%
Cameroon	Robusta	15%	26%	40%	-1%
Central African Republic	Robusta	3%	15%	67%	51%

Appendix 2.A: Coffee market reforms by country

Brazil

Prior to the liberalization in 1990 the Brazilian coffee sector was run by the parastatal Instituto Brasileiro do Café (IBC), which was responsible for a vast range of activities: setting minimum export prices, regulating standards, supervising domestic sales and exports, purchasing surplus coffee and administering stocks. Most notably, the government was involved in price stabilization, buying any surplus green coffee from millers at a guaranteed minimum price. In 1990 the sector was almost entirely liberalized, abolishing minimum prices and placing marketing in the hands of private traders.

The post-reform state involvement in the sector is limited to management and sale of publicly owned stocks, providing credit for growing, harvesting and processing and funding coffee research. Both domestic purchasing and exporting are run by the private sector. Prices are fully determined by the market. Although private exporters were allowed prior to liberalization, entry into the sector increased drastically after the reforms. Over 220 companies are listed as exporters, with none exporting more than 10% of the total. However, there is some indication of increasing collusion among exporters (CRMG).

Colombia

Colombia is an outstanding example of a coffee sector entirely run by an association of producers. The powerful Federación Nacional de Cafeteros de Colombia (FNC) exerts major influence on the functioning of the sector. The FNC is contracted by the government to implement coffee policy and its involvement in coffee marketing is substantial: the FNC sets minimum producer prices, controls purchasing, processing and exporting of coffee and provides extension services, support to research and funding of infrastructure projects. FNC's agents handle half of all coffee sales, with the remaining crop being sold to private traders. In 1996 private exporters accounted for approximately 60% of all exports, while 40% were handled by the FNC. In addition, the FNC acts as a stabilization fund, buying surplus coffee from producers at a guaranteed price, which may exceed the world price net of marketing costs. In particular, between 1989 and 1994 producer received artificially high administered prices, causing losses to the FNC. Unsustainable in the long run, the system was abolished in 1995. Although no radical structural changes were made that year, 1995 is taken as the year of the reforms, because the high producer prices were suspended, which brought the internal prices closer to the world market prices.

While the Colombian coffee sector is marked by high degree of regulation, the system seems to benefit the growers. Acting unified, Colombian growers manage to get a substantial price premium on the world market and can influence the domestic policy to their benefit. Unlike in many other coffee producing countries, the system serves the interests of producers, not government bureaucrats or influential exporters.

Ethiopia

Until 1992 the Ethiopian Coffee Marketing Corporation (ECMC) fully controlled coffee marketing, handling 86% of all crop purchases in 1990/91. Growers were committed to deliver annual quotas at a fixed price. After the switch in the country's economic policy towards a market-based economy, ECMC was divided into two structures: the Ethiopian Coffee Purchasing Enterprise (ECPE), which purchases coffee, and the Ethiopian Coffee Export Enterprise (ECEE), which handles exports. Both compete with the private sector. The reforms facilitated entry of new traders and exporters. Around 75 exporters are now active and 240 hold an export license. Private traders account for 75% of exports, compared to only 10% prior to 1992. However, the sector remains somewhat regulated, with Coffee Price Differential Setting Committee setting daily minimum export differentials.

Kenya

Similar to the Colombian case, the parastatal coffee regulatory and monitoring authority in Kenya (the Coffee Board of Kenya, CBK) is an organization dominated by producers and serves their interests. CBK's board consists of nine growers and four government officials. Throughout the years CBK managed to get the highest price margins for exported coffee and Kenya is considered to be one of the highest quality producers of arabica in the world. To this date CBK remains in control of licensing producers and traders and is involved in marketing and research. Direct involvement in marketing is very limited, however. Coffee produced by smallholders is marketed by co-operatives, while the larger estates have their own marketing channels. All coffee in Kenya is sold to licensed traders and exporters at weekly auctions at the Nairobi Coffee Exchange.

Liberalization of the Kenyan coffee sector followed a piecemeal approach. Prior to liberalization, growers received payments for their coffee in installments as coffee passed through the various stages of processing and marketing. The final price paid to producers was based on the average auction price for the season. In 1993 the pricing system was changed, and growers began receiving one payment, equaling the actual price of the coffee auctioned less marketing costs. Another outcome of the liberalization process was greater competition in coffee processing. Prior to 1994-1995 the Kenya Planter's Co-operative Union (KPCU) carried out all milling of coffee. The monopoly ended when two other mills were established. Finally, in 1997 the monopoly of the Kenya Coffee Auctions (partly owned by CBK) to act as broker in coffee auctions ended, and the growers were able to choose a private broker, if they wished. Because the pricing mechanism can be expected to have a direct impact on the prices received by growers, 1993 is set as the year of the most important reforms.

Tanzania

In Tanzania the liberalization took place in 1994, when private traders were allowed to purchase, process and export coffee. Prior to 1994 marketing was handled by the Tanzania Coffee Marketing Board (TCMB) and the government-controlled cooperative unions. TCMB controlled internal prices and exports. Farmers delivered coffee to primary societies at a previously announced price. The cooperative unions then performed milling and grading and brought coffee to TCMB to be sold to private exporters through auctions. The proceeds were then passed back to growers through cooperative unions and primary societies, deducting marketing and processing costs at each stage. It took at least a year for growers to receive the second portion of the payment (Baffes, 2003). Following the liberalization, the market share of private traders in the internal market changed from zero to 67%, with vertically integrated exporters accounting for almost half of the coffee trade. The share handled by cooperative unions and other government organizations fell accordingly from 94% to 33%. (Baffes, 2003). While the reforms seem to have created greater competition in the marketing sector upon their implementation, in the last couple of years the trend has reversed. In 2000/2001 the Coffee Board revoked buying licenses of the private traders to ensure that the government-guaranteed loans to the cooperative unions get repaid. The ban was extended for the 2001/2002 season. The mandatory coffee auction is still in place. The existing tax system is too complex. The taxes are high and have been increasing in the last couple of years, eroding the revenues generated within the sector.

India

In the beginning of 1990's India switched its course from a centrally planned economy towards a free market system. Prior to the liberalization of the coffee market, the Coffee Board (CB) was in full control of coffee purchasing, processing and exporting. The CB ran two auctions: one for the domestic market and one for the export market. Similar to the pre-reform systems in many other countries, growers were paid in two stages: an advance at the delivery point and after the coffee has been auctioned. Given the inefficiencies of the marketing system, this meant that in some cases growers had to wait up to two years after the delivery to receive their payment in full. The reforms were introduced gradually, starting in 1992-1993 when producers were allowed to market 30% of their own crop on the domestic market, with the remaining coffee sold at the CB's auctions.

By 1996 the CB's involvement in marketing ended completely, and coffee growers and exporters were free to trade the crop as they chose. Pooling of coffee into compulsory auctions had also ended. These changes meant that the producers received payment much faster, within days after sale. Coffee can be sold at farm-gate to domestic agents and exporters. The number of registered exporters increased from approximately 50 to almost 100 since early 1990's. The role of the CB today is limited to quality control, industry regulation, research and other non-interventionist functions.

Mexico

The liberalization of the Mexican coffee sector took place in 1993, when the Mexican Coffee Institute (INMECAFE), previously in charge of managing the ICO quotas, was replaced by the Mexican Coffee Council. The scope of the government intervention in the sector was reduced to promotion of Mexican coffee domestically and internationally and providing technical assistance to growers. Coffee is bought from farmers by producer organization and private traders, processed and sold to domestic roasters and exporters. In 1997 there were 230 exporters, 15 of which accounted for 68% of the total volume exported (CRMG, 2002a).

Uganda

Until 1992 the exports of coffee from Uganda were fully controlled by the government, which acted through the Coffee Marketing Board (CMB) and the official cooperative societies. The farmgate prices were fixed. Liberalization of the coffee sector occurred in several stages. First, CMB lost the monopoly power over exports, and private traders and cooperatives were allowed to export directly. In 1991 a new agency, the Uganda Coffee Development Authority (UCDA), was formed with the mandate "to promote and oversee the coffee industry by developing research, controlling quality, improving the market and to provide for other matters connected therewith"[2]. The same year the administered prices were replaced by indicative prices. In 1992 the export tax on coffee was removed, but was reintroduced in 1994 as a stabilization tax. Since the liberalization the share of CMB in coffee exports declined steadily, and full withdrawal took place in 1997/1998. Within months after the reforms 18 companies were registered as legal exporters and by 1994/95 the number reached 117. However, in the following years the number of registered exporters declined sharply: In the 2000/01 season there were only 22. At the same time, the share of top ten firms grew from 71% in 1994/95 to 87% in 2000/01 (CRMG, 2002b).

Madagascar

Madagascar liberalized the coffee sector earlier than other countries. Prior to the reforms the marketing and stabilization board Caisse de Commercialisation et de Stabilisation des Prix du Café, de la Vanille et du Girofle (CAVAGI) was in charge of negotiating export contracts and managed five state owned exporting firms. Grower prices and marketing margins were fixed at the beginning of each crop year. In 1988 the sector was liberalized. The level of taxation was reduced and a large number of buyers entered the market. The number of exporters rose from five to 35. Since 1996 the concentration increased, the exports now being dominated by a few firms (between five and ten), all with strong links to multinational trade companies (ICO).

Togo

As in a typical pre-reform marketing system, the parastatal agency in Togo, OPAT (*Office des Produits Agricoles Togolais*), fixed grower prices and traders' marketing margins and acted as a monopoly exporter. Internal marketing, on the other

[2] UCDA's webpage: http://www.ugandacoffee.org/

hand, was handled by the private sector. Following the liberalization in 1996, the role of the government in commodity marketing became confined to provision of inputs and supporting establishment of farmers' organizations. The monopoly over exporting activities ended, and new traders and exporters emerged on the market. However, entry into exporting remained limited. Four companies dominate the market, accounting for approximately 75% of exports (CRMG). Internal marketing is carried out by private agents and co-operatives.

Angola

Prior to 1991 Angola's coffee sector was run by two state marketing boards: Cafangol, which operated throughout the country, and Uigimex, which was responsible for coffee marketing and exporting only from Uige province. Partial liberalization began in 1991/1992, when private agents were allowed to compete Cafangol and Uigimex by buying coffee from farmers. The ICO reports that including the two parastatal agencies there are 25 licensed exporters, but five of them handled over 90% of the total exports in 1998. There is still substantial governmental involvement in the sector. The State Secretariat for Coffee (Secafé) regulates and oversees the coffee industry, operating through the National Coffee Institute (INCA). The prices are regulated, with INCA setting the minimum producer prices at the beginning of the coffee season in May. The prices can be changed during the year. Clearly, the actual price paid to growers could exceed the minimum price, but it appears that only in very few areas of the country grower prices are higher than the announced minimum price.

Cameroon

Two marketing channels were operational in Cameroon prior to the reforms. In the anglophone areas, ONCPB, (*Office National de Comercialisation des Produits de Base*) acted as a marketing board, buying the crop from licensed agents and exporting it. In the francophone zones, private agents were allowed to export under the negotiated export contracts, but ONCBP fixed regional farm prices and marketing margins. The liberalization of the coffee sector was gradual, ending in complete elimination of government involvement in the sector. In 1991 state licensing of domestic traders was abolished, and private exporters were allowed to export directly. While arabica marketing was fully liberalized, the state continued to fix marketing margins for robusta coffee, and a stabilization fund was established to control farm prices. The stabilization mechanism was dismantled in 1994/95. Immediately following the reforms, the number of exporters increased drastically from around 60 to over 300, but later declined to around 50, with ten firms exporting over 70% of the total (ICO). No government approval is needed to become an exporter, a simple statement of existence is sufficient (CRMG, 2002c).

Central African Republic

The stabilization fund of the Central African Republic was dissolved in 1991 and a new agency, the Office for the Regulation of Marketing and Quality Control of Agricultural Products (ORCCPA), was formed to oversee coffee marketing. Today the government announces indicator prices at the beginning of the harvest season, and producer prices are negotiated on the basis of those prices. Grower prices are depressed by high transportation costs associated with getting export coffee to the port in Douala in Cameroon, which is the closest port to the landlocked Central African Republic.

Appendix 2.B: Derivation of the degree of adjustment

Initially, when the world price is p^w, the equilibrium domestic price equals γp^w. When the world price changes by Δp^w, the new long-term equilibrium level of the domestic price is $\gamma(p^w + \Delta p^w)$. Thus, a full adjustment would require the domestic price to change by $\gamma \Delta p^w$. At $t = 0$, when the change in the world price occurs, the internal price changes by $\delta \Delta p^w$. The degree of adjustment is then δ/γ. Note that if $\delta = \gamma$ the degree of adjustment is one, meaning that full adjustment occurs immediately following the change in the world price. Otherwise, an error-correction component is added to the domestic price in the following period.

Note that the cumulative change in the domestic price n periods after the jump in the world prices equals the sum of all previous changes in the domestic price plus the error-correction term

$$\sum_{t=0}^{n} \Delta p_t^d = \sum_{t=0}^{n-1} \Delta p_t^d + \theta(p_{n-1}^d - \gamma p_{n-1}^w) \qquad (2.B.1)$$

Since $p_{n-1}^d = \gamma p^w + \sum_{t=0}^{n-1} \Delta p_t^d$ and $p_{n-1}^w = p^w + \Delta p^w$ for all $n>0$, this simplifies to

$$\sum_{t=0}^{n} \Delta p_t^d = \sum_{t=0}^{n-1} \Delta p_t^d + \theta\left(\sum_{t=0}^{n-1} \Delta p_t^d - \gamma \Delta p^w\right) = \sum_{t=0}^{n-1} \Delta p_t^d (1+\theta) - \gamma\theta\Delta p^w \qquad (2.B.2)$$

At $t = 1$, the total change in the domestic price equals

$$\sum_{t=0}^{1} \Delta p_t^d = \delta\Delta p^w + \theta(\delta\Delta p^w - \gamma\Delta p^w) = \left(\delta(1+\theta) - \gamma\theta\right)\Delta p^w \qquad (2.B.3)$$

Note that $\delta(1+\theta) - \gamma\theta$ can be rewritten as $\gamma - (\gamma - \delta)(1+\theta)$. Then, in accordance with (B.2), the total change in p^d at $t = 2$ equals

$$\sum_{t=0}^{2} \Delta p_t^d = \left(\gamma - (\gamma - \delta)(1+\theta)\right)(1+\theta)\Delta p^w - \gamma\theta\Delta p^w = \left(\gamma - (\gamma - \delta)(1+\theta)^2\right)\Delta p^w \quad (2.B.4)$$

In the next period, at *t = 3*, the total change in the domestic price is

$$\sum_{t=0}^{3} \Delta p_t^d = \left(\gamma - (\gamma - \delta)(1+\theta)^2\right)(1+\theta)\Delta p^w - \gamma\theta\Delta p^w = \left(\gamma - (\gamma - \delta)(1+\theta)^3\right)\Delta p^w \quad (2.B.5)$$

Hence, at time $t = n$ the change equals

$$\sum_{t=0}^{n} \Delta p_t^d = \left(\gamma - (\gamma - \delta)(1+\theta)^n\right)\Delta p^w \quad (2.B.6)$$

The degree of adjustment is the total change in the domestic price relative to full adjustment, which is $\gamma \Delta p^w$. Thus, n period after the change in the world price the degree of adjustment equals

$$m_n = \frac{\sum_{t=0}^{n} \Delta p_t^d}{\gamma \Delta p^w} = 1 - \left(\frac{(\gamma - \delta)(1+\theta)^n}{\gamma}\right) \quad (2.B.7)$$

Chapter 3: Producer prices and trader competition: the case of coffee in India

3.1 Introduction

In development economics lack of competition in the marketing sector of commodity producing countries is often mentioned as a constraint to effective market functioning. It is often argued that structural impediments, such as the high cost of obtaining information regarding market conditions, poor infrastructure and limited access to credit, curtail competition among market intermediaries and thereby inflate marketing margins and suppress the earnings of farmers. In the case of coffee, growers receive a notoriously small share of the export price of green coffee beans. This has significant implications for the welfare of the growers, most of which are smallholders with low incomes.

Two of the most common concerns raised by coffee producers are limited access to information about local and international prices and the high degree of market power of intermediaries. It is a widespread belief that traders and exporters take advantage of the growers not only by exercising oligopsony power, but also by constraining the flow of market information, resulting in lower than competitive prices to producers. For example, a World Bank report states: "On a CRMG[3] mission to India an often-heard complaint of the smallest growers who attended information sessions on the risk management plan was that they had only one available buyer and that they were not always clear that the prices they were receiving were in line with

[3] International Task Force on Commodity Risk Management in Developing Countries

prices paid elsewhere, and that information from the agents about the market were correct." (CRMG, 2003).

This chapter investigates the roles of competition among market intermediaries in determining the spread between export prices of coffee and prices received by growers, utilizing a survey of coffee producers in the state of Karnataka in India. A model with oligopsonic competition in the marketing sector is developed and the impact of competition on producer prices is tested empirically.

3.2 Marketing margins and market power: the evidence

Agricultural economists have long been concerned with the presence of imperfect competition in food markets. For the past 30 years, the empirical work in this area has been dominated by "New Empirical Industrial Organization" paradigm. Bresnahan (1989) provides an extensive review of the econometric studies of market power that follow the NEIO approach. An updated review of empirical research in this area is provided by Digal and Ahmadi-Esfahani (2002). These studies seek to detect and quantify market power in single markets or groups of related markets. NEIO is a structural approach which relies on economic theory for specification of the empirical model and interpretation of the results. Typically, the studies develop a stylized econometric model of oligopoly or oligopsony interaction, based on economic theory, and estimate a system of simultaneous equations to either test for presence of monopolistic competition or to capture the market power parameter itself. The only endogenous variables are usually output prices and quantities, while input prices are taken as given. Some studies estimate the structural equations of the model directly. Others, lacking data on price or quantity, rely on reduced form estimation.

To arrive at the reduced form, these studies typically make simplifying assumptions on the functional form of the equations, such as constant elasticities or linear functions describing the demand for final good and input supply. In general, this type of study uses time series pertaining to a specific industry.

The methodology has found broad application in particular in empirical analysis of marketing margins in agricultural commodity markets, as documented in Wohlgenant (2001). In terms of theoretical underpinnings, papers of this type often build upon the farm-retail model developed by Gardner (1975) to detect market power. The theoretical model consists of three interdependent markets: food retail market and markets for farm product and marketing services. All markets are characterized by perfect competition. Gardner shows in the context of his model how shifts in exogenous variables (shocks to supply and demand functions) affect the equilibrium levels of the endogenous variables and the farm-retail price spread. Gardner's paper builds a basic framework for analysis of the interdependent markets that constitute the farm-food retail chain and which can be useful for estimating marketing margins and price transmission in agricultural markets, but it does not allow for imperfect competition.

Several generalizations and extensions of this model exist. Conceptual and empirical framework is expanded by introducing additional refinement to Gardner's model and exploring the roles of trade policy (Chambers, 1983), output price uncertainty (Schroeter and Azzam, 1991) and the nature of causality of farm- and retail- price shocks (Holloway and Hertel, 1996). Holloway (1991) relaxes the assumption of competitive firm behavior in Gardner's model and introduces oligopoly in the retail food industry. The paper develops an empirical methodology for detecting imperfect competition in food marketing and applies it to eight products on the US market. The approach is similar to the one originally developed by Appelbaum (1982) to estimate the degree of oligopoly power.

The empirical NEIO literature has produced a wealth of evidence that many agricultural sectors are characterized by substantial market power in marketing and distribution. Schroeter (1988) used fixed proportions between the farm and marketing inputs to develop a model that allowed for both oligopoly and oligopsony power in the beef packing industry. Small, but significant, market power in both the output and input markets was detected. The evidence of imperfect competition in the meat-packing industry is even more compelling in Azzam and Pagoulatos (1990), who extended Schroeter's model to allow for variable input proportions. An interesting result in this paper is also that the monopsony distortion was much larger than the monopoly distortion. More recently, Bhuyan and Lopez (1997) relax the common assumption of constant returns to scale and estimate the degree of oligopoly power for forty US food and tobacco industries, finding that most industries exhibit significant oligopoly power.

Numerous studies highlight the persistence of oligopsony distortions in agricultural processing and marketing sectors. For example, Just and Chern, (1980) find evidence of price-leadership oligopsony in the tomato market, Schroeter and Azzam (1991) detect oligopsony in the pork-packing industry and Schroeter (1987) finds monopsony price distortion in the beef-packing sector.

Most empirical studies used to detect market power in food and agricultural marketing focus on the US market, because the data are readily available. Empirical evidence of noncompetitive behavior in other countries, on the other hand, is limited. One of the few empirical studies that utilize European data (Gohin and Guyomard, 2000) conclude that the French food retailing sector is characterized by imperfect competition. The data are particularly scarce for developing countries and therefore there are practically no studies on developing economies, although casual reporting on market power in the marketing sector is abundant. One notable exception to this is Lopez and You (1993a), who estimate the degree of oligopsony power in the Haitian coffee sector.

While the NEIO literature typically focuses on testing for noncompetitive firm behavior using measurable market outcomes such as prices and quantities, there are practically no published studies that do the reverse: estimate the effect of market power on market outcomes. Clearly, this shortcoming is due to the fact that market power can not be observed and measured. The few papers that attempt to establish this relationship rely on simulations using either estimated or assumed elasticities of demand and supply. Thus, McCorriston et al.(1998) follow the approach taken by Gardner (1975) and Holloway (1991) to develop a model that explores the role of market power in determining the elasticity of price transmission from farm to retail. The paper focuses explicitly on the transmission of exogenous price shocks from farm to retail and shows how this transmission depends on the extent of oligopoly power. The authors simulate the effect of changes in the market power parameter on the farm to retail price transmission for a hypothetical food sector to demonstrate that transmission elasticity is lower in noncompetitive cases. Again, simulations using developing economies data are extremely scarce. One example of such study is a paper by Lopez and You (1993b), who use estimated supply and demand elasticities in the Haitian coffee sector to calculate the impact of market power on coffee prices.

A related branch of the literature in the area of development economics documents more loosely the presence of imperfect competition in the marketing sector in commodity markets, often focusing on the number of traders in a particular sector, and discusses the potential implications for the welfare of farmers. Special attention in this literature is given to commodity market reforms in developing countries, which had entry of traders and increased competition in the marketing sector as one of the objectives, and their consequences for marketing margins and farm-gate prices (Akiyama et.al, 2001). The evidence of the reforms being successful in enhancing competition among commodity traders has been mixed. Typically, the studies do find that market reforms produced an inflow of private traders and reduced the marketing margins, for example in the study of the Tanzanian coffee system by Winter-Nelson and Temu (2002). However, consistency and effectiveness of the reforms have been questioned. Using the data from a survey of traders in Madagascar, Barrett (1997) concludes that that post-liberalization entry is constrained by a number of factors such as sunk costs, access to capital and relationship to the state food marketing channel.

Concerns have also been raised about the fact that while liberalization initially produced an inflow of private traders into marketing to replace the inefficient state trading enterprises, at a later point buyer concentration increased substantially and collusion among traders became common. Today, marketing and exporting activities in many commodity producing countries are dominated by few domestic or multinational firms as barriers to entry persist. Thus, in Tanzania, in 2000/2001 the Coffee Board revoked the buying licenses of private traders, effectively handing monopsony power to the cooperative unions (Baffes, 2005).

This paper contributes to the existing literature with empirical analysis of farm-gate coffee producer prices in India. The goal of the study is to estimate the impact of competition in the marketing sector, as perceived by growers, and other market variables on producer prices. As explained above, the empirical NEIO literature typically seeks to detect and quantify market power and rarely evaluates the effect of this market power on producer prices. On the other hand, development economics literature provides some interesting observations and basic analysis of the competition issues in commodity markets, but does not provide convincing empirical evidence of the relationship between oligopsony power of traders and prices received by growers. This paper intends to fill these two gaps.

3.3 Coffee production and marketing in India

3.3.1 Production and processing

India's contribution to world's coffee production and export is modest, yet it is increasing steadily. Coffee exports more than doubled from 1990 to 2005 and at the same time India's share in global trade increased from 2% to 4%. Production fell substantially in the years following the coffee price crisis in 2000-2003, but recovered remarkably in 2005 and grew by 20%, despite continued slump in global production. In the 2005/06 harvest period the total production reached 294 thousand MT and about 70% of it was exported. Approximately two thirds of Indian exports are of Robusta variety and one third is Arabica coffee[4]. The most important export markets are Italy, Germany, Belgium and Russia, which together account for over half of the volume of Indian exports of coffee. Coffee growing is concentrated in 3 southern states: Karnataka, Kerala and Tamilnadu. It is estimated that nearly 5 million people in total depend on income from coffee production either through ownership of plantations, farm labor (578 thousands in 2005/06) or employment in processing, roasting, soluble manufacture and export sectors (CRMG 2003). According to the Coffee Board of India, in 2003/04 72% of all coffee growers were smallholders with planted area less than 10 hectares. These farms produce approximately 60% of all Indian coffee.

Producers choose to grow either Arabica or Robusta coffee or both and they perform basic processing on the farm before selling the coffee. The production cycles for both Robusta and Arabica start in April. Harvesting of Arabica starts in December, and Robusta is harvested in January and February. Most farmers do not carry over stocks and therefore most coffee is traded locally and exported in the months following the harvest, with largest volumes traded between March and May.

The two processes used in India to transform raw coffee into the green bean are the dry method and the wet method (washing). The berries of the coffee plant, both Arabica and Robusta, are harvested and subjected to on-farm processing to extract the bean in its raw form. The dry method is the simplest and least costly method as it requires little machinery. Drying is typically done by spreading the ripe

[4] Arabica coffee exported by India is classified as Other Milds type by the International Coffee Organization.

cherries in the sun. Most Robusta coffee undergoes this type of processing. The wet method requires the use of specific equipment and substantial quantities of water and is therefore more costly. The principal difference between dry and wet processing is that when wet method is applied, the flesh of the berry (pulp) is removed from the coffee bean before the drying stage. Consequently, the degree of on-farm processing is far higher under the wet method and that is reflected in the farm-gate price. Moreover, the wet method allows the intrinsic qualities of the coffee beans to be better preserved, producing a green coffee which is homogeneous and has few defective beans. Hence, the coffee produced by this method is usually regarded as being of better quality and commands a higher export price. The dry-processed (unwashed) coffee, on the other hand, is likely to have inferior aroma and flavor and therefore receives a lower price. India Coffee Board price data shows that unwashed coffee sold at farm-gate receives on average only 45-50% of the washed coffee price.

The last stage of coffee processing for both types is “curing”, which usually takes place at a curing plant shortly before the coffee is sold for export. Typically the process involves mechanical removal of stones, dirt and sticks, hulling (removal of the husk cover in the case of unwashed coffee and parchment cover in the case of washed coffee), screening, grading, sorting by color which allows elimination of defective beans and bagging into 50 kg bags.

3.3.2 Marketing

The marketing chain for coffee in India consists of four major players: growers, intermediaries (agents and traders), curing plants and exporters. Typically, local traders or agents for exporters and curing plants purchase coffee directly from plantation owners at the farm-gate, that is, traders come to estates to purchase coffee. All trade is made on the spot, with immediate payment and delivery. The use of production contracts and options is very limited. Small growers typically deliver dry-processed cherry, while larger estates that own the necessary equipment deliver washed coffee. Most local traders are linked to exporters, which are all Indian-owned companies, with little or no foreign participation. There are approximately 40 major buying centers and in general the level of competition among local traders is perceived as high. However, smaller growers, and in particular in remote areas, often deal with only one buyer, and a common claim is that farmers are not well informed about the local coffee prices making it easy for the trader to take advantage of them. They often receive the information regarding current market conditions directly from traders and are not convinced that the information is correct.

After the curing process has been completed, curers or agents sell the coffee to exporters or to domestic wholesalers, either directly or through the weekly Indian Coffee Traders Association (ICTA) auction in Bangalore. Agents, traders and curers bring a sample of cured coffee (green beans) to the auction where coffee is sold though oral, ascending bid English auction to exporters and local buyers. Based on the type of processing (dry or wet), four types of raw coffee beans are traded in the Indian market: Washed Arabica (commercially known as Plantation); Unwashed Arabica (commercially known as Arabica Cherry); Washed Robusta (commercially known as Robusta Parchment) and Unwashed Robusta (commercially known as Robusta Cherry). Because the washing method is better for preserving the quality of the coffee, the final product (green bean) that underwent wet-processed received higher price than coffee that was processed by the dry method.

There are two main producer organizations in Karnataka. Larger farms belong to the United Planters Association of South India, whereas smaller estates are often members of Karnataka Growers Federation. There are very few grower cooperatives, the most important one is Comark, which provides credit to members and also operates small-scale insurance schemes. According to the India Coffee Board , the quality is fairly homogeneous across estates and green coffee is not graded by farms prior to the sale. Local prices vary during the harvest year: prices are typically lowest during harvest time when most growers sell their coffee and rise as the supply shrinks.

3.3.3 Policy

Prior to the liberalization of the coffee market, the Coffee Board (CB) was in full control of coffee purchasing, processing and exporting. The CB ran two auctions: one for the domestic market and one for the export market. Growers were paid in two stages: an advance at the delivery point and after the coffee has been auctioned. Given the inefficiencies of the marketing system, this meant that in some cases growers had to wait up to two years after the delivery to receive their payment in full.

The reforms were introduced gradually, starting in 1992-1993 when producers were allowed to market 30% of their own crop on the domestic market, with the remaining coffee sold at the CB's auctions. By 1996 the CB's involvement in marketing ended completely, and coffee growers and exporters were free to trade the crop as they chose. Pooling of coffee into compulsory auctions had also ended.

Auctions are still held every two weeks but the volumes traded there are quite small. These changes meant that the producers received payment much faster, within days after sale. Coffee can be sold at farm-gate to domestic agents and exporters. The number of registered exporters increased from approximately 50 to almost 100 since early 1990's.

The role of the CB today is limited to quality improvement programs, research, providing market information, export promotion and other non-interventionist functions. CB has 33 members: 11 central and regional government representatives and 22 are private industry (11 of which are growers – 3 large-scale and 8 small-scale producer groups).

Liberalization had two important implications for the growers. On the one hand, a more efficient market characterized by a greater degree of competition among traders led to contraction of the marketing margins and a greater share of producer prices in the world market price, as established in Chapter 2. On the other hand, liberalization left farmers exposed to fluctuations in the global prices, as protection in the form of pooled prices and variable export tax rates was removed. During the coffee price crisis that began in 2001 the drastic reduction in world market prices was passed on fully to farmers and their incomes plummeted, turning into losses in many cases. Combined, these two effects meant that the impact of liberalization on producer income during last decade has been ambiguous.

3.4 Methodology

To estimate the impact of competition among traders on prices received by growers, a basic food industry model with two inputs (farm commodity and marketing service) and one output is developed, along the lines of Gardner (1975). The model allows for noncompetitive firm behavior, following in the conceptual footsteps of Appelbaum (1982) and Holloway (1991). Rather than considering oligopoly, as in these two papers, this chapter analyzes the case of oligopsony power in the marketing sector. A departure from the typical farm-retail price ratio models (McCorriston et.al 1998 and 2001) is that the price of output (green coffee for export) is the exogenous world market price p^w. Given that India supplies only 4% of all coffee traded internationally, India is assumed to be a price taker in the world coffee market. Traders buy coffee from growers at the farm-gate, bring it to curers and then sell the processed coffee to exporters. Traders have identical production functions and, given their limited number, exhort oligopsony power over producers in each area where they operate.

For simplicity, assume a generalized Cobb-Douglas industry production function $Q(A,X) = \mu A^{\alpha} X^{\beta}$, where Q is the quantity of wholesale green coffee, A is the quantity of coffee bought by traders from coffee estates and X is the quantity of a composite input that includes transportation and processing. Profit maximization by traders yields input demand for marketing inputs and coffee at farm-gate, with first-order conditions for profit maximization by traders (who also supply services X):

$$p^x = p^w f_X \tag{3.1}$$

and $$p^a\left(1+\frac{\theta_i}{\varepsilon}\right)=p^w f_A \qquad (3.2)$$

where θ_i is the conjectural variation coefficient $\frac{\partial A}{\partial A_i}\frac{A_i}{A}$ that describes the belief of trader *i* regarding how her own actions affect the total quantity of raw coffee demanded, and ε is the price elasticity of coffee supply by farms, $\frac{\partial A}{\partial p^d}\frac{p^d}{A}$. p^a and p^x are the prices of coffee sold at farm-gate and marketing services, respectively. θ ranges from 0 (perfect competition) to 1 (monopsony). Any value in between is consistent with Cournot competition. Given that traders have identical technologies and pay the same prices for inputs *x*, in equilibrium all trader's conjectures are identical, so that $\theta_i = \theta$.

Furthermore, assume constant elasticity of supply for both the composite input and coffee at farm-gate[5]. Taking the log of the production function as well as the supply and demand equations yields the following system of equations:

$$\ln Q = \mu + \alpha \ln A + \beta \ln X \qquad (3.3)$$

$$\ln p^x = \frac{1}{\gamma}\ln X \qquad (3.4)$$

$$\ln p^a = \frac{1}{\varepsilon}\ln A \qquad (3.5)$$

[5] It should be noted that farm supply of coffee, a tree plant, is to a large extent determined by planting decisions made years earlier. Quantities produced depend on the area planted as well as yield, and farmers typically harvest all the coffee. Thus, the short-run supply elasticity is close to zero. However, in the long run adjustments can be made both to acreage and inputs of fertilizers and pesticides, based on price expectations. Moreover, faced with liquidity constraints and being risk averse, some farmers exit the sector when prices become sufficiently low. Therefore, in the long-run supply elasticity is greater than zero.

$$\ln p^x = \ln p^w + \ln f_X \tag{3.6}$$

$$\ln p^a = \ln\left(\frac{\varepsilon}{\varepsilon+\theta}\right) + \ln p^w + \ln f_A \tag{3.7}$$

Equating (3.4) and (3.6) and using (3.5) as well as marginal products $f_A = \alpha\mu A^{\alpha\text{-}1}X^{\beta}$ and $f_X = \beta\mu A^{\alpha}X^{\beta\text{-}1}$ to solve for ln X results in

$$\ln X = \frac{\gamma}{1+\gamma(1-\beta)}\left(\ln p^w + \alpha\varepsilon \ln p^a + \ln\beta + \ln\mu\right) \tag{3.8}$$

This, together with (3.5), inserted into (3.7), yields

$$\ln p^a = \frac{1}{D}\left[(1+\gamma)\ln\mu + C\ln\alpha + \gamma\beta\ln\beta + (1+\gamma)\ln p^w + C\ln\left(\frac{\varepsilon}{\varepsilon+\theta}\right)\right] \tag{3.9}$$

where $C = 1 + \gamma(1-\beta)$ and $D = (1+\varepsilon)C - \varepsilon(1+\gamma)$.

Equation (3.9) expresses lnp^a in terms of exogenous variables only and represents the market equilibrium that is the solution to the system of equations (3.3) – (3.7). The expression shows the relationship between the farm-gate prices and the export price, as well as the conjectural variation describing competition among traders and other exogenous variables.

Note that a sufficient condition for the partial derivative of lnp^a with respect to lnp^w to be positive (and to be negative with respect to θ) is production function exhibiting either decreasing or constant returns to scale ($\alpha + \beta \leq 1$). Increasing returns to scale could potentially result in a contra-intuitive result that farm-gate prices are declining in world price.

For further simplification assume a Cobb-Douglas production function ($\alpha + \beta = 1$). Then equation (3.9) reduces to

$$\ln p^a = \frac{1}{1+\gamma\alpha+\varepsilon(1-\alpha)}\left[K+(1+\gamma)\ln p^w+(1+\gamma\alpha)\ln\left(\frac{\varepsilon}{\varepsilon+\theta}\right)\right] \tag{3.10}$$

where

$K = (1+\gamma)\ln\mu + (1+\gamma\alpha)\ln\alpha + \gamma(1-\alpha)\ln(1-\alpha)$

is a combination of parameters common to all producers. Clearly, in this setting the price paid to growers is positively related to the world price and is negatively affected by noncompetitive behavior of traders captured by θ. That is, we can expect the price paid to growers be declining as the marketing sector moves from perfect competition to oligopsony.

Note that the elasticity of farm-gate price with respect to the world price $\frac{\partial \ln p^a}{\partial \ln p^w}$ equals one if input supply elasticities are the same for farm input and marketing services, $\varepsilon = \gamma$. The elasticity is greater that one if $\varepsilon < \gamma$ and less than one if $\varepsilon > \gamma$. That is, producer prices increase proportionally less than the world price only if the supply of farm input is more elastic than the supply of marketing services.

The last term on the right-hand side of (3.10) can be approximated by a linear expression in θ, θ^2 etc. by applying a Taylor Series expansion. Around $\theta = 0$ quadratic approximation with Taylor expansion yields

$$\ln\left(\frac{\varepsilon}{\varepsilon+\theta}\right) \approx -\frac{1}{\varepsilon}\theta + \frac{1}{2\varepsilon}\theta^2 \tag{3.11}$$

The first derivative of this expression with respect to θ is negative, since θ is between 0 and 1.

The empirical strategy is to verify the sign and estimate the magnitude of the relationships established above. I estimate a modified form of equation (3.10) in which a distinction is made between the conjectural variation θ and the perceived ability of the growers to switch between different traders, which is the information contained in the survey. The respondents are asked whether or not they find it easy to switch between buyers. It can therefore be expected that θ is a function of the dummy variable associated with the response:

$$\theta = k(M) \qquad\qquad k'(M) \leq 0$$

$$M = \begin{cases} 0 & \text{not easy to switch buyers} \\ 1 & \text{easy to switch buyers} \end{cases}$$

Based on the above, the empirical model is:

$$\ln p_i^a = \alpha + \beta \ln p_i^w + \eta M_i + \sum_j \psi_j r_{ij} + \sum_h \phi_h s_{ih} + \varepsilon_i \tag{3.12}$$

where p_i^a is the price paid to grower *i* at farm-gate, p_i^w is the world market price corresponding to grower *i*, M_i is the variable describing the perceived level of competition among traders that purchase from *i*, r_{ij} are dummy variables describing marketing channels used by farmer *i* and farmer's access to information regarding local prices and s_{ih} are personal and farm characteristics.

The idea behind including availability of information about local prices is that violation of the standard assumption of perfect information would affect the equilibrium price paid to growers. Without adequate access to information about prices offered by other traders in the area, the reservation value of coffee harvested may be very low. That is, not knowing the price that the grower may receive elsewhere is likely to reduce the price at which she is willing to sell her coffee. The hypothesis to test here is whether being better informed improves the bargaining power of the seller and therefore increases the price she receives.

The variable p_i^w needs to be clarified. While at any given point in time traders that buy coffee from growers in Karnataka face essentially the same export price, growers sell coffee at different times throughout the year, with most sales realized immediately after harvest. Fluctuations in the world market price in the course of a year can be considerable. That is, depending on when the farmer sells her output to traders, the export price could be higher or lower. Moreover, the survey is designed in such a way, that we only know the average price for the 2001/2002 harvest season realized by each producers and the quarterly distribution of sales from each farm. Meanwhile, price fluctuations during harvest year can be significant – producer prices tend to increase as supply gradually dries out after the harvest period. Average price received by growers as reported in the survey is therefore an annual average, weighted by quantities sold in each period. In order to analyze the relationship between farm-gate and export prices we need to make the two variables comparable. To do that, I construct a weighted export price for each producer, using the distribution of coffee sales across quarterly periods in one harvest year from the farm and quarterly export prices for Indian coffee:

$$p_i^w = \sum_{t=1}^{4} p_t^w a_{it}$$

where p_t^w is the world market price received in period t and a_{it} is the share of total production sold in period t. The periods refer to first, second, third and fourth quarter of 2002, respectively. The resulting indicator reflects the composite export price that can be compared to the average price received by each grower. It can also be thought of as the average price the farmer would have received if he sold her coffee directly on the world market without any intermediaries.

Apart from equation (3.12) I also estimate a regression where producer price share is used as the dependent variable:

$$p_i^a \big/ p_i^w = \alpha + \eta M_i + \sum_j \psi_j r_{ij} + \sum_h \phi_h s_{ih} + \varepsilon_i \qquad (3.13)$$

Note, however, that the theoretical model developed above does not warrant imposing the restriction that the producer price share is constant. The hypothesis that the share of producer price in the export price (and consequently the share of marketing margin in the export price) is constant in p^w is tested by estimating equation (3.12) and then testing for β being equal to 1.

3.5 Data

The cross-section farm-level data on producer prices, marketing channels, availability of information and grower characteristics come from a survey of coffee producers in Karnataka conducted by the Commodity Risk Management Group (CRMG) of the World Bank in cooperation with the Coffee Board of India[6]. The survey comprised five hundred farms from the hillsides of Karnataka[7] where most of the coffee in India is grown. The responses regarding quantities produced and marketed refer to 2001/2002 harvest year.

[6] Concerned with the adverse effect of the coffee price crisis on growers, the Coffee Board of India began investigating the opportunities for a price risk management project jointly with Canara Bank, a state-owned bank that provides credit to coffee planters and CRMG. The survey was intended to obtain market information for designing a pilot price risk insurance program and to explore the demand among growers and their ability to pay for price insurance

[7] Chikmagalur, Hassan and Kodagu districts.

Most of the surveyed growers in Karnataka are smallholders – 61% have 25 hectares or less. On average, over 90% of the estate's area is used for coffee and 90% of income is derived from farming. Coffee accounts for 80% of farm income on average. Clearly, farmers rely on coffee for their livelihood and the impact of coffee prices on household income and welfare is tremendous. Other crops include pepper, cardamom, oranges and bananas.

Growers appear to have good knowledge about local prices: 96% responded that they knew what the price was. More than half (54%) of farmers sell all their coffee to traders, 18% sell all output to curers, 8% sell to agents working for exporters and 4% sell directly to exporters. The remaining growers sell to different buyers in various proportions. It is interesting to note that exporters deal predominantly with larger sellers, while smaller farms typically sell to local traders (Table 3.1). In terms of production, those growers in the survey who sell only to an exporter produce on average three time the quantity of coffee produced by those who only sell to local traders.

More than half of growers receive their information regarding prices predominantly from local traders and agents. In addition, 21% list curing plants as their primary source of information. Only 12% of farmers rely on newspapers for price information and 3% use internet. It is interesting to note, that among those who sell all output to traders and agents, which is the majority, most (70%) also declare them as the most important source of information. That is, 42.5% of all growers sell exclusively to local traders and also receive market information from them (Table 3.2). About half of those who sell all output directly to exporters and curers also rely on their buyer to convey the price signals. This is consistent with the claims made by farmers that they typically receive the price information from their buyers and lack access to independent sources of information. It is also interesting to note that most growers find that it is easy to change buyers (87.8%). However, this seems to depend on the location of the farm. While only 8.4% of farms that are located within 10 kilometers from any town report difficulty with switching buyers, the proportion doubles to 16.1% when farms are located further. Altitude affects the level of competition in a similar way, since farms located above 3000 feet are twice as likely to report that they find it difficult to change buyer (Table 3.3).

Coffee is sold throughout the year, although most sales are realized within the first six months following the harvest (68%). Carrying over the stocks to next year is rare as the use of storage is limited (only 6% of farmers hold stock) due to immediate cash needs and fear of falling prices. On the other hand, those who kept stock did it in expectation of higher prices and as a form of saving. Half of all growers are members of a cooperative and 22% are members of both cooperative and a grower's association.

As is evident from Table 3.4, marketing margins appear rather high in India. Unwashed coffee receives only 43-45% of the price realized at the auction, while washed coffee receives approximately 73%. The large difference in these figures is explained by the fact that washed coffee undergoes substantial processing at the farm prior to the sale, while unwashed coffee requires additional operations, as explained in Section 3.3.

The export price used in the analysis is the average auction price realized at the weekly auction of the Indian Coffee Trade Association (ICTA) in Bangalore. In principal, one could also use the world market prices: International Coffee Organization (ICO) prices, reported separately for arabica and robusta in green beans equivalent. However, there are two problems with using ICO prices. First, these prices don’t allow us to assess the gaps between the world price and farm-gate price separately for wet and dry-processed coffee. Second, these are not equivalent to India’s export prices, but average prices of traded coffee at the New York and London stock exchanges from few benchmark countries. The ICO indicator price therefore does not reflect the specific quality of Indian coffee, which would affect the price India receives on the world market. Using the ICTA auction price offsets these weaknesses, as it reflects the wholesale/export prices for each of the four groups marketed in India: washed Arabica, unwashed Arabica, washed Robusta and unwashed cherry. Although volumes traded at the auction are modest relative to quantities sold directly to exporters, the prices provide a good approximation of India’s export price at any given point in time. Coffee sold at the auction can either be exported or consumed domestically, however domestic prices tend to adapt to world market prices, given that most coffee produced in India is exported, and there is no export tax or other policy distortions. Thus, the ICTA prices allow us to assess the marketing margins in India more accurately then when using world market prices of coffee traded in New York and London.

The evolution of world market prices (ICO indicator price), ICTA auction prices and producer prices (ICO average prices in green bean equivalent) between

2002 and 2007 is depicted in Figures 3.1 and 3.2. In the case of Arabica coffee the price time series follow each other closely. The auction prices for both wet and dry processed Arabica are below the ICO indicator price, except in the end of 2006, which is to be expected, since the ICO Other Milds for Arabica coffee price is based on the prices of coffee originating from four Latin American countries typically associated with high quality coffee and is usually processed by the wet method only[8]. The average producer prices lie between the two ICTA prices, which is consistent with the fact that the grower price is calculated combining wet and dry-processed coffee. Turning to Robusta coffee, we note that there is a close relationship and very little gap between the ICO indicator, producer prices and the auction price for unwashed coffee, however the auction price for washed Robusta is significantly higher than all of them, although the fluctuations seem to follow the overall trend. The explanation could be that Robusta coffee in India is typically produced using the dry method and those few producers who use the more expensive washing method are inclined to do so to preserve the intrinsic quality of a particular type of coffee. In the sample we find evidence that those estates that trade washed Robusta are located at higher altitude, which is likely to have a positive impact on the quality.[9]

3.6 Estimation results

Tables 3.5 and 3.6 show the estimation results based on equations (3.12) and (3.13), respectively, for all coffee types. The independent variable in Table 3.5 is the log of

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[8] Costa Rica, El Salvador, Guatemala and Mexico.

[9] Coffee beans are graded according to their density, with a higher density receiving higher value. There is a positive correlation between coffee density and the altitude that the coffee plant is growing at. As a result, gourmet coffee usually encompasses coffee beans grown from Arabica coffee plants that are situated at a high altitude.

producer price and in Table 3.6 producer price shares are used. Note that the auction price used as the export price is type-specific. Three different model specifications are used: 1) a model that includes personal and farm characteristics, ease of switching buyers and price awareness, 2) a model that adds marketing channels to the above and 3) a model that adds marketing channels and membership in a producer association.

The results show that when Arabica and Robusta coffees are pooled together, the level of competition (ease of switching buyers) does not seem to matter. Moreover, marketing channels don't play a major role in determining the margin between producer price and export price: curers, traders and exporters do not offer significantly different prices to producers. The hypothesis of the elasticity of producer price with respect to export price being one is rejected at 5% significance in all cases. Neither gender nor age has significant impacts on prices received. But education level of growers matters: growers with secondary and university education fetch higher prices than those with primary education only by 4% and 5%, respectively. Distance to nearest town and membership in cooperatives and producer organizations do not seem to affect the prices when all coffee is pooled together, but altitude matters: higher location brings in a premium. The coefficient on knowing the local price is positive, but significant only at 10%. Washed coffee captures significantly larger share of the realized price than unwashed, which is consistent with the fact that an important part of the processing is done on farms and therefore the price reflects the returns to labor as well as equipment used for wet processing. In addition, the price of unwashed Robusta is significantly lower than the price of unwashed Arabica.

Next, I estimate the same equations separately for each type of coffee traded on the Indian market: washed Robusta, unwashed Robusta, washed Arabica and unwashed Arabica. The reason for that is twofold. First, yields, production technology and processing methods vary substantially between Arabica and Robusta, which may affect how the variables in question influence prices received. For example, Arabica variety requires higher altitude, and since quality is typically positively correlated with altitude, location of the farm could affect the price differently depending on which type of coffee is sold. Second, there are more possibilities for diversification and producing higher quality and specialty coffees in the case of Arabica, in particular when it is wet-processed. Some of the quality Arabica could receive a premium on the world market, while Robusta, which is a cheaper and more basic variety, is a more homogenous product, and there is little variation in prices received by the growers. The farm-gate prices for Robusta coffee, in particular the unwashed kind, are therefore less likely to be driven by the quality of the coffee, while the price differentials in Arabica coffee could be due to quality dispersion, which is unobserved. I also do a Chow test for differences in coefficients estimated using the Arabica and Robusta coffee separately and conclude that separate regressions should be used (Table 3.15).

The results for Robusta and Arabica vary dramatically. Tables 3.7 through 3.10 report the results for the Robusta variety. For unwashed Robusta, the main result is that the level of competition among traders (the perceived ease of switching buyers), the type of marketing channel and distance to nearest town all have significant impacts on farm-gate prices (Table 3.7). Those are important findings, given that most Robusta coffee in India is processed by the dry (unwashed) method. If a grower can easily switch buyers, it increases the price she receives by 9%, which indicates that greater competition substantially reduces the margin between farm-gate and border price. Selling the output exclusively to exporter also increases the price substantially: it raises the farm-gate price by 13% or 17%, depending on model specification, which is consistent with the expectation that fewer intermediaries in the marketing chain would reduce the marketing margin. Distance to nearest town has a significant and negative coefficient in the case of unwashed Robusta, reflecting the local transportation cost. The estimated coefficient implies that the price declines with distance to nearest town, approximately 0.3% for each kilometer. The median distance to town in the sample is 10 km, but 5% of all farms are located more than 28 km from any town. If those remote farms were located 10 km to the town, they could receive at least 3% more for their output. Finally, growers with university education receive 8% higher prices than those with only primary education. The hypothesis of the coefficient of $\ln p^w$ being one is rejected in the case of unwashed Robusta. The coefficient is 0.39 and significant at 5% significance level.

On the other hand, the elasticity of farm-gate price for washed Robusta with respect to export price is significantly greater than one when the full model is considered (Table 3.9). The coefficient on ease of switching is buyer is even higher than for unwashed Robusta, however it is only significant at 10% when log prices are used and only in the full model. It is insignificant when price share is used as the dependent variable (Table 3.10). The sellers of washed Robusta receive significantly higher prices (18%) if they sell all output either to exporters (significant at 10% and only in the full model) or traders, rather than to curers. An interesting result is that for sellers of washed Robusta membership in a cooperative could increase the price by entire 23%, implying that growers may be able to secure a higher price if they bargain with market intermediaries collectively. In terms of producer price share the result is that cooperative membership would increase the share by 16 percent points. Interestingly, knowing the level of local prices does not affect the farm-gate price for either washed or unwashed Robusta.

The estimation results for Arabica are far less telling, as it can be seen from Tables 3.11 through 3.14. The regression for unwashed Arabica provides a very poor fit (only 7% of the variation in the log domestic price can be explained by the full model), and therefore provides no useful information regarding the interplay of the variables in question. The only variable with a coefficient significantly different from zero (at 10% significance) is the dummy for university education. When the washed type is considered, the only determinants of prices that are significant at 5% are distance to town (which has a contra-intuitive sign), altitude and the type of buyer. Neither the ease of switching buyers nor awareness of local prices affects producer prices. While these results are somewhat discouraging, they are nevertheless consistent with the observation that quality and consistency play a greater role in determining prices for Arabica coffee than for Robusta. The quality can not be observed directly, but quality expectations of a buyer based on a previous experience with the grower would certainly affect the interaction between the two. The closest indication we have of the quality is the altitude, and it indeed has a positive and significant coefficient. Among the surveyed producers, the average altitude for

Arabica growing estates is 3250 feet and the maximum is 4920 feet. Based on the estimated coefficient the predicted difference in prices between a higher and a lower location, when the difference in altitude is 1000 feet, is almost 7%. The estimated coefficient on distance is contra-intuitive: the price seems to increase with distance to nearest town. However, this could be related to the fact that the farms that are located at higher altitudes are also located further from towns. The type of buyer affects the price for washed Arabica: growers receive less if they sell all coffee to a curing plant rather than to an exporter or diversify their marketing channels.

A further exploration into competition among marketing intermediaries through maximum likelihood estimation of a probit model reveals that the ease of switching buyers depends on the location of the farm (Table 3.16): the probability that it would be easy to choose among traders declines with the distance to nearest town and altitude. This indicates, at least in the case of unwashed Robusta, that remote farms not only receive lower prices because of the transportation costs, but also because fewer traders operate in the area and would take advantage of the market power they possess.

There are two possible explanations for the relatively poor fit of some models, in particular for unwashed Robusta and Arabica. First, any model that attempts to explain the price differentials across producers will inevitably suffer from unobserved heterogeneity related to quality. Although there is reportedly little variation in the quality of coffee produced in Karnataka and coffee is sold ungraded by growers, as explained in Section 3.3, traders are likely to have certain expectations about the quality of coffee produced at each farm. It is plausible, that based on previous interactions of the grower, traders and exporters would form expectations regarding the average grade of coffee from each location and pay each estate accordingly. Moreover, traders value consistency (uniform quality and timely delivery) and could have the incentive to reward consistent suppliers through higher prices to prevent them from switching to other buyers. Since quality and consistency are not observable, this fact could affect the results. Second, the empirical strategy relied on relating average producer price to the average auction price based on quarterly sales. However, there may be significant fluctuations in price from one month to another and this would not be captured by the data, since monthly distribution of sales is unknown. For example, from October to November 2002 (the year of the survey), the world market price for Robusta, as well as the average producer price across India, jumped 14%. A grower that sold more of his coffee in October would be expected to receive a lower average price than someone who sold more output in November.

3.7 Conclusions

This paper provides an empirical analysis of producer prices in the Karnataka state. The principal result is that determinants of prices vary substantially by the type of coffee trader. The overall results are therefore mixed. The empirical findings indicate that the prices for Arabica coffee are driven by the unobserved quality of the coffee more than by marketing conditions. Arabica coffee exhibits both higher average prices and a greater spread in premiums than Robusta coffee, which is a more homogeneous commodity. In the case of Robusta, in particular the most common unwashed type, the evidence is that ease of switching buyers, which is indicative of the degree of competition among traders, plays an important role in determining prices to growers, consistent with the theory. The implied price increase associated with the shift towards a greater competition among traders in line with the findings in Lopez and You (1993b), who find that the move from oligopsony to perfect competition in Haiti would increase farm-level prices by 17%, although the magnitude of this effect is found to be smaller.

While almost 90% of growers in the survey find it easy to switch buyers, there are still some remote farms that not only lose income due to higher transportation costs, but also experience distortions associated with monopsonistic competition. The analysis also points towards the value of education: those with university education are able to negotiate higher prices. In some cases (washed Robusta) we find that membership in a cooperative has a tremendous impact on prices, presumably though collective bargaining and the scale effect of pooling the coffee together. The evidence is also mixed regarding the effect of transportation costs on prices: only in the case of Robusta we find that prices decline with distance to nearest town.

The fact that altitude has a positive effect on price is driven by the relationship between the altitude-dependent climatic conditions the taste of the coffee, as found in other studies, for example in Avelino et.al. (2005) for Costa Rica.

The type of marketing intermediary seems to matter for equilibrium prices, but the results vary by coffee type: sellers of unwashed Robusta receive highest prices from exporters; washed Robusta is more profitably sold to traders, and in the case of washed Arabica it pays off to sell through outlets other than curing plants. Thus, the often expressed claim that passing intermediaries by selling directly to exporters increases the prices to producers only holds for unwashed Robusta. This particular finding naturally raises the question why all growers, knowing that different intermediaries offer different prices, do not simply choose the most profitable outlet? A possible reason could be that not everyone is able to establish a relationship with a well-paying buyer. Most major exporters require consistent quality and relatively large volumes of trade. It is therefore harder for a smallholder to sell directly to exporters. Collective negotiation of contracts and pooling of coffee for marketing at the village level could help to overcome these constraints.

Figure 3.1 Producer and wholesale Arabica prices in India

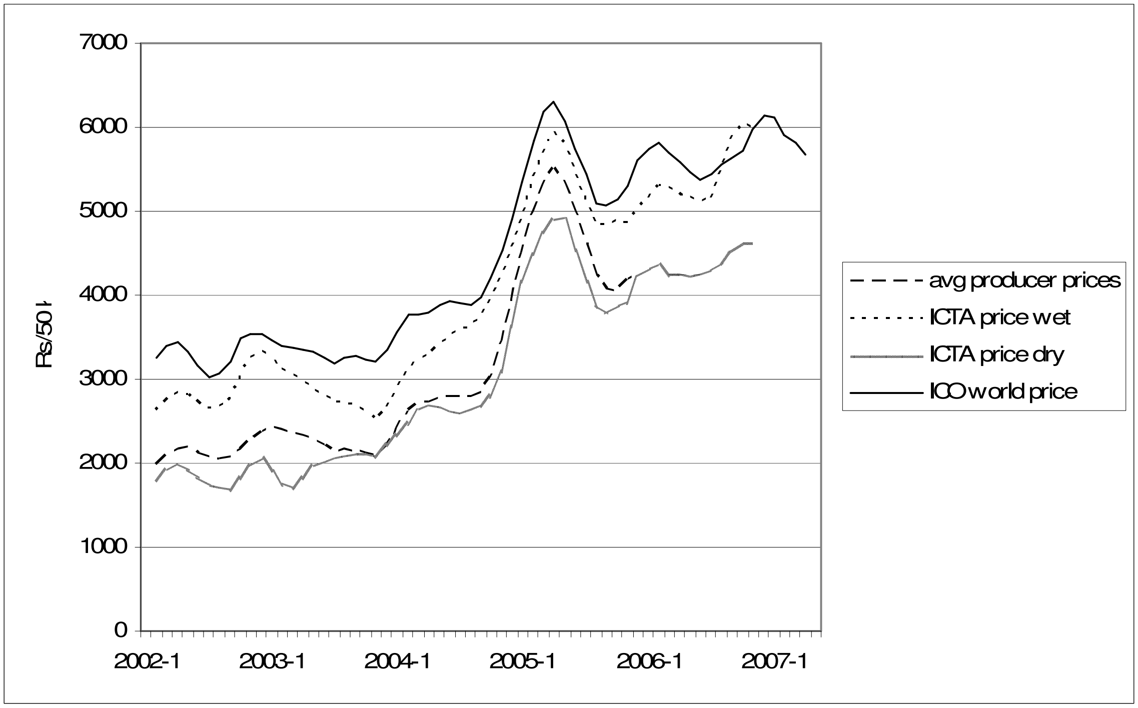

Figure 3.2 Producer and wholesale Robusta prices in India

Table 3.1 Marketing and farm size

	Area estate		
Buyer	<=25 acres	>25 acres	Total
Exporter	0.8%	3.0%	3.8%
Exporter agent	6.0%	1.8%	7.8%
Curing plant	7.2%	10.4%	17.6%
Local trader	41.0%	12.8%	53.8%
Mix	6.4%	10.6%	17.0%
Total	61.4%	38.6%	100.0%

Table 3.2 Marketing and source of information

	Main source of information						
Buyer	Exporter	Curing plant	Trader/agent	Internet	Newspaper	Other	Total
Exporters	1.8%	0.4%	0.4%	0.6%	0.2%	0.4%	3.8%
Curing plants	1.0%	9.2%	4.0%	0.8%	1.8%	0.8%	17.6%
Trader/agent	1.0%	6.8%	42.4%	0.2%	9.0%	2.2%	61.6%
Mix	2.2%	4.8%	6.4%	1.4%	1.2%	1.0%	17.0%
Total	6.0%	21.2%	53.2%	3.0%	12.2%	4.4%	100.0%

Table 3.3 Ease of switching buyer, distance to nearest town and altitude

	Distance to nearest town		Altitude	
Ease of switching buyers	< 10 km	>= 10 km	< 3000 feet	>= 3000 feet
Not easy	8.4%	16.1%	7.4%	15.9%
Easy	91.6%	83.9%	92.6%	84.1%
Total	100.0%	100.0%	100.0%	100.0%

Table 3.4 Average producer price share by coffee type

	Arabica	Robusta
Dry processed	44.6%	42.5%
Wet processed	72.5%	73.3%

Table 3.5 Determinants of farm-gate prices: All coffee

	y: ln(pd)			y: ln(pd)			y: ln(pd)		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
Export price (ln)	0.3553	***	(0.1186)	0.3483	***	(0.1191)	0.3436	***	(0.1194)
Dummy washed arabica	0.7364	***	(0.0475)	0.7393	***	(0.0477)	0.7405	***	(0.0478)
Dummy unwashed robusta	-0.2393	***	(0.0385)	-0.2441	***	(0.0386)	-0.2449	***	(0.0388)
Dummy washed robusta	0.4284	***	(0.0234)	0.4279	***	(0.0236)	0.4277	***	(0.0237)
Dummy secondary education	0.0377	**	(0.0173)	0.0369	**	(0.0173)	0.0386	**	(0.0174)
Dummy university education	0.0522	***	(0.0177)	0.0550	***	(0.0178)	0.0571	***	(0.0180)
Gender (female=0; male=1)	-0.0028		(0.0233)	-0.0060		(0.0233)	-0.0048		(0.0234)
Age	0.0027		(0.0026)	0.0025		(0.0026)	0.0027		(0.0026)
Age squared	-1.2E-05		(2.3E-05)	-1.1E-05		(2.3E-05)	-1.1E-05		(2.3E-05)
Distance to nearest town	0.0004		(0.0005)	0.0005		(0.0005)	0.0005		(0.0005)
Altitude	3.9E-05	***	(1.2E-05)	3.9E-05	***	(1.2E-05)	3.7E-05	***	(1.2E-05)
Dummy ease of switching buyer	0.0105		(0.0149)	0.0115		(0.0149)	0.0098		(0.0150)
Dummy know price	0.0388	*	(0.0212)	0.0388	*	(0.0213)	0.0387	*	(0.0213)
Dummy member of cooperative							-0.0002		(0.0097)
Dummy member of grower association							-0.0080		(0.0101)
Dummy member of other producer organization							-0.0197		(0.0130)
Dummy sold to curer				-0.0122		(0.0143)	-0.0158		(0.0145)
Dummy sold to exporter				0.0320		(0.0247)	0.0361		(0.0261)
Dummy sold to trader				0.0086		(0.0119)	0.0045		(0.0124)
Constant	3.7036	***	(0.8909)	3.7583	***	(0.8958)	3.8002	***	(0.8982)
No of observations	865			865			861		
R-squared	0.937			0.937			0.937		

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.6 Determinants of producer price share: All coffee

	y: price share			y: price share			y: price share		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
Dummy washed arabica	0.2772	***	(0.0060)	0.2773	***	(0.0060)	0.2771	***	(0.0060)
Dummy unwashed robusta	-0.0119	*	(0.0066)	-0.0135	**	(0.0067)	-0.0135	**	(0.0068)
Dummy washed robusta	0.2934	***	(0.0110)	0.2942	***	(0.0111)	0.2944	***	(0.0111)
Dummy secondary education	0.0192	**	(0.0094)	0.0191	**	(0.0094)	0.0202	**	(0.0094)
Dummy university education	0.0204	**	(0.0096)	0.0222	**	(0.0096)	0.0237	**	(0.0097)
Gender (female=0; male=1)	0.0020		(0.0126)	0.0007		(0.0126)	0.0016		(0.0127)
Age	0.0007		(0.0014)	0.0006		(0.0014)	0.0007		(0.0014)
Age squared	-1.1E-06		(1.3E-05)	1.5E-07		(1.3E-05)	-9.6E-08		(1.3E-05)
Distance to nearest town	0.0005		(0.0003)	0.0005	*	(0.0003)	0.0005	*	(0.0003)
Altitude	3E-05	***	(6.4-06)	3E-05	***	(6.4-06)	3E-05	***	(6.5E-06)
Dummy ease of switching buyer	0.0023		(0.0081)	0.0029		(0.0081)	0.0023		(0.0081)
Dummy know price	0.0188		(0.0115)	0.0196	*	(0.0116)	0.0198	*	(0.0116)
Dummy member of cooperative				0.0000		(0.0000)	-0.0014		(0.0053)
Dummy member of grower association				0.0000		(0.0000)	-0.0066		(0.0055)
Dummy member of other producer organization				0.0000		(0.0000)	-0.0061		(0.0070)
Dummy sold to curer				-0.0028		(0.0078)	-0.0046		(0.0079)
Dummy sold to exporter				0.0148		(0.0134)	0.0169		(0.0142)
Dummy sold to trader				0.0085		(0.0064)	0.0058		(0.0067)
Constant	0.2766	***	(0.0464)	0.2729	***	(0.0468)	0.2772	***	(0.0470)
No of observations	865			865			861		
R-squared	0.800			0.801			0.801		

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.7 Determinants of farm-gate prices: Unwashed Robusta

	y: ln(pd)		y: ln(pd)		y: ln(pd)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Export price (ln)	0.4304 **	(0.1801)	0.4226 **	(0.1799)	0.3908 **	(0.1816)
Dummy type of processing (unwashed=0; washed=1)						
Dummy secondary education	0.0464	(0.0370)	0.0441	(0.0373)	0.0398	(0.0377)
Dummy university education	0.0786 **	(0.0385)	0.0806 **	(0.0388)	0.0805 **	(0.0392)
Gender (female=0; male=1)	-0.0279	(0.0431)	-0.0311	(0.0430)	-0.0301	(0.0433)
Age	0.0017	(0.0062)	0.0011	(0.0062)	0.0017	(0.0063)
Age squared	-3.2E-06	(5.5E-05)	2.6E-06	(5.5E-05)	-2.1E-06	(5.6E-05)
Distance to nearest town	-0.0035 ***	(0.0013)	-0.0035 **	(0.0013)	-0.0033 **	(0.0014)
Altitude	2.9E-06	(3.2E-05)	-1.6E-06	(3.2E-05)	-5.9E-06	(3.3E-05)
Dummy ease of switching buyer	0.0929 ***	(0.0354)	0.0905 **	(0.0353)	0.0867 **	(0.0355)
Dummy know price	0.0655	(0.0496)	0.0643	(0.0496)	0.0648	(0.0498)
Dummy member of cooperative					0.0241	(0.0230)
Dummy member of grower association					-0.0115	(0.0224)
Dummy member of other producer organization					-0.0241	(0.0259)
Dummy sold to curer			0.0212		0.0189	(0.0390)
Dummy sold to exporter			0.1319 **		0.1708 **	(0.0718)
Dummy sold to trader			0.0272		0.0171	(0.0281)
Constant	2.9943 **	(1.3010)	3.0628 **	(1.3011)	3.2889 **	(1.3123)
No of observations	239		239		238	
R-squared	0.138		0.154		0.166	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.8 Determinants of producer price share: Unwashed Robusta

	y: price share		y: price share		y: price share	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Dummy secondary education	0.0198	(0.0161)	0.0196	(0.0165)	0.0178	(0.0165)
Dummy university education	0.0262	(0.0167)	0.0271	(0.0170)	0.0262	(0.0170)
Gender (female=0; male=1)	-0.0145	(0.0187)	-0.0159	(0.0189)	0.0161	(0.0189)
Age	0.0004	(0.0027)	0.0002	(0.0028)	0.0004	(0.0028)
Age squared	-2.5E-07	(2.4E-05)	1.9E-06	(2.4E-05)	4.4E-07	(2.4E-05)
Distance to nearest town	-0.0015 **	(0.0006)	-0.0015 **	(0.0006)	0.0015 **	(0.0006)
Altitude	4.6E-06	(1.4E-05)	2.6E-06	(1.4E-05)	1.0E-06	(1.4E-05)
Dummy ease of switching buyer	0.0346 **	(0.0153)	0.0335 **	(0.0154)	0.0321 **	(0.0154)
Dummy know price	0.0272	(0.0216)	0.0264	(0.0217)	0.0263	(0.0217)
Dummy member of cooperative					0.0083	(0.0100)
Dummy member of grower association					0.0016	(0.0098)
Dummy member of other producer organization					0.0098	(0.0113)
Dummy sold to curer			0.0133	(0.0170)	0.0126	(0.0170)
Dummy sold to exporter			0.0528 *	(0.0313)	0.0683 **	(0.0313)
Dummy sold to trader			0.0112	(0.0123)	0.0084	(0.0123)
Constant			0.3420 ***	(0.0923)	0.3432 ***	(0.0923)
No of observations	239		239		238	
R-squared	0.082		0.096		0.106	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.9 Determinants of farm-gate prices: Washed Robusta

	y: ln(pd)		y: ln(pd)		y: ln(pd)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Export price (ln)	0.9102 *	(0.5267)	1.1849 **	(0.5715)	1.6236 ***	(0.5555)
Dummy type of processing (unwashed=0; washed=1)						
Dummy secondary education	0.2125	(0.1569)	0.1934	(0.1569)	0.1237	(0.1488)
Dummy university education	0.2208	(0.1478)	0.1728	(0.1472)	0.1483	(0.1369)
Gender (female=0; male=1)	0.2596 *	(0.1510)	0.2377	(0.1520)	0.1851	(0.1416)
Age	0.0304	(0.0232)	-0.0286	(0.0229)	-0.0256	(0.0210)
Age squared	2.9E-04	(2.1E-04)	2.7E-04	(2.0E-04)	2.5E-04	(1.9E-04)
Distance to nearest town	0.0014	(0.0043)	0.0022	(0.0043)	0.0038	(0.0039)
Altitude	4.7E-05	(1.0E-04)	-5.0E-05	(1.0E-04)	-1.5E-04	(9.9E-05)
Dummy ease of switching buyer	0.0708	(0.1213)	0.1095	(0.1214)	0.2134 *	(0.1153)
Dummy know price	0.4912	(0.2996)	-0.3915	(0.3107)	-0.3933	(0.2806)
Dummy member of cooperative					0.2345 ***	(0.0701)
Dummy member of grower association					-0.0067	(0.0769)
Dummy member of other producer organization					-0.0789	(0.0801)
Dummy sold to curer			0.0523		0.0764	(0.0706)
Dummy sold to exporter			0.1106		0.1815 *	(0.1034)
Dummy sold to trader			0.1417 *		0.1828 ***	(0.0656)
Constant	1.1840	(3.8120)	-1.0446	(4.1754)	-4.1926	(4.0284)
No of observations	53		53		53	
R-squared	0.182		0.265		0.450	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.10 Determinants of producer price share: Washed Robusta

	y: price share		y: price share		y: price share	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Dummy secondary education	0.1623	(0.1107)	0.1386	(0.1037)	0.0801	(0.1037)
Dummy university education	0.1731	(0.1051)	0.1353	(0.0967)	0.1193	(0.0967)
Gender (female=0; male=1)	0.1514	(0.1032)	0.1210	(0.0961)	0.0648	(0.0961)
Age	-0.0294 *	(0.0160)	-0.0262	(0.0144)	-0.0211	(0.0144)
Age squared	2.8E-04 *	(1.4E-04)	2.5E-04 *	(1.4E-04)	2.1E-04	(1.3E-04)
Distance to nearest town	0.0015	(0.0030)	0.0018	(0.0027)	0.0024	(0.0027)
Altitude	-1.8E-05	(7.3E-05)	-2.0E-05	(7.3E-05)	-9.6E-05	(7.0E-05)
Dummy ease of switching buyer	0.0519	(0.0833)	0.0724	(0.0785)	0.1263	(0.0785)
Dummy know price	-0.3180	(0.1985)	-0.1977	(0.1840)	-0.1365	(0.1840)
Dummy member of cooperative					0.1641 ***	(0.0490)
Dummy member of grower association					-0.0090	(0.0533)
Dummy member of other producer organization					-0.0719	(0.0554)
Dummy sold to curer			0.0317	(0.0455)	0.0311	(0.0455)
Dummy sold to exporter			0.0592	(0.0696)	0.0939	(0.0696)
Dummy sold to trader			0.1042 **	(0.0448)	0.1223 **	(0.0448)
Constant			1.2575 **	(0.4241)	1.2566 ***	(0.4241)
No of observations	53		53		53	
R-squared	0.210		0.297		0.475	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.11 Determinants of farm-gate prices: Unwashed Arabica

	y: ln(pd)		y: ln(pd)		y: ln(pd)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Export price (ln)	0.3880	(0.3543)	0.3705	(0.3573)	0.3888	(0.3590)
Dummy type of processing (unwashed=0; washed=1)						
Dummy secondary education	0.0398	(0.0272)	0.0397	(0.0274)	0.0406	(0.0276)
Dummy university education	0.0491 *	(0.0279)	0.0509 *	(0.0282)	0.0493 *	(0.0287)
Gender (female=0; male=1)	-0.0407	(0.0434)	-0.0432	(0.0438)	-0.0410	(0.0442)
Age	0.0052	(0.0041)	0.0052	(0.0041)	0.0053	(0.0042)
Age squared	-3.5E-05	(3.6E-05)	-3.5E-05	(3.7E-05)	-3.6E-05	(3.7E-05)
Distance to nearest town	0.0011	(0.0008)	0.0011	(0.0009)	0.0010	(0.0009)
Altitude	1.5E-05	(1.8E-05)	1.6E-05	(1.8E-05)	1.5E-05	(1.9E-05)
Dummy ease of switching buyer	-0.0116	(0.0236)	-0.0121	(0.0240)	-0.0141	(0.0241)
Dummy know price	0.0468	(0.0320)	0.0459	(0.0323)	0.0446	(0.0325)
Dummy member of cooperative					-0.0012	(0.0160)
Dummy member of grower association					0.0056	(0.0166)
Dummy member of other producer organization					-0.0345	(0.0223)
Dummy sold to curer			-0.0120		-0.0151	(0.0236)
Dummy sold to exporter			0.0026		0.0081	(0.0427)
Dummy sold to trader			-0.0010		-0.0015	(0.0207)
Constant	3.5137	(2.6561)	3.6470	(2.6797)	3.5113	(2.6925)
No of observations	293		293		292	
R-squared	0.060		0.061		0.070	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.12 Determinants of producer price share: Unwashed Arabica

	y: price share		y: price share		y: price share	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Dummy secondary education	0.0172	(0.0109)	0.0172	(0.0111)	0.0175	(0.0111)
Dummy university education	0.0172	(0.0111)	0.0180	(0.0114)	0.0175	(0.0114)
Gender (female=0; male=1)	-0.0212	(0.0172)	-0.0221	(0.0176)	-0.0209	(0.0176)
Age	0.0020	(0.0016)	0.0020	(0.0017)	0.0021	(0.0017)
Age squared	-1.4E-05	(1.5E-05)	-1.3E-05	(1.5E-05)	-1.4E-05	(1.5E-05)
Distance to nearest town	0.0004	(0.0003)	0.0004	(0.0003)	0.0004	(0.0003)
Altitude	6.0E-06	(7.2E-06)	6.4E-06	(7.3E-06)	5.7E-06	(7.4E-06)
Dummy ease of switching buyer	-0.0037	(0.0094)	-0.0040	(0.0097)	-0.0043	(0.0097)
Dummy know price	0.0224 *	(0.0128)	0.0224 *	(0.0130)	0.0224 *	(0.0130)
Dummy member of cooperative					-0.0027	(0.0064)
Dummy member of grower association					0.0003	(0.0067)
Dummy member of other producer organization					-0.0079	(0.0089)
Dummy sold to curer			-0.0038	(0.0094)	-0.0050	(0.0094)
Dummy sold to exporter			-0.0008	(0.0171)	0.0027	(0.0171)
Dummy sold to trader			0.0006	(0.0083)	0.0000	(0.0083)
Constant			0.3422 ***	(0.0550)	0.3426 ***	(0.0550)
No of observations	293		293		292	
R-squared	0.056		0.057		0.061	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.13 Determinants of farm-gate prices: Washed Arabica

	y: ln(pd)		y: ln(pd)		y: ln(pd)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Export price (ln)	-0.1008	(0.2113)	-0.1734	(0.2131)	-0.1852	(0.2142)
Dummy type of processing (unwashed=0; washed=1)						
Dummy secondary education	0.0133	(0.0231)	0.0153	(0.0230)	0.0149	(0.0230)
Dummy university education	0.0209	(0.0236)	0.0273	(0.0236)	0.0273	(0.0238)
Gender (female=0; male=1)	0.0469	(0.0332)	0.0389	(0.0330)	0.0465	(0.0333)
Age	0.0022	(0.0032)	0.0028	(0.0032)	0.0032	(0.0032)
Age squared	-1.1E-05	(2.8E-05)	-1.7E-05	(2.8E-05)	-1.9E-05	(2.9E-05)
Distance to nearest town	0.0017 **	(0.0007)	0.0016 **	(0.0007)	0.0015 **	(0.0007)
Altitude	7.0E-05 ***	(1.4E-05)	7.2E-05 ***	(1.4E-05)	6.8E-05 ***	(1.5E-05)
Dummy ease of switching buyer	-0.0218	(0.0182)	-0.0257	(0.0182)	-0.0283	(0.0184)
Dummy know price	0.0035	(0.0271)	-0.0041	(0.0270)	-0.0042	(0.0270)
Dummy member of cooperative					-0.0237 *	(0.0124)
Dummy member of grower association					-0.0024	(0.0128)
Dummy member of other producer organization					-0.0049	(0.0182)
Dummy sold to curer			-0.0490 ***		-0.0541 ***	(0.0178)
Dummy sold to exporter			-0.0143		-0.0274	(0.0323)
Dummy sold to trader			-0.0246		-0.0258	(0.0157)
Constant	7.9918 ***	(1.6762)	8.5836 ***	(1.6928)	8.6849 ***	(1.7013)
No of observations	280		280		278	
R-squared	0.175		0.198		0.211	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.14 Determinants of producer price share: Washed Arabica

	y: price share		y: price share		y: price share	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Dummy secondary education	0.0089	(0.0173)	0.0105	(0.0174)	0.0108	(0.0174)
Dummy university education	0.0079	(0.0176)	0.0119	(0.0179)	0.0132	(0.0179)
Gender (female=0; male=1)	0.0313	(0.0248)	0.0267	(0.0251)	0.0312	(0.0251)
Age	0.0019	(0.0024)	0.0022	(0.0024)	0.0025	(0.0024)
Age squared	-1.2E-05	(2.2E-05)	-1.5E-05	(2.1E-05)	-1.6E-05	(2.1E-05)
Distance to nearest town	0.0013 ***	(0.0005)	0.0013 **	(0.0005)	0.0012 **	(0.0005)
Altitude	5.7E-05 ***	(1.1E-05)	5.9E-05 ***	(1.1E-05)	5.6E-05 ***	(1.1E-05)
Dummy ease of switching buyer	-0.0156	(0.0136)	-0.0179	(0.0138)	-0.0192	(0.0138)
Dummy know price	0.0080	(0.0202)	0.0050	(0.0203)	0.0054	(0.0203)
Dummy member of cooperative					-0.0159 *	(0.0093)
Dummy member of grower association					-0.0079	(0.0097)
Dummy member of other producer organization					-0.0017	(0.0137)
Dummy sold to curer			-0.0262 **	(0.0134)	-0.0300 **	(0.0134)
Dummy sold to exporter			-0.0128	(0.0244)	-0.0195	(0.0244)
Dummy sold to trader			-0.0088	(0.0117)	-0.0113	(0.0117)
Constant			0.4295 ***	(0.0800)	0.4399 ***	(0.0800)
No of observations	280		280		278	
R-squared	0.184		0.197		0.210	

*** significant at 1%; ** significant at 5%; * significant at 10%

Table 3.15 Chow test for coefficients being the same for Robusta and Arabica

H_0: coefficients are the same in the two regressions	
Pooled regression	
SSR	15.25
n	861
k	18
Separate regressions	
SSR1	6.66
n1	291
k1	18
SSR2	7.05
n2	570
k2	18
F statistic	**5.17**
5% critical value of F(18,825)	**1.59**
Conclusion: reject H_0 at 5% significance	

Table 3.16 Probit estimation: Ease of switching buyers

Probit estimates	Number of obs	904
	LR chi2(2)	49.49
	Prob > chi2	0
Log likelihood = -309.97248	Pseudo R2	0.0739

	dF/dx	Std. Err.	z	P>|z|	x-bar
Distance	-0.00307	0.00108	-2.86	0.004	11.5
Altitude	-0.00012	0.00002	-5.22	0.000	3146.1

z and P>|z| are the test of the underlying coefficient being 0

Chapter 4: Attitude to risk and informal insurance

4.1 Introduction

Coffee price volatility has a negative and even disastrous impact on welfare of coffee farmers, income distribution and poverty. The consequence of price instability goes beyond contemporaneous effects on input use, production and incomes. Producer welfare is also affected in the medium to long-term, since uncertainty makes it difficult for farmers to make adequate production decisions, obtain credit and maintain reliable marketing relations. During particularly abrupt income shocks, such as during the recent coffee price crisis during 2000-2003, some farmers even abandon their plantations. Moreover, given the importance of coffee farming in some economies, price volatility often has a negative impact on economic growth at regional and national levels. In the past, attempts were made to deal with price instability through collusion among coffee-producing countries and domestic government interventions that targeted price stabilization. In most cases stabilization was either unsuccessful or very difficult and costly to maintain in the long run. However, it did provide some degree of protection to producers, albeit at high transaction costs and adding uncertainty associated with ad-hoc policy decisions. In the post-liberalization environment, where producer prices are more closely integrated with world prices, and in the face of a price collapse, farmers are more exposed and vulnerable to price risks than before market reforms. There is therefore growing interest in new, market-based instruments for reducing coffee risks. However, there are substantial barriers to development of risk management products.

Access to these products by smallholder farmers, who are the majority of coffee growers, is constrained by lack of information and proper understanding of these instruments, high transactions costs relative to small volumes of trade and absence of institutions that could act as intermediaries between growers and international hedging markets.

In some countries, the local banks and industry regulatory bodies have taken the initiative to set up programs intended to reduce the volatility of growers' income. Coffee is well suited for application of the new price risk management instruments since it is characterized by high price volatility and because the well-established international commodity futures markets offers possibilities for producers to manage the price risk by hedging on these markets. One example is introduction of a collateral management program for production risk combined with options contracts to reduce price volatility by a local bank in Tanzania (World Bank, 2005a). A pilot price insurance scheme for small farmers was set up in Nicaragua with the help of the International Task Force on Commodity Risk Management, a World Bank initiative, and replicated in some other countries.

In India, the gradual implementation of market reforms from 1992-1996 enhanced the efficiency of domestic coffee trading, but left producers without any formal risk management tools. This year for the first time an index-based weather insurance was introduced by the Agricultural Insurance Company of India and the Coffee Board. Why did it take ten years after market liberalization to come up with this type of instruments? The answer lies in the characteristics of the Indian coffee sector shared by many other coffee producing nations as discussed above. On the one hand, the transaction costs of supplying risk reduction products are too high relative to the size of operations: an overwhelming majority of coffee growers are smallholders. There are no institutions in place that could act as intermediaries between smallholders and global markets to allow them to hedge. However, demand is also constrained: Farmers are rather wary of the new financial products. Their perception of globalization is rather negative, because growers blame it for the collapse of coffee prices, and they often mistrust the government. It short, there are two major constraints: lack of scale and lack of transparency regarding product options and their benefits. Thus, the role of the state in coffee production and marketing is reinvented: Rather than being directly involved in those activities, public entities, such as the Coffee Board, could now act as facilitators, educators and transmitters of information. Local institutions such as banks and producer cooperatives also have an important role to play, since they constitute vibrant formal and informal networks through which risk management products can be distributed and popularized. These networks stand to gain from mitigating income risks to producers since the welfare of their members or customers would positively affect their contribution: For example, repayment rates on loans are closely correlated with income stability.

However, even with strong support from national and local institutions, and technical support from the World Bank and other organizations, the progress in establishing functioning insurance mechanisms has been uneven. To understand the reason for this on the demand side, it would be useful to take a closer look at two issues. First, what is the relationship between farmers' risk aversion and acceptable premiums on price insurance? Second, how do farmers deal with risks in the absence of formal insurance? In other words, what are their alternatives in terms of informal risk management practices?

This paper studies a hypothetical price insurance scheme suggested to coffee growers in Karnataka, the main coffee producing state in India. Using the data from a survey specifically designed to establish demand for such insurance, the paper attempts to answer the two research questions outlined above.

4.2 Existing evidence on risk aversion and participation in insurance

What drives participation in crop insurance? The conventional justification for the use of hedging instruments in agriculture is risk reduction for farmers that are characterized by aversion to risk. However, the vast literature shows that there are two other major considerations that motivate farmers to insure. First, farmers may be inclined to purchase insurance if they expect their mean income to increase as the result. Second, participation is motivated by informational asymmetries between growers and insurers, which give rise to moral hazard problems. As Just et. al. (1999) show, crop insurance incentives can be decomposed in into risk-aversion (hedging), subsidy (actuarial) and asymmetric information incentives. The authors use U.S. multiple peril crop insurance data to show that insurance participation is primarily determined by subsidies and asymmetric information considerations.

Numerous studies analyzed the demand for price hedging with futures and options by agricultural producers that face both price and yield uncertainty. For example, Rolfe (1980) derived the optimal use of futures as a hedging instrument for cocoa producers. Sakong et.al. (1993) studied the role of options, in addition to futures, in reducing agricultural risks in the presence of production uncertainty and simulated optimal hedge using the data for Iowa corn growers. Mahul (2003) examined the use of options and futures by French farmers when both yield and revenue insurance are available.

In development economics, agricultural risks and insurance receive particularly close attention, both because poor agents are taken to be more risk averse (assuming decreasing absolute risk aversion, which is supported by experimental and empirical evidence) and because market failures in developing countries prevent farmers from achieving an adequate level of insurance. The use of price risk management tools for commodity producers in developing counties has been advocated by development scholars and widely promoted by international financial organizations and the donor community (Varangis and Larson, 1996; Sarris 2003; World Bank, 2005a). However, the rate of participation in these risk-hedging schemes tends to be low. In India, Rosenzweig and Binswanger (1993) predict weak participation in rainfall insurance. This finding is supported by empirical evidence in a recent paper Giné et.al. (2007), who explicitly analyze the determinants of rainfall insurance participation in India. The survey data they used indicate that farmers who decline rainfall insurance do so predominantly because of a low level of familiarity with the product or due to a liquidity constraint. Contrary to theoretical predictions, they find that risk averse households are less likely to purchase insurance. The authors offer an explanation to this puzzle, which is that the results reflect uncertainty about the insurance product itself. Analyzing price risks for Costa Rican coffee growers, Hazell (2000) finds that farmers are managing price risk surprisingly well and accurately predict coffee prices. The potential gains of price hedging with futures are therefore considered to be relatively modest.

An important empirical question in this context is the prevalence and magnitude of risk aversion in a low-income rural setting. Evaluation of the risk aversion parameter is typically done using experimental design with lotteries, pioneered by Binswanger (1980) and subsequently applied in a number of developing countries, most recently by Harrison et.al. (2007). A wealth of empirical evidence suggests that farmers indeed are risk averse, and the poor ones even more so. It should be noted that these experiments are not easily applied to riskiness of income from agricultural activity, since farm income is subject to multiple sources of uncertainty that could be correlated. Typically, prices and yields are correlated, which could either reduce or exacerbate the overall income risk. Therefore, focusing on only one type of risk at a time and ignoring the price-yield correlation would produce erroneous results. On the other hand, the use of revealed preference data for estimation of agricultural risks and risk aversion can also be problematic. As Just and Just (2007) convincingly demonstrate, imposing specific functional forms on the utility function and distribution of stochastic variables, as it is commonly done, may in fact determine the estimated structure of risk preferences that fits the data.

A related and equally important question in the case of rural producers is what risk-reducing strategies do risk averse farmers adopt in the absence of crop insurance or other arrangements that directly affect farm income? Studies suggest that low-income rural communities have a number of formal and informal mechanisms at their disposal to help smooth consumption to offset income variability (Townsend, 1994, provides a brief overview). Evidence from rural India suggests that, as consumption-stabilizing strategies, producers resort to intra-household income transfers (Rosenzweig, 1988; Rosenzweig and Stark, 1989), shifting labor from farm to off-farm employment (Kochar 1999), risk- sharing through informal community-based institutions (Townsend, 1994) or through informal credit arrangements (Bell et.al., 1999). Clearly, these strategies are only useful for shocks that do not affect all members at once, and are ineffective if the unit of risk pooling (village or region) is vulnerable to the same aggregate risk, such as price fall or drought.

The contribution of this chapter to the literature is two-fold: First, it offers a simple methodology for detecting risk aversion using farmers' responses on maximum premiums they would be willing to pay for price insurance. Second, it provides empirical evidence of the use of informal mechanisms that contribute to either risk mitigation or consumption smoothing in absence of formal insurance, when farmers are risk averse.

4.3 Sources of income volatility and risk management tools

4.3.1 Incidence of risk in the Indian coffee sector

Indian coffee growers face multiple sources of income volatility, typically related to either price or yield risk. Risks can be systemic, local or idiosyncratic. Systemic risks affect a large number of growers at the same time. Fluctuations in world prices, droughts and floods are typical examples. An example of a local risk shared by producers in a limited geographical area is the amount of rainfall. Idiosyncratic risks are the risks that affect one coffee farm at a time, for example fire or damage to facilities.

Production and yields of coffee in India from 1986 to 2006 are shown in Figure 4.1 and 4.2. An upward trend in production is evident for both Arabica and Robusta, reflecting increases in planted area, while yields have been fluctuating with little change in the trend over time. In the last few years yields of both Arabica and Robusta have declined relative to 2001, presumably in response to a slump in global prices. Both production and yield of Robusta appear to be more volatile than in Arabica. The coefficient of variation (CV, the ratio of standard deviation to the mean) of annual yields in 1986-2006 has been 17.2% for Arabica and 35.8% for Robusta.

Price risk is the second most important risk reported by Karnataka growers. Annual fluctuations of price levels from 1986 to 2005 are shown in Figure 4.3. Four sets of prices are displayed: world prices of Arabica and Robusta as well as producer prices in India for both types. All prices were collected by the International Coffee Organization (ICO). In the case of Arabica a combination of average spot prices of "Other Mild" coffee traded daily in the New York and Hamburg markets is used as the world market price. In the case of Robusta, the international price is the combination of average spot price of "Robusta" coffee traded daily in the New York and Le Havre/Marseilles markets[10]. Producer prices are the average farm-gate prices for all grades reported by Indian authorities to ICO. All prices have been deflated using the CPI for India (2000=100). As shown in the figure, coffee prices declined at the time of collapse of the International Coffee Agreement (ICA) in 1989, but rose following the frosts and drought in Brazil in 1994. Overall, the prices have been quite volatile until 1999, when the last coffee price crisis began. From 1999 to 2003 prices

[10] The share of each market in the two groups is as follows:

- Other Milds: 40% New York; 60% Hamburg
- Robustas: 25% New York; 75% Le Havre/Marseilles

were on a steady decline, and from 2003 have been on a recovery path. The average share of producer prices in the world market price between 1986 and 2006 was 77% and 68% for Robusta and Arabica, respectively. Producer prices have been less volatile than world prices, measured by the coefficient of variation (CV). The CVs of annual world prices in 1986-2005 are 0.49 and 0.37 for Robusta and Arabica, respectively, while the CVs for producer prices in the same period are 0.34 and 0.30. Variability of producer prices within a year can be observed in Figure 4.4, where the CVs for the monthly prices within each year are plotted. This intrayear variability has been highest in the early 1990's, and is on average higher for Robusta than for Arabica (0.13 vesus 0.11).

Producer price fluctuations are determined by a number of causes. First and perhaps most important in the case of coffee, producer prices are affected by fluctuations in world market prices caused by shocks to global supply and demand. The world price is impacted by agreements among coffee producing countries, entry of new major suppliers and the demand patterns in consuming countries. India has no export restrictions on coffee and most coffee is exported. Therefore producer prices tend to follow world market price. Second, producer prices are sensitive to the local market conditions, such as barriers to entry in the marketing sector, collusion among traders and access to timely information, as discussed in the precious chapter. Third, producer prices fluctuate in response to government policy affecting production and marketing of coffee.

As discussed in Chapter 2 of this thesis, liberalization had a significant impact on the dynamics of producer prices in India. Since completion of the reforms in 1996 the share of producer prices in the world price increased significantly and the price paid to growers adjusts faster today to changing market conditions. Before market reforms the Coffee Board of India had marketed all coffee in India. It is commonly assumed that state trading benefits price stability through stabilization policies such as minimum prices. In the case of India, pooled prices and variable export tax rates provided some protection for growers. However, these policies did not appear to provide reduction of the price risk. Price data show that prices were actually more volatile before the reforms. The CV of monthly producer prices prior to 1996 was 0.42 and 0.40 for Robusta and Arabica, respectively, and the corresponding measures were 0.37 and 0.34 between 1996 and 2005.

A bigger problem for producers than monthly fluctuations is posed by extended periods of low prices, as in the case of the recent coffee price crisis. The downward trend in prices began in 1999 and intensified over 2001 and 2002. At the lowest point in 2002 producer prices had fallen to 39% of the average of prices during the 1990's for Robusta and 49% for Arabica. The price crash had implications for the Indian coffee industry and for growers in particular. A typical smallholder grower is not adequately equipped to deal with a prolonged slump. Most small farms rely on coffee as the only crop. According to the survey of coffee growers in Karnataka, income from farming constitutes 92% of all income on average among coffee growers with estate areas smaller than 20 acres, which is roughly half of all growers. On average, 79% of all farm income by coffee farms in Kartataka is derived from coffee. In addition, smallholder farmers tend to have low savings and have limited off-farm employment opportunities. Therefore losses from coffee farming induced by a collapse in prices can be expected to translate into cuts in consumption.

Depressed and volatile prices have caused wide swings in coffee income in India, leading to substantial reduction in inputs and therefore lower production, which in turn affects the local economy of coffee growing districts. Unable to deal with the hardships of the crisis, some planters abandoned their estates in desperation (ICO 2002, Oxfam 2005), and there have been reports of indebted farmers committing suicide[11].

4.3.2 Strategies for managing income risks

Although the prices have partially recovered since 2003, coffee growers remain vulnerable to price fluctuations as well as other risks. Risk management instruments at their disposal are very limited. Risk reduction strategies at the farm level (self-insurance) include inter-cropping, in particular with pepper, which grows around shade trees, diversification of income-generating activities (off-farm employment) and the use of credit, either formal or informal, to help smooth consumption over time. Risk pooling through cooperatives or other organizations is also common. Collective management of saved resources at the community level can help deal with small risks, as long as these risks are not correlated across members so that all incur losses at the same time. Apart from risk mitigation through farming decisions and risk pooling, there are practically no other ways to reduce income uncertainty. Typical risk sharing activities that include the use of marketing and production contracts, vertical integration, hedging on international commodity futures

[11] According to The Hindu newspaper (2007), between 2001 and 2007 150 coffee growers committed suicide in Hassan, Chikmagalur and Kodagu districts of Karnataka.

and options markets and insurance are not available to Indian coffee growers. Virtually all trade is done on the spot, and marketing contracts are not common. According to a report by the International Task Force on Commodity Risk Management (CRMG, 2003), however, some exporters do offer price-fixation schemes based on London and New York futures markets to larger planters and commercial estates. In addition, the government applies measures to protect growers from price uncertainty. Thus, during the coffee price crisis the government restructured terms of loans to growers, subsidized interest paid by small growers and provided export incentives.

Commodity options trading is not allowed in domestic markets in India, and overseas trading in options is strictly regulated, requiring clearance from the government. The Coffee Board of India attempted to set up a pilot risk management scheme based on an exchange-traded put options contract in order to provide producers with access to international markets for price hedging. The pilot scheme, which essentially would have worked as price insurance, was implemented with the technical support from the World Bank and participation of local banks as distributors of the insurance, but ultimately was not successful. Apart from bureaucratic complications, the primary reason for failure was insufficient interest among the growers. A survey sponsored by the World Bank was conducted in March 2003 to assess producer demand for price insurance and acceptable premiums. The growers were asked whether they would be interested in participating in such a scheme, and while the majority replied that they would at least consider it, the subsequent questions on acceptable premiums revealed that very few would pay even an actuarially fair premium. Therefore it is unlikely that the scheme would have been financially viable.

Weather-related yield volatility continues to be the single most important risk to producers. Therefore, in March 2007 the Agricultural Insurance Company of India jointly with the Coffee Board launched a rainfall insurance program to reduce rainfall-induced coffee yield risks. The risks covered are lack of rains during "Blossom" and "Backing"periods (from March 1 to April 15 every year in case of Robusta and from March 1 to April 30 in case of Arabica), as well as excess rains during the Monsoon period (from July 1 to August 31). The Indian Coffee Board offered a 50% subsidy to the small growers to cover insurance premiums. The premium amount varies from zone to zone, based of the 30-year historical rainfall data across 43 different coffee zones. The insurance claims will be automated based on actual rainfall data. This type of weather-indexed insurance does not suffer from the usual moral hazard problem and has lower administrative costs than traditional crop insurance. It is therefore better suited to small farmers who depend on rainfall. The scheme is intended to cover about 85,000 growers in Karnataka, Tamil Nadu and Kerala. The extent of participation in this scheme will become apparent after December 2007, when insurance for 2008 will become available.

4.4 Methodology

This chapter develops a methodology for assessing producers' risk preferences based on subjective price expectations and reported maximum premiums for price insurance. Rather than estimating the risk aversion parameter explicitly, this paper seeks to separate risk averse growers from other growers utilizing the information on changes in risk premiums in response to a shift in price distribution caused by insurance. A number of tests are then performed to conclude whether risk averse farmers differ in their assessments and decisions from other producers.

As it is typical for coffee plantations, planting decisions are assumed to be made years in advance, and effort at harvesting is determined by the planted area and yield, which is stochastic. Both price *p* and output *q* are stochastic, and growers maximize their expected utility under income uncertainty. Utility depends on income $Y=pq$ and effort at harvesting $l(q)$ and the farmer maximizes expected utility $EU(\pi) = EU(Y - wl(q))$. Price insurance is offered to producers in the beginning of a crop year. With price insurance, the producer is guaranteed a certain price $\tilde{p}$ if the market price at the time of sale is below $\tilde{p}$. The insurance has a premium of *x* rupees per bag of insured coffee. It is assumed that effort at harvesting is not affected by whether or not price insurance is purchased. The farmer chooses quantity $\tilde{q}$ to insure. Assume that this quantity has an upper bound at total production, $\tilde{q} < q$. The income under insurance is

$$\tilde{Y} = \begin{cases} \tilde{q}(\tilde{p} - x) + (q - \tilde{q})p & if \ \ p < \tilde{p} \\ qp - \tilde{q}x & if \ \ p \geq \tilde{p} \end{cases} \qquad (4.1)$$
$$= qp - \tilde{q}x + \tilde{q}Z$$

where $Z = \tilde{p} - p$ if $p < \tilde{p}$ and $Z = 0$ otherwise. The mean and variance of income under insurance are

$$E(\tilde{Y}) = E(Y) - \tilde{q}(x - E(Z)) \qquad (4.2)$$

and

$$Var(\tilde{Y}) = Var(Y) + \tilde{q}^2 Var(Z) + 2\tilde{q}Cov(Y, Z) \qquad (4.3)$$

A producer buys price insurance if it makes her better off than not doing so. Therefore, the break even insurance premium x^* at which the farmer is indifferent between purchasing the insurance and not doing it is determined by:

$$EU\left(qp - \tilde{q}x^* + \tilde{q}Z - wl(q)\right) = EU\left(qp - wl(q)\right) \quad (4.4)$$

This implies that the certainty equivalent of income should be the same with and without insurance:

$$CE\left(\tilde{Y} - wl(q)\right) = CE\left(Y - wl(q)\right) \quad (4.5)$$

which can be written as

$$E(\tilde{Y}) - \tilde{R} = E(Y) - R \quad (4.6)$$

where $\tilde{R}$ and R are risk premiums with and without insurance, respectively. Inserting *E(Y)=E(pq)* and (4.2) into (4.6) and rearranging we obtain the break even premium:

$$\tilde{q}x^* = \tilde{q}E(Z) + (R - \tilde{R}) \quad (4.7)$$

This expression shows that the break even insurance premium on price insurance equals the expected gain from the insurance that can be decomposed into the benefit from a change in expected income and the benefit from risk hedging. If a grower is risk neutral, she only cares about the expected income, setting $E(\tilde{Y}) = E(Y)$, and would therefore buy price insurance only if $x \le E(Z)$, that is, if insurance premium does not exceed the expected improvement in the mean income. If, on the other hand, the maximum premium the grower is willing to pay exceeds *E(Z)*, it is because she is willing to pay $R - \tilde{R} > 0$ for a reduction of the income volatility if producer is risk averse.

Limiting the analysis to two parameter distributions that depend only on the mean and the variance, note that the risk premium is strictly increasing in variance $\frac{\partial R}{\partial Var(Y)} > 0$. This holds for the typical set-ups with a CARA or CRRA utility function and normal or lognormal prices. In this setting $Var(\tilde{Y}) < Var(Y)$ implies $\tilde{R} < R$. In terms of the mean-variance trade-off it implies that a risk averse grower would be willing to trade some of the expected income for a reduction in variance. Appendix 4.A shows that in the setting described above, the variance of income declines when the grower buys price insurance. Since participation in insurance reduces income volatility it follows from (4.7) that a risk averse grower would be willing to pay an insurance premium x^* that exceeds *E(Z)*.

The expected value and variance of *Z* are

$E(Z) = \Phi(\tilde{p} - E(p_T))$ and (4.8)

$Var(Z) = \Phi^2 Var(p_T)$, (4.9)

where $E(p_T) = E(p \mid p < \tilde{p})$ and $Var(p_T) = Var(p \mid p < \tilde{p})$ are the mean and variance of the price truncated from above at the insured price $\tilde{p}$ and $\Phi = \Pr(p < \tilde{p})$.

The empirical approach in this Chapter is as follows. First, *E(Z)* is evaluated analytically for each grower using (4.8) and information on growers' perceptions of the price distribution. This is done under assumptions of normal and log normal prices. When price is assumed to be normally distributed with parameters μ_p and σ_p^2, a formula for the mean of a normal distribution truncated from above is applied to calculate $E(p_{Ti})$ for grower *i*:

$$E(p_{Ti}) = \mu_{pi} + \sigma_{pi}\lambda(\alpha_i) \quad (4.10)$$

where $\alpha_i = \dfrac{\tilde{p} - \mu_{pi}}{\sigma_{pi}}$, $\lambda(\alpha_i) = -\dfrac{\varphi(\alpha_i)}{\Phi(\alpha_i)}$, $\varphi(\alpha_i)$ is the standard normal density and $\Phi(\alpha_i)$ is the cumulative standard normal distribution (Greene, Theorem 20.2). The moments of the price distribution are obtained from the information on farmers' expectations regarding future market prices from a survey presented in the next section. Coffee growers are asked what they perceive as the "most likely" level of prices in 5 months. The response is used as the expected price μ_{pi} . The survey also contains questions on the highest and the lowest price that the growers expect. To evaluate σ_{pi}^2 I use

$$\Pr(p_i < p_i^{high}) = \Phi\left(\frac{p_i^{high} - \mu_{pi}}{\sigma_{pi}}\right) \tag{4.11}$$

and two different assumptions: $\Pr(p_i < p_i^{high}) = 0.95$ and

$\Pr(p_i < p_i^{high}) = 0.99$.

Under assumption of log normal price distribution with $\mu_{\ln p} = E(\ln p)$ and $\sigma_{\ln p}^2 = Var(\ln p)$, $E(p_{Ti})$ is calculated as follows. I apply a formula for the mean of a log-normal distribution truncated from below, provided by Johnson et.al. (1994):

$$E(p_i \mid p_i > \tilde{p}) = \mu_{pi}\left(\frac{1 - \Phi(U_{0i} - \sigma_{pi})}{1 - \Phi(U_{0i})}\right) \tag{4.12}$$

where $U_{oi} = (\ln \tilde{p} - \mu_{\ln pi}) / \sigma_{\ln pi}$.

Then, $E(p_{Ti}) = E(p_i \mid p_i < \tilde{p})$ can be found from:

$$\Phi(U_{0i})E(p_i \mid p_i < \tilde{p}) + \left(1 - \Phi(U_{0i})\right)E(p_i \mid p_i > \tilde{p}) = \mu_{pi} \tag{4.13}$$

The moments of lognormal distribution for each grower *i* are calculated by solving the system of two equations for $\mu_{\ln pi}$ and $\sigma^2_{\ln pi}$:

$$\Pr\left(p_i < p_i^{high}\right) = \Phi\left(\frac{\ln p_i^{high} - \mu_{\ln pi}}{\sigma_{\ln pi}}\right) \tag{4.14}$$

$$\mu_{pi} = \exp(\mu_{\ln p_i} + \frac{\sigma^2_{\ln pi}}{2}) \tag{4.15}$$

where $\mu_{pi} = E(p_i)$ is the expected price reported by grower *i*. The second equation follows from the expectations of a log-normal distribution. Again, two different assumptions are made on the perceived probability of price falling below the reported high price: $\Pr(p_i < p_i^{high}) = 0.95$ and $\Pr(p_i < p_i^{high}) = 0.99$.

After evaluating *E(Z)*, the responses of growers regarding the maximum premium that they would agree to pay to participate in a price insurance scheme (x^*) are compared to *E(Z)*, and growers are classified as either risk averse or risk neutral/risk loving according to the following criteria implied by (4.7):

$$x^* > E(Z) \quad \Rightarrow \quad \textit{risk averse}$$
$$x^* \leq E(Z) \quad \Rightarrow \quad \textit{non risk averse}$$

Note that while the last condition implies either risk neutrality or risk loving behavior, the latter is not supported by empirical and experimental evidence on farmers' attitudes toward risk in developing countries. Finally, a number of tests are performed to assess whether risk averse growers differ from other growers in their farm management and consumption smoothing decisions.

Note that while it may be tempting to try to calculate the risk aversion parameter based on knowledge of x^* and the moments of price and output, this requires imposition of constraints on the form of the utility function, which implies restrictions on the structure of risk preferences that one tries to estimate (Just and Just, 2007). Moreover, the problem outlined above does not easily simplify to a standard certainty equivalent representation based on CRRA utility and lognormal income (or CARA utility and normally distributed income). Even if pq follows a lognormal or normal distribution, $\tilde{Y}$ in (4.1) does not, since the price is truncated at $\tilde{p}$. Therefore, the approach taken in this paper is to evaluate attitude towards risk by analyzing the behavior of the risk premium in response to a monotonic shrinking of the price distribution, but without estimating the risk aversion parameter explicitly.

An important caveat applies with respect to the methodology outlined above. To infer the variance of price from the survey data it was necessary to impose restrictions on the farmers' interpretation of the question regarding "highest likely" price. Clearly, the probability that growers assign to the price falling below the high price has direct implications for the calculated variance, as demonstrated in (4.11), (4.14) and (4.15). The proportion of growers being classified as risk averse hinges critically on this assumption. Section 4.6 discusses the results with this caveat in mind and shows how the change in the assumption on perceived probabilities affects the outcome. In the following probability levels 95% and 99% are chosen as the most plausible in terms of interpretation of the survey question, albeit somewhat arbitrary. Another point to bear in mind is that the approach outlined above relies on the assumption that all farmers have the same interpretation of price being high.

4.5 Data

The data used for this exercise stem from the same survey of Karnataka coffee growers which provided the data for the analysis in the previous chapter. The survey was conducted in March 2003 as part of analytical work in preparations for a pilot insurance scheme. The idea was to offer growers an insurance scheme based on put options, priced against London and/or New York futures. The Canara Bank in India and the Coffee Board jointly approached the World Bank for assistance in setting a risk management program for producers.

Five hundred growers were interviewed during survey data collection. Summary statistics on some grower and farm characteristics are presented in Table 4.1. Coffee producers are 96% male and the average age is 54. Almost half of growers have university education, which is high, given that the enrollment rate for university education in India is approximately 10% on aggregate. Approximately half of all coffee producers are members of a cooperative and/or a grower organization. The average area of a coffee plantation is 52 acres, but dispersion is very high with some very large estates and a large number with smaller farms, with a median of the sample at 20 acres. There is also great variability in output. Most producers grow Arabica coffee, but on average produce smaller quantities than Robusta growers. Median output falls short of the mean in all cases, given a large number of small producers in Karnataka. There is also some variation in prices across producers, as discussed in more detail in the previous chapter. On average, unwashed (dry-processed) coffee brings in less than half of the price of washed (wet-processed) coffee per bag of coffee, which reflects the difference both in quality and the density of the product, since in washed coffee the pulp is removed before it is sold to traders. The average revenue from coffee was 617 thousands Rs. (US$12,680) and the total farm income was 762 thousands Rs. (US$15,670), while 5% of all farms had a revenue of over 3 million Rs. (US$63,600). The average cultivation cost is 17 thousand Rs. per acre for Arabica and 12 thousand Rs. for Robusta.

The survey questionnaire contains a separate part intended to assess growers' ability to pay for coffee price insurance. First, producers are asked whether they would consider insuring a minimum price for the next three or six months. Next, for each of the three types of coffee (wet-processed Arabica, dry-processed Arabica and dry-processed Robusta), producers are asked whether they would be willing to pay a certain premium per bag of coffee for a certain guaranteed price. If the answer is yes, the premium is increased, and if the answer is no, the amount is decreased, and the respondents are asked again whether they would participate. After these two questions are answered, the growers are asked about the maximum premium they would be willing to pay to insure coffee at a given guarantee price. The response to this last question is used in the analysis as x^* to establish risk preferences of growers, using (4.7). Table 4.1 shows the summary statistics for reported price expectations. The median expected price for both unwashed Arabica and unwashed Robusta is 900 Rs. per bag of coffee. The median expected price is 1,725 Rs. for washed Robusta and 2,255 for washed Arabica.

Table 4.2 summarizes the responses on insurance premiums that growers would be willing to pay to enroll in each of the six suggested price insurance schemes. As it is evident from the table the participation rate varies substantially by the type of coffee and the level of protection offered. Higher guaranteed price induces higher participation rate with positive insurance premiums. For example, when 2500 Rs. in insured price for washed Arabica are offered, 93% of farmers reply that they would participate and pay a premium. It is interesting to note, however, that when the insured price is raised to 2800 Rs., the rate of participation drops to 81%. The only reasonable explanation for this inconsistency is that growers either do not understand how the insurance scheme works or do not trust that they would receive a price that high. The participation rate is lowest for a guaranteed price of 800 Rs. for unwashed Robusta and Arabica (51% and 37%, respectively). Overall, across the six schemes offered, 68% of growers reported positive acceptable premiums, which is rather low. This is somewhat puzzling, given that the guaranteed prices offered are substantially higher than the expected prices, averaged over all growers, in all cases, except when 800 Rs. was offered as the insured price for unwashed Arabica and Robusta.

4.6 Empirical results

This section utilizes survey responses of unwashed Robusta and Arabica coffee growers on the maximum premiums they would be willing to pay for a price insurance with a price guarantee of 800 Rs. The reason for limiting the analysis to this scheme is that it offers an intuitively appealing trade-off between expected income and income variability: most farmers expect the price to be higher than 800 Rs. in the future, and the experiment is therefore to see if they would trade some of the expected mean for greater certainty. When growers are offered a 1000 Rs. minimum price, on the other hand, speculative considerations could overshadow the benefits of risk reduction, since most growers expect the price to be far lower than 1000 Rs. (the average expected price is 905 Rs. for unwashed Arabica and 946 Rs. for unwashed Robusta).

Tables 4.3 through 4.5 report findings based on the assumption of log normal prices and the probability of prices falling below high prices being 95%. Descriptive statistics for the calculated break even insurance premium under risk neutrality $x^* = E(Z)$ are presented in Table 4.3. Note that under risk neutrality the average premium that growers would be willing to pay for price insurance is around 18-19 Rs. per bag of coffee, depending on the type traded. However, there are many zero responses, and the medians are only 3 Rs. and 1 Rs. for Robusta and Arabica, respectively. The correspondence between price expectations and break even premiums under risk neutrality is shown in Table 4.4. It demonstrates how $E(Z)$ decreases with price expectations, so that higher price expectations result in lower break even premiums.

Table 4.5 compares the calculated premiums under risk neutrality with the positive acceptable premiums reported by the growers in the survey. The average calculated premiums under risk neutrality of those who reported greater than zero but lower than 25 Rs. as the maximum premium they would be willing to pay fall within that range for both Robusta and Arabica growers (the means are 20.2 and 20.1, respectively). However, the average $E(Z)$ fall below the lower bound in the next three ranges, indicating that at least some growers are willing to pay higher premiums than what can be predicted with risk neutral behavior.

Table 4.6 reports the shares of risk averse and non risk averse farmers according to the established criteria for risk aversion ($x^* > E(Z)$), under different assumptions on price distribution and perceived probabilities by growers. Overall, approximately one third of growers can be characterized as risk averse. The share is highest when log normal prices are assumed and a thinner tail ($Pr(p<p^{high}) = 0.99$): 38.5% of all growers are classified as risk averse[12].

The next step is to examine empirically the relationship between attitudes toward risk and farm characteristics as well as farm decisions that could be considered a form of self-insurance. In the following analysis Robusta and Arabica growers are pooled together. Two simple tests are used to test hypotheses on the interaction between risk aversion and other variables. In the case of dichotomous variables I use Pearson's chi-square test of independence. For continuous variables a t-test of the equality of means is performed to establish whether the means of the variables in question differ for risk averse and non risk averse growers. Equality of variances in the two groups is tested in each case using an F-test. If equality cannot be rejected, the t-test assumes that the variance is the same in the two groups. Otherwise, this assumption is relaxed.

Tables 4.7 through 4.10 contain the results of this exercise under different assumptions. First, Table 4.7 demonstrates that while risk averse growers appear to have smaller farms than other growers and produce less on average, the differences between the two groups are not statistically significant. Thus, owners of small and large farms are equally risk averse. Next, the relationship between income

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[12] As discussed in Section 4.4, the calculated share of risk averse farmers is directly dependent on the perceived price distribution. It follows from Table 4.6 that the share is higher at lower $Pr(p<p^{high})$: In the two cases studied, the share of risk averse growers is highest when the probability is assumed to be 99% rather than 95%. Assuming $Pr(p<p^{high}) = 0.75$ decreases the share even further: only 14.9% (if log-normal prices are assumed) and 13.7% (in the case of normal prices) would be classified as risk averse. These results follow from the fact that fatter tail on the price distribution implies lower $E(p_T)$ in (4.8), and therefore stronger incentive to participate in price insurance for risk neutral agents. The reported high maximum premiums for price insurance would in this case reflect higher expected payoff under price insurance rather than risk aversion.

diversification and risk aversion is analyzed (Table 4.8). Crop diversification, commonly considered an important instrument of risk reduction, does not seem to vary with attitudes to risk.[13] There is no evidence that risk averse farmers differ from other farmers in their decision to diversify or concentrate their crop portfolio. In addition, risk averse farmers do not tend to have a greater share of off-farm income, as one may expect.

Table 4.9 considers actions taken to self insure and to smooth consumption. In three out of four settings considered, risk averse farmers are found to be less likely to carry over stocks of coffee. As the table shows, less than 3% of risk averse growers carry over stocks, compared to approximately 7% of other farmers, and the difference is significant at the 10% level in all cases except III. This is fully consistent with the expectation that risk averse farmers would try to sell as much output as possible following harvest, to avoid bearing the risk of a price change in the next season. Under assumptions in case I, risk averse farmers also tend to be better informed about the current levels of grower prices: 98% replied that they knew what the price was, relative to 95% of other growers. The difference is significant at 10% in case I, but not in other cases. Another variable of interest is membership in cooperative. In three out four scenarios the share of risk averse farmers that are members of a cooperative is higher than of other farmers (approximately 60% versus 50%) and the difference is significant. This is an indication of the importance of cooperatives for risk sharing at

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[13] Herfidahl index of revenue shares was used a measure of diversification, $H_i = \sum_{j=1}^{N} \gamma_{ij}$, where γ_j is the proportion of revenue from growing crop *j*. The following crops are included, besides coffee: pepper, cardamom, oranges, paddy rice, bananas, ginger, areca nut and vanilla

the local level. The relationship between risk aversion and credit is examined by looking at proportion of growers with an account in a financial institution. The table shows that in two out of four cases the difference in share between risk averse growers and other growers and positive and significant.

Table 4.10 presents the evidence on dealing with decline in income under risk aversion. All farmers report reduction in non-essential expenditure and difficulty paying debt as the two most important strategies for dealing with income decline. 73% on average name expenditure reduction as important or very important and 64% of all growers have difficulty repaying debt according to the same criteria. Interestingly, risk averse farmers are less likely to reduce expenditure, but are more likely to have trouble repaying debts than non risk averse farmers, at least in case II, where both differences are found to be significant at the 10% level. This supports previous findings that farm incomes and rural credit are interlinked in a way that induces risk sharing. Both groups seek financial help from family members during hardships, but there is no significant different across risk averse and other growers.

Finally, Table 4.11 compares prices received by risk averse and non risk averse growers. The intuition is that risk averse growers would be inclined to trade some of the expected price for certainty and would therefore either sell early on in the season, instead of waiting for better prices by holding stocks or sell coffee to traders at unfavorable terms to avoid the risk of lower prices from other traders. This reasoning is supported by evidence only in the case of unwashed Robusta (the most common type traded in India) when lognormal prices are assumed. Under this assumption, risk averse Robusta growers received between 3.3% and 3.9% lower price per 50 kg of unwashed coffee than other growers.

4.7 Willingness to pay for price insurance and education

This paper assumes that low participation rates and low willingness to pay for price insurance are driven by lack of risk aversion. However, lack of interest in insurance could potentially be attributed to lack of familiarity of the growers with price insurance instruments, their design, costs and benefits. In addition, the survey was done during a severe price crisis, and the responses may have been affected by lack of liquidity as the farmers were experiencing losses from growing coffee. These are the reasons typically highlighted in the literature. In a survey on participation in a rainfall insurance in rural India (Giné et. al., 2007) most farmers named not understanding the project and cash or credit constraints as the main reasons for not buying the insurance. Similarly, the comprehensive case studies in the book by Claessens and Duncan (1993) concluded that lack of awareness of risks and lack of understanding of market instruments were the principal reasons for underutilization of price management tools in developing countries.

To assess whether understanding of how the insurance scheme works has an important effect on participation in insurance, the relationship between education level of growers and their reported willingness to pay is explored, and the results are presented in Tables 4.12 and 4.13. The hypothesis is that education level and the degree of comprehension with regard to insurance are closely correlated. Table 4.12 shows the average reported premiums by education level. Among the three categories, the average is slightly higher among the growers with secondary education, and not among those with university education, as one may expect.

Table 4.13 reports the results of OLS regressions for unwashed Arabica and Robusta coffees, where the dependent variable is the reported maximum premium that growers are willing to pay to insure, and the independent variables are mean and variance of price and education. The hypothesis is that those with higher education would be more interested in price insurance, since they have a better understanding of the benefits it offers. In addition the regression tests whether producers with lowest price expectations and highest subjective price variance are most interested in price insurance, since that would be the prediction of the model with a two-moment price distribution. The implicit assumption is that all growers have the same degree of risk aversion. The results show that the moments of price distribution and education level are poor predictors of willingness to pay for price insurance, when risk aversion is omitted. All coefficients have the expected signs, but none are significant. In addition, the model fit is poor, with very low R-squared. This could indicate that growers differ in their attitude to risk, and that the level of comprehension of the instruments and price expectations are not the only determinants of participation in insurance.

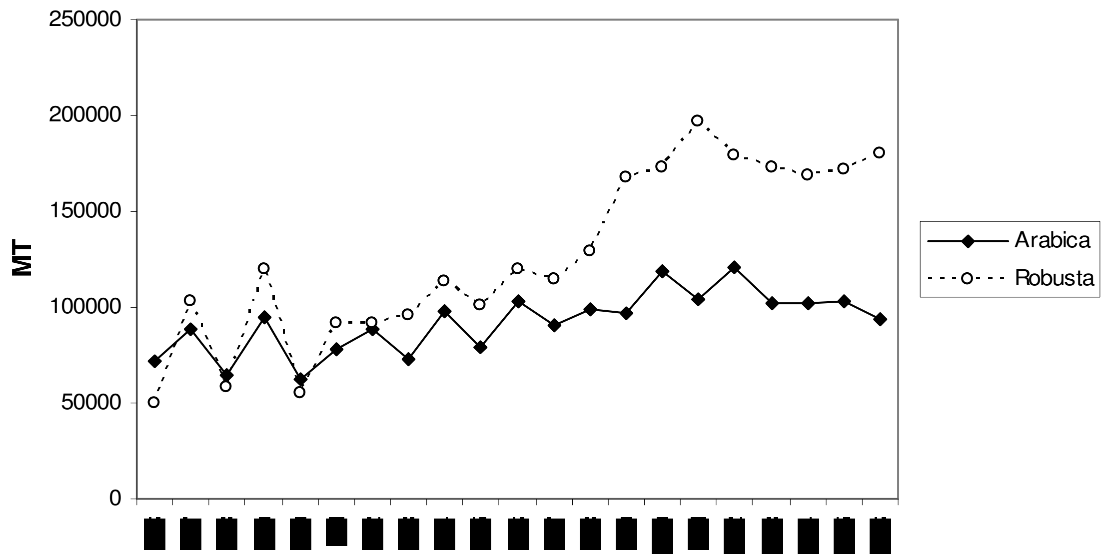
4.8 Conclusions

This chapter developed a framework for assessing farmers' risk preferences using their responses regarding participation in price insurance and maximum acceptable insurance premiums. The data from a survey on Karnataka coffee growers are used to separate risk averse producers from other producers and to test empirically the relationship between risk preferences and self-insurance strategies.

Approximately one third of all coffee growers in the sample can be classified as risk averse. No relationship was found between risk aversion and farm size. Although risk averse farmers are not more likely than other growers to make efforts to diversify income, these growers were found to be more prone to taking other actions to reduce income risk and smooth consumption. Thus, risk averse farmers are less likely to hold stocks, which makes intuitive sense, because carrying stocks involves assuming the risk of changing prices. The same argument holds for the finding that in the case of unwashed Robusta, the most common type of coffee bought from farms in India, risk averse growers receive lower prices than other growers when lognormal prices are assumed, presumably because they trade some of the price for avoiding the price uncertainty. If risk averse farmers were better informed about local prices, it could provide further evidence that risk averse agents are more likely to take steps to reduce income uncertainty. However, the difference in awareness was only found to be significant in one out of four cases. Risk averse growers are more likely to smooth consumption at the time of income decline by having an account with a financial institution. Interestingly, these farmers also find it more difficult to repay loans when their incomes fall to avoid reducing expenditure, which is consistent with the literature on risk-sharing in the rural credit markets.

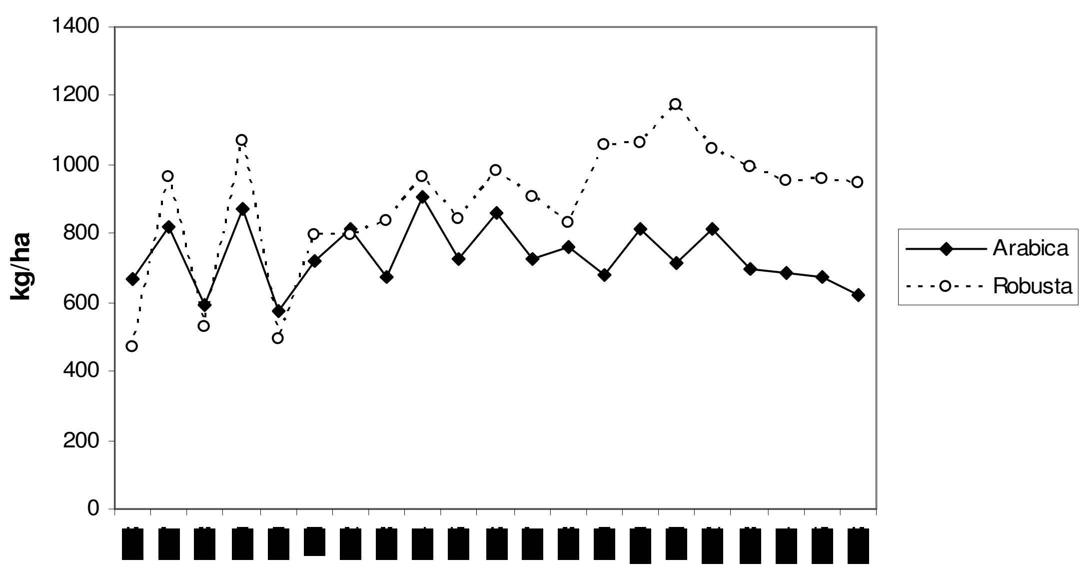
The responses of Karnataka coffee growers support earlier findings that demand for price risk management instruments in developing countries is rather weak. Only 68% of growers are willing to pay anything at all to hedge coffee price and most would only accept low premiums. This paper attributes the differences in reported willingness to pay across producers to differences in attitude towards risk and shows that education level alone cannot explain why producers differ in their decision to purchase insurance.

Figure 4.1 Coffee production in India, 1986-2006



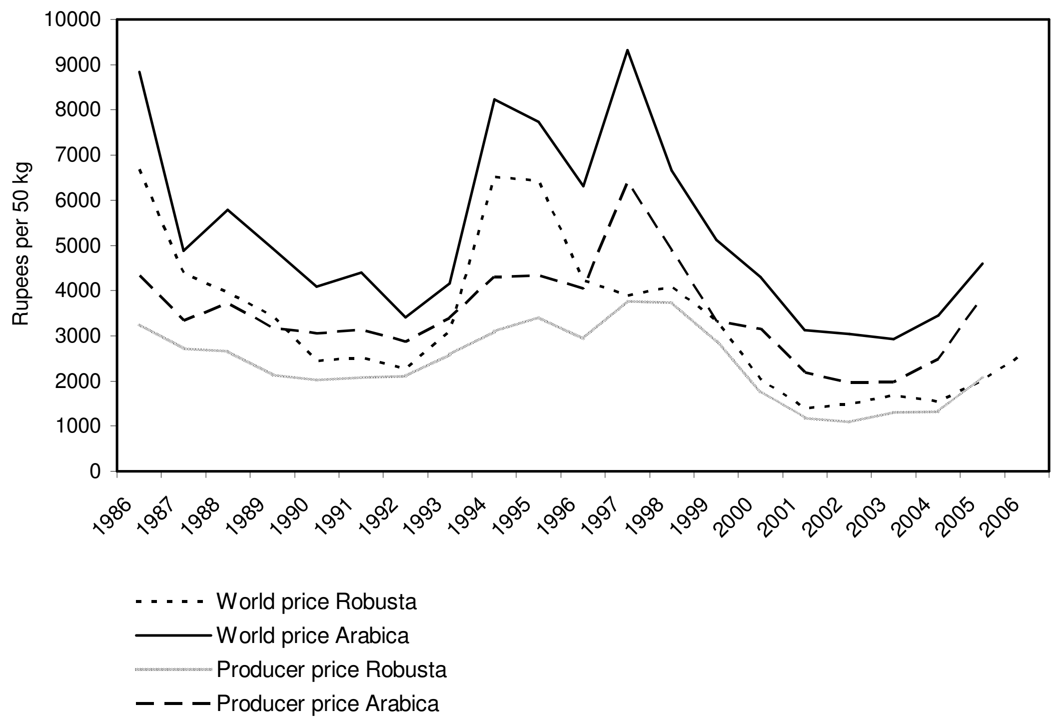
Source: Coffee Board of India

Figure 4.2 Coffee yields in India, 1986-2006



Source: Coffee Board of India

Figure 4.3 Yearly average real world and domestic coffee prices
(2000=100)



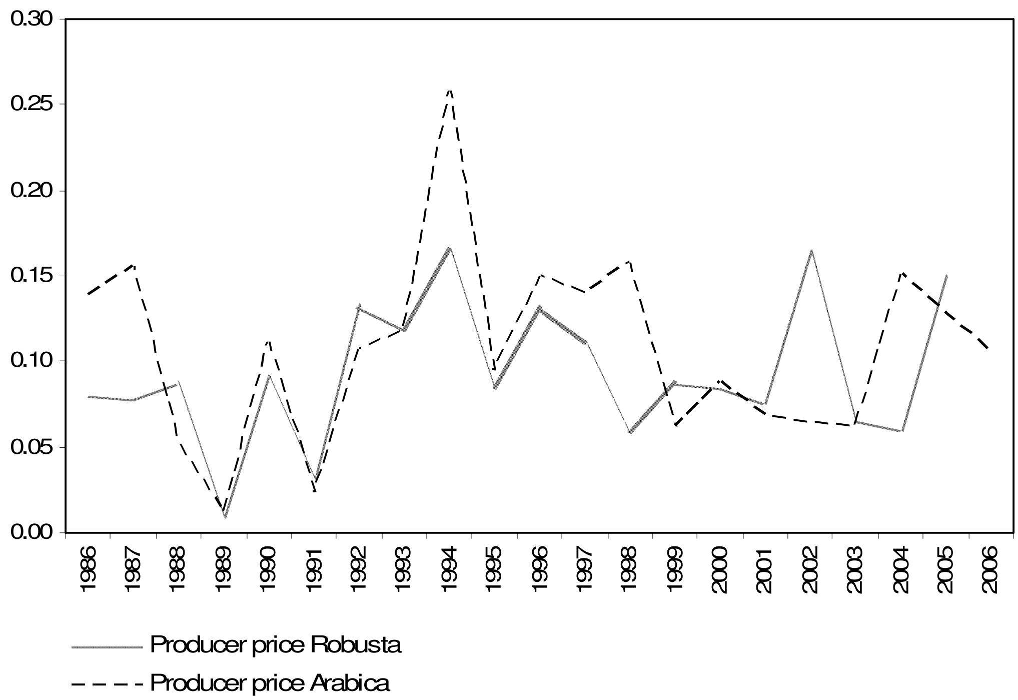
World price Robusta: Combined spot prices of "Robusta" coffee traded daily in the New York and Le Havre/Marseilles markets (weights: 25% New York, 75% Le Havre/Marseilles)

World price Arabica: Combined spot prices of "Other Mild" coffee traded daily in the New York and Hamburg markets (weights: 40% New York; 60% Hamburg)

Producer prices: Average farm-gate prices for all grades, reported by the Indian Coffee Board to ICO.

Source: International Coffee Organization (ICO)

Figure 4.4 Coefficient of variation of domestic coffee prices
Monthly variation within a year (2000=100)



Average farm-gate prices for all grades, reported by the Indian Coffee Board to ICO.

Source: International Coffee Organization (ICO)

Table 4.1 Summary Statistics

	Obs	Mean	Median	Std. Dev.	Min	Max
Age	494	54.5		12.4	25	94
Gender (1=male)	500	0.95		0.22	0	1
Primary education	500	0.08		0.27	0	1
Secondary education	500	0.43		0.50	0	1
University education	500	0.47		0.50	0	1
Member of cooperative	500	0.51		0.50	0	1
Member of grower association	500	0.48		0.50	0	1
Member of another organization	500	0.16		0.37	0	1
Area of estate, acres	500	51.8	20.0	96.7	2	890
Planted area, acres	500	48.0	17.0	90.3	1	884
Yielding area, acres	500	46.7	16.0	85.3	1	750
Output, unwashed Arabica, 50 kg bags	225	88	36	208	2	2,600
Output, washed Arabica, 50 kg bags	222	328	118	619	3	6,092
Output, unwashed Robusta, 50 kg bags	187	362	221	390	4	2,100
Output, washed Robusta, 50 kg bags	52	713	320	1185	3	6,933
Sale price, unwashed Arabica, 50 kg bags	233	815	800	94	250	1,200
Sale price, washed Arabica, 50 kg bags	221	1,927	1900	191	1200	2,600
Sale price, unwashed Robusta, 50 kg bags	188	574	600	83	400	850
Sale price, washed Robusta, 50 kg bags	44	1,231	1200	218	700	1,800
Coffee revenue, 1000 Rs.	374	617	230	1,274	4	11,900
Total farm revenue, 1000 Rs.	379	762	263	1,860	1	25,800
Cost of cultivation of Arabica, 1000 Rs/acre	229	17.0	17.0	3.7	5.0	25.5
Cost of cultivation of Robusta, 1000 Rs/acre	192	11.7	12.0	3.3	1.0	22.0
Share of farm income in total income, %	380	91.4		19.6	25	100
Share of coffee in farm income	379	79.2		15.5	25	100
Expected price washed Arabica	242	2,255	2,300	337.1	200	3,000
Expected price unwashed Arabica	240	905	900	119.4	350	1,500
Expected price washed Robusta	58	1,745	1,725	178.0	1,100	2,200
Expected price unwashed Robusta	200	901	900	127.2	100	1,250

Table 4.2 Accepted premiums for price insurance

Robusta (unwashed)

Guaranteed price of 800 Rs. per bag

Premium range	Freq.	Percent	Cum.
0	121	48.8	48.8
0-25	52	21.0	69.8
25-50	55	22.2	91.9
50-75	13	5.2	97.2
>75	7	2.8	100.0
Share of wtp>0	51.2%		
Total	248	100	

Guaranteed price of 1000 Rs. per bag

Premium range	Freq.	Percent	Cum.
0	35	14.1	14.1
0-25	19	7.7	21.8
25-50	109	44.0	65.7
50-100	78	31.5	97.2
>100	7	2.8	100.0
Share of wtp>0	85.9%		
Total	248	100	

Arabica (unwashed)

Guaranteed price of 800 Rs. per bag

Premium range	Freq.	Percent	Cum.
0	194	63.2	63.2
0-25	31	10.1	73.3
25-50	68	22.2	95.4
50-75	8	2.6	98.1
>75	6	2.0	100.0
Share of wtp>0	36.8%		
Total	307	100	

Guaranteed price of 1000 Rs. per bag

Premium range	Freq.	Percent	Cum.
0	113	36.8	36.8
0-25	16	5.2	42.0
25-50	105	34.2	76.2
50-100	67	21.8	98.1
>100	6	2.0	100.0
Share of wtp>0	63.2%		
Total	307	100	

Arabica (washed)

Guaranteed price of 2500 Rs. per bag

Premium range	Freq.	Percent	Cum.
0	21	7.0	7.0
0-50	25	8.3	15.3
50-100	150	49.8	65.1
100-200	100	33.2	98.3
>200	5	1.7	100.0
Share of wtp>0	93.0%		
Total	301	100	

Guaranteed price of 2800 Rs. per bag

Premium range	Freq.	Percent	Cum.
0	56	19	18.6
0-100	49	16	34.9
100-200	137	46	80.4
200-300	46	15	95.7
>300	13	4.3	100.0
Share of wtp>0	81.4%		
Total	301	100	

Table 4.3 Break even insurance premiums under risk neutrality, *E(Z)*
Summary statistics

	Robusta	Arabica	Percentiles	Robusta	Arabica
Obs	190	234	1%	0.0000	0.0000
Mean	19.14	17.98	5%	0.0002	0.0000
Std. Dev.	29.36	47.33	10%	0.001	0.014
Variance	862.15	2240.48	25%	0.79	0.79
Skewness	2.82	6.82	50%	3.24	1.01
Kurtosis	14.96	64.23	75%	24.96	23.37
			90%	47.94	45.20
			95%	85.40	85.40
			99%	124.33	219.36

Calculated using $E(Z) = \Phi\left(\tilde{p} - E(p \mid p < \tilde{p})\right)$
Price is assumed to be log normally distributed and Pr(p<phigh) = 0.95.

Table 4.4 Price expectations and *E(Z)*

	Robusta					Arabica				
		Expected price		E(Z)			Expected price		E(Z)	
Expected price	Obs	Mean	St.D.	Mean	St.D.	Obs	Mean	St.D.	Mean	St.D.
<700	0					3	517	152.8	318.2	191.9
700-800	15	735	28.6	88.6	44.6	12	744	24.1	87.3	51.7
800-900	72	822	26.3	25.9	20.4	87	832	28.1	19.6	24.3
900-1000	58	912	22.1	5.0	8.6	81	906	17.2	4.5	11.9
1000-1100	36	1000	0.0	4.2	8.6	33	1002	8.7	4.1	7.0
>=1110	9	1183	50.0	0.0	0.0	18	1142	49.3	0.2	0.4
Total	**190**	**893**	**103.9**	**19.1**	**29.4**	**234**	**897**	**108.0**	**18.0**	**47.3**

Price is assumed to be log normally distributed and Pr(p<phigh) = 0.95.

Table 4.5 Accepted premiums for price insurance and *E(Z)*

Range of premium	Calculated premium under risk neutrality, E(Z)					
	Robusta			**Arabica**		
	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.
[0, 25]	20.2	21.4	42	20.1	37.9	26
[25, 50]	16.0	26.6	40	28.1	47.9	59
[50, 75]	22.5	30.8	11	12.0	22.4	6
>75	18.2	15.6	6	6.5	11.3	4

Price is assumed to be log normally distributed and Pr(p<phigh) = 0.95

Only positive reported premiums are included

Table 4.6 Share of risk averse farmers

under different assumptions on price distribution

	I.		**II.**		**III.**		**IV.**	
	Lognormal, $Pr(p<p^{high})=0.95$		**Lognormal,** $Pr(p<p^{high})=0.99$		**Normal,** $Pr(p<p^{high})=0.95$		**Normal,** $Pr(p<p^{high})=0.99$	
	Obs	**Share**	**Obs**	**Share**	**Obs**	**Share**	**Obs**	**Share**
Not risk averse	237	64.9%	224	61.5%	251	68.6%	244	66.7%
Risk averse	128	35.1%	140	38.5%	115	31.4%	122	33.3%
Total	365	100.0%	364	100.0%	366	100.0%	366	100.0%

Table 4.7 Risk aversion and farm size

	I.				II.				III.				IV.			
	Lognormal, *$Pr(p<p^{high})=0.95$*				Lognormal, *$Pr(p<p^{high})=0.99$*				Normal, *$Pr(p<p^{high})=0.95$*				Normal, *$Pr(p<p^{high})=0.99$*			
	Mean	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**
Area of the estate, acres																
Not risk averse	49.3	6.2	95.0		49.0	6.4	96.2		50.0	6.0	94.9		50.5	6.2	96.2	
Risk averse	42.6	7.1	80.7		43.7	6.8	80.4		40.0	7.3	78.5		39.4	6.9	76.4	
combined	46.9	4.7	90.2		47.0	4.7	90.3		46.8	4.7	90.1		46.8	4.7	90.1	
diff	6.7	9.4		0.71	5.3	9.3		0.57	10.0	9.5		1.06	11.1	9.3		1.20
Total production																
Not risk averse	532.6	58.2	895.8		495.2	53.6	801.6		525.6	55.4	877.2		530.5	56.9	888.3	
Risk averse	461.7	81.5	922.2		528.4	89.1	1053.9		465.3	89.6	960.9		459.1	84.7	935.0	
combined	507.7	47.3	904.5		508.0	47.5	905.7		506.7	47.2	903.5		506.7	47.2	903.5	
diff	70.9	99.3		0.71	-33.1	103.9		-0.32	60.3	101.8		0.59	71.4	100.2		0.71

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.8 Risk aversion and income diversification

	I.				II.				III.				IV.			
	Lognormal, *Pr(p<p^high^)=0.95*				Lognormal, *Pr(p<p^high^)=0.99*				Normal, *Pr(p<p^high^)=0.95*				Normal, *Pr(p<p^high^)=0.99*			
	Mean	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**
Crop diversification, Herfindahl index																
Not risk averse	0.835	0.01	0.2		0.832	0.01	0.2		0.834	0.01	0.2		0.834	0.01	0.2	
Risk averse	0.832	0.02	0.2		0.836	0.02	0.2		0.835	0.02	0.2		0.835	0.02	0.2	
combined	0.834	0.01	0.2		0.833	0.01	0.2		0.834	0.01	0.2		0.834	0.01	0.2	
diff	0.003	0.02		0.15	-0.005	0.02		-0.23	-0.001	0.02		-0.07	-0.001	0.02		-0.03
Share of off-farm income, %																
Not risk averse	8.65	1.28	19.6		8.71	1.34	20.0		8.76	1.25	19.8		9.02	1.28	20.0	
Risk averse	9.57	1.82	20.6		9.46	1.69	20.0		9.35	1.89	20.3		8.81	1.79	19.8	
combined	8.97	1.04	20.0		9.00	1.05	20.0		8.95	1.04	19.9		8.95	1.04	19.9	
diff	-0.48	2.08		-0.42	-0.76	2.16		-0.35	-0.58	2.25		0.26	0.20	2.21		0.09

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.9 Risk aversion and self-insurance

	I.				II.				III.				IV.			
	Lognormal, $Pr(p<p^{high})=0.95$				Lognormal, $Pr(p<p^{high})=0.99$				Lognormal, $Pr(p<p^{high})=0.95$				Lognormal, $Pr(p<p^{high})=0.99$			
	No	Yes	Total	Pearson chi2(1)	No	Yes	Total	Pearson chi2(1)	No	Yes	Total	Pearson chi2(1)	No	Yes	Total	Pearson chi2(1)
Holding stock																
Not risk averse	220	17	237		208	16	224		234	17	251		2.27	17	244	
	92.8%	7.2%	100%		92.9%	7.1%	100%		93.2%	6.8%	100%		93.0%	7.0%	100%	
Risk averse	125	3	128		136	4	140		112	3	115		119	3	122	
	97.7%	2.3%	100%		97.1%	2.9%	100%		97.4%	2.6%	100%		97.5%	2.5%	100%	
Total	345	20	365	3.743 *	344	20	364	3.047 *	346	20	366	2.647	346	20	366	3.200 *
	94.5%	5.5%	100%		94.5%	5.5%	100%		94.5%	5.5%	100%		94.5%	5.5%	100%	
Aware of local prices																
Not risk averse	12	224	236		11	212	223		12	238	250		11	232	243	
	5.1%	94.9%	100%		4.9%	95.1%	100%		4.8%	95.2%	100%		4.5%	95.5%	100%	
Risk averse	2	126	128		3	137	140		2	113	115		3	119	122	
	1.6%	98.4%	100%		2.1%	97.9%	100%		1.7%	98.3%	100%		2.5%	97.5%	100%	
Total	14	350	364	2.784 *	14	349	363	1.805	14	351	365	2.000	14	351	365	0.942
	3.9%	96.2%	100%		3.9%	96.1%	100%		3.8%	96.2%	100%		3.8%	96.2%	100%	
Memership in a cooperative																
Not risk averse	117	120	237		111	113	224		126	125	251		124	120	244	
	49.4%	50.6%	100%		49.6%	50.5%	100%		50.2%	49.8%	100%		50.8%	49.2%	100%	
Risk averse	52	76	128		57	83	140		44	71	115		46	76	122	
	40.6%	59.4%	100%		40.7%	59.3%	100%		38.3%	61.7%	100%		37.7%	62.3%	100%	
Total	169	196	365	2.555	168	196	364	2.709 *	170	196	366	4.519 **	170	196	366	5.624 **
	46.3%	53.7%	100%		46.2%	53.9%	100%		46.5%	53.6%	100%		46.5%	53.6%	100%	
Account with financial institution																
Not risk averse	16	221	237		16	208	224		17	234	251		17	227	244	
	6.8%	93.3%	100%		7.1%	92.9%	100%		6.8%	93.2%	100%		7.0%	93.0%	100%	
Risk averse	4	124	128		4	136	140		3	112	115		3	119	122	
	31.3%	96.9%	100%		2.9%	97.1%	100%		2.6%	97.4%	100%		2.5%	97.5%	100%	
Total	20	345	365	2.110	20	344	364	3.047 *	20	346	366	2.647	20	346	366	3.200 *
	54.8%	94.5%	100%		5.5%	94.5%	100%		5.5%	94.5%	100%		5.5%	94.5%	100%	

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.10 Risk aversion and ways of dealing with income decline

	Lognormal, $Pr(p<p^{high})=0.95$					Lognormal, $Pr(p<p^{high})=0.99$				
	Not important/ Not very important	**Somewhat important**	**Important/ Very important**	**Total**	**Pearson chi2(1)**	**Not important/ Not very important**	**Somewhat important**	**Important/ Very important**	**Total**	**Pearson chi2(1)**
Reduce non-essential expenditure										
Not risk averse	8	49	180	237		8	44	172	224	
	3.4%	20.7%	76.0%	100%		3.6%	19.6%	76.8%	100%	
Risk averse	4	38	86	128		4	43	93	140	
	3.1%	29.7%	67.2%	100%		2.9%	30.7%	66.4%	100%	
Total	12	87	266	365	3.724	12	87	265	364	5.821 *
	3.3%	23.8%	72.9%	100%		3.3%	23.9%	72.8%	100%	
Have difficulty paying debts										
Not risk averse	28	64	145	237		26	62	136	224	
	11.8%	27.0%	61.2%	100%		11.6%	27.7%	60.7%	100%	
Risk averse	20	20	87	127		22	22	95	139	
	15.8%	15.8%	68.5%	100%		15.8%	15.8%	68.4%	100%	
Total	48	84	232	364	6.206 **	48	84	231	363	7.146 **
	13.2%	23.1%	63.7%	100%		13.2%	23.1%	63.6%	100%	
Seek financial help from family										
Not risk averse	163	52	21	236		154	50	19	223	
	69.1%	22.0%	8.9%	100%		69.1%	22.4%	8.5%	100%	
Risk averse	81	33	13	127		89	35	15	139	
	63.8%	26.0%	10.2%	100%		64.0%	25.2%	10.8%	100%	
Total	244	85	34	363	1.052	243	85	34	362	1.070
	67.2%	23.4%	9.4%	100%		67.1%	23.5%	9.4%	100%	

	Normal, $Pr(p<p^{high})=0.95$					Normal, $Pr(p<p^{high})=0.99$				
	Not important/ Not very important	**Somewhat important**	**Important/ Very important**	**Total**	**Pearson chi2(1)**	**Not important/ Not very important**	**Somewhat important**	**Important/ Very important**	**Total**	**Pearson chi2(1)**
Reduce non-essential expenditure										
Not risk averse	9	52	190	251		9	50	185	244	
	3.6%	20.7%	75.7%	100%		3.7%	2.0%	75.8%	100%	
Risk averse	3	36	76	115		3	38	81	122	
	2.6%	31.3%	66.1%	100%		2.5%	3.1%	66.4%	100%	
Total	12	88	266	366	4.908 *	12	88	266	366	5.210 *
	3.3%	24.0%	72.7%	100%		3.8%	2.4%	72.7%	100%	
Have difficulty paying debts										
Not risk averse	32	65	154	251		32	64	148	244	
	12.8%	25.9%	61.4%	100%		13.1%	26.2%	60.7%	100%	
Risk averse	16	19	79	114		16	20	85	121	
	14.0%	16.7%	69.3%	100%		13.2%	16.5%	70.3%	100%	
Total	48	84	233	365	3.775	48	84	233	365	
	13.2%	23.0%	63.8%	100%		13.2%	23.0%	63.8%	100%	4.474
Seek financial help from family										
Not risk averse	173	55	22	250		168	54	21	243	
	69.2%	22.0%	8.8%	100%		69.1%	22.2%	8.6%	100%	
Risk averse	71	31	12	114		76	32	13	121	
	62.3%	27.2%	10.5%	100%		62.8%	26.5%	10.7%	100%	
Total	244	86	34	364	1.703	244	86	34	364	1.474
	67.0%	23.6%	9.3%	100%		67.0%	23.6%	9.3%	100%	

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.11 Risk aversion and realized price

	I.				II.				III.				IV.			
	Lognormal, $Pr(p<p^{high})=0.95$				Lognormal, $Pr(p<p^{high})=0.99$				Normal, $Pr(p<p^{high})=0.95$				Normal, $Pr(p<p^{high})=0.99$			
	Mean	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**	**Mean**	**Std. Err.**	**Std. Dev.**	**t**
Washed Arabica																
Not risk averse	1916	15.9	187.4		1920	16.0	185.9		1913	15.5	189.0		1914	15.8	190.5	
Risk averse	1939	22.5	189.3		1929	22.4	192.3		1947	23.3	185.0		1942	22.5	182.6	
combined	1924	13.0	187.9		1923	13.0	187.8		1923	12.9	188.1		1923	12.9	188.1	
diff	-23	27.4		-0.83	-9	27.2		-0.32	-35	28.3		-1.22	-28	27.9		-0.99
Unwashed Arabica																
Not risk averse	818	7.9	96.6		820	8.0	96.8		817	7.5	95.1		819	7.6	95.4	
Risk averse	805	10.6	89.8		800	10.3	89.5		805	11.5	92.2		802	11.1	91.2	
combined	814	6.3	94.5		814	6.4	94.6		814	6.3	94.3		814	6.3	94.3	
diff	13	13.5		1.00	20	13.4		1.48 *	12	14.0		0.89	16	13.8		1.18
Washed Robusta																
Not risk averse	1214	42.4	228.4		1216	43.1	215.5		1216	39.7	221.2		1216	39.7	221.2	
Risk averse	1275	69.6	220.2		1254	66.2	247.7		1281	87.6	247.8		1281	87.6	247.8	
combined	1229	36.0	225.0		1229	36.0	225.0		1229	36.0	225.0		1229	36.0	225.0	
diff	-61	83.0		-0.74	-38	75.9		-0.50	-65	89.8		-0.73	-65	89.8		-0.73
Unwashed Robusta																
Not risk averse	580	7.6	81.3		580	8.0	82.1		577	7.4	80.9		577	7.6	82.0	
Risk averse	557	10.2	81.8		561	9.4	81.0		561	11.1	83.8		562	10.4	81.6	
combined	572	6.1	82.0		572	6.1	82.0		572	6.1	82.0		572	6.1	82.0	
diff	23	12.7		1.77 **	19	12.4		1.54 *	16	13.1		1.24	15	12.9		1.15

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4.12 Maximum acceptable premiums and education

Education	Max premium for Unwashed Arabica			Max premium for Unwashed Robusta		
	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.
Primary	26.82	9.82	11	21.25	13.82	8
Secondary	30.33	16.05	51	24.71	15.61	45
University	28.80	29.25	46	24.35	16.28	57
Total	29.32	22.15	108	24.27	15.73	110

* At 800 Rs. guaranteed price

Table 4.13 Maximum acceptable premiums, price expectations and education
Regression results

	Unwashed Arabica		Unwashed Robusta	
	Coef.	Std. Err.	Coef.	Std. Err.
Price mean	0.026	0.024	0.013	0.016
Price variance	-4E-05	5E-05	-7E-05	9E-05
Dummy secondary education	3.847	7.929	3.492	6.866
Dummy university education	1.742	7.966	-1.025	6.789
Constant	3.896	22.264	12.752	16.013
No of observations	92		87	
R-squared	0.026		0.034	

*** significant at 1%; ** significant at 5%; * significant at 10%

Appendix 4.A: Variance of income under price insurance

To show that income variance is reduced by participation in price insurance, first note that total income under insurance can be decomposed into income generated by the insured quantity $\tilde{q}$ and the remaining (uninsured) output $\hat{q} = q - \tilde{q}$. Define $\tilde{Y}$ as income under insurance. It equals the sum of incomes from insured and uninsured quantities, net of insurance premium payment:

$$\tilde{Y} = \tilde{Y}(\tilde{q}) + \tilde{Y}(\hat{q}) - \tilde{q}x \quad (4.A.1)$$

Without a loss of generality, the total income without insurance can be written as the sum of incomes derived from sale of the same two quantities:

$$Y = Y(\tilde{q}) + Y(\hat{q}) \quad (4.A.2)$$

In the following decomposition of variance is used to demonstrate that $Var(\tilde{Y}) < Var(Y)$. The variance decomposition rule can be used to show that the variance of income can be written as

$$Var(Y) = E[Var(Y \mid p)] + Var[E(Y \mid p)] \quad (4.A.3)$$

This property is useful when dealing with censored data, such as in this case, where price is a censored variable under insurance: any price below $\tilde{p}$ is replaced with $\tilde{p}$ for insured output.

Without insurance the truncated moments of income are:

$$E(Y \mid p < \tilde{p}) = \tilde{q}E(p \mid p < \tilde{p}) + E(p\hat{q} \mid p < \tilde{p}) \quad (4.A.4)$$

$$E(Y \mid p > \tilde{p}) = \tilde{q}E(p \mid p > \tilde{p}) + E(p\hat{q} \mid p > \tilde{p}) \quad (4.A.5)$$

$$Var(Y \mid p < \tilde{p}) = Var(p\tilde{q} \mid p < \tilde{p}) + Var(p\hat{q} \mid p < \tilde{p}) + 2Cov(p\tilde{q}, p\hat{q} \mid p < \tilde{p}) \quad (4.A.6)$$

$$Var(Y \mid p > \tilde{p}) = Var(p\tilde{q} \mid p > \tilde{p}) + Var(p\hat{q} \mid p > \tilde{p}) + 2Cov(p\tilde{q}, p\hat{q} \mid p > \tilde{p}) \quad (4.A.7)$$

and the untruncated mean of income is

$$E(Y) = \tilde{q}E(p) + E(p\hat{q}) \quad (4.A.8)$$

With insurance the truncated moments of income are

$$E(\tilde{Y} \mid p < \tilde{p}) = \tilde{p}\tilde{q} + E(p\hat{q} \mid p < \tilde{p}) - \tilde{q}x \quad (4.A.9)$$

$$E(\tilde{Y} \mid p > \tilde{p}) = \tilde{q}E(p \mid p > \tilde{p}) + E(p\hat{q} \mid p > \tilde{p}) - \tilde{q}x \quad (4.A.10)$$

$$Var(\tilde{Y} \mid p < \tilde{p}) = Var(p\hat{q} \mid p < \tilde{p}) \quad (4.A.11)$$

$$Var(\tilde{Y} \mid p > \tilde{p}) = Var(p\tilde{q} \mid p > \tilde{p}) + Var(p\hat{q} \mid p > \tilde{p}) + 2Cov(p\tilde{q}, p\hat{q} \mid p > \tilde{p}) \quad (4.A.12)$$

and the untruncated mean of income is

$$E(\tilde{Y}) = \Phi\tilde{p}\tilde{q} + (1-\Phi)\tilde{q}E(p \mid p > \tilde{p}) + E(p\hat{q}) - \tilde{q}x \quad (4.A.13)$$

where $\Phi = \Pr(p < \tilde{p})$

Note that only the insured quantity $\tilde{q}$ is affected by the purchase of insurance. The changes in moments of income in response to insurance purchase occur only through the effect of price censoring on $\tilde{q}$ .When price falls below $\tilde{p}$, income from selling $\tilde{q}$ becomes $\tilde{p}\tilde{q}$. When $p < \tilde{p}$ both the variance of income from $\tilde{q}$ and the covariance between $\tilde{p}\tilde{q}$ and $p\hat{q}$ are zero. The mean and variance of income generated by marketing of $\hat{q}$ is the same with and without insurance.

Denote $E[Var(\tilde{Y} \mid p)]$ and $E[Var(Y \mid p)]$ the means of conditional variances in (4.A.3), with and without insurance, respectively. As long as growers' income is increasing in market price $\left(\frac{\partial(p\hat{q})}{\partial p} \geq 0\right)$, $Cov(p\tilde{q}, p\hat{q}) = \tilde{q}Cov(p, p\hat{q})$ implies that the covariance between incomes from sale of $\tilde{q}$ and $\hat{q}$ in (4.A.6) is nonnegative. Then, according to (4.A.6) and (4.A.11) it holds that $Var\left(\tilde{Y} \mid p < \tilde{p}\right) < Var\left(Y \mid p < \tilde{p}\right)$. In addition, note that (4.A.7) and (4.A.12) imply that $Var\left(\tilde{Y} \mid p > \tilde{p}\right) = Var\left(Y \mid p > \tilde{p}\right)$ since enrollment in insurance does not change the variance of income conditional on price exceeding $\tilde{p}$. Therefore, the mean of variance under insurance is necessarily smaller than without insurance: $E\left[Var\left(\tilde{Y} \mid p\right)\right] < E\left[Var\left(Y \mid p\right)\right]$.

Next denote $Var\left[E\left(\tilde{Y} \mid p\right)\right]$ and $Var\left[E\left(Y \mid p\right)\right]$ the variances of conditional means with and without insurance, respectively, as referenced in (4.A.3). These equal

$$Var(L) = \Phi\left[E\left(Y \mid p < \tilde{p}\right) - E\left(Y\right)\right]^2 + \left(1-\Phi\right)\left[E\left(Y \mid p > \tilde{p}\right) - E\left(Y\right)\right]^2 \quad (4.A.14)$$

$$Var(\tilde{L}) = \Phi\left[E\left(\tilde{Y} \mid p < \tilde{p}\right) - E\left(\tilde{Y}\right)\right]^2 + \left(1-\Phi\right)\left[E\left(\tilde{Y} \mid p > \tilde{p}\right) - E\left(\tilde{Y}\right)\right]^2 \quad (4.A.15)$$

Inserting (4.A.4), (4.A.5) and (4.A.8) into (4.A.14) and (4.A.9), (4.A.10) and (4.A.13) into (4.A.15) and simplifying yields

$$Var\left[E\left(Y \mid p\right)\right] = \Phi\left(1-\Phi\right)\left[\Delta E\left(\tilde{q}\right) + \Delta E\left(\hat{q}\right)\right]^2 \quad (4.A.16)$$

and

$$Var\left[E\left(\tilde{Y} \mid p\right)\right] = \Phi\left(1-\Phi\right)\left[\Delta \tilde{E}\left(\tilde{q}\right) + \Delta E\left(\hat{q}\right)\right]^2 \quad (4.A.17)$$

where $\Delta E\left(\tilde{q}\right) = \tilde{q}\left(E\left(p \mid p > \tilde{p}\right) - E\left(p \mid p < \tilde{p}\right)\right)$, $\Delta \tilde{E}\left(\tilde{q}\right) = \tilde{q}\left(E\left(p \mid p > \tilde{p}\right) - \tilde{p}\right)$ and $\Delta E\left(\hat{q}\right) = E\left(p\hat{q} \mid p > \tilde{p}\right) - E\left(p\hat{q} \mid p < \tilde{p}\right)$.

Since $\tilde{p} > E\left(p \mid p < \tilde{p}\right)$, this implies that $Var\left[E\left(\tilde{Y} \mid p\right)\right] < Var\left[E\left(Y \mid p\right)\right]$. Given that both the mean of income variance and the variance of income mean in (4.A.3) are lower under insurance, the variance of income is lower under price insurance than without insurance.

Chapter 5: Concluding remarks

5.1 Summary of results

This dissertation is intended to contribute to the ongoing debate on the future of coffee growing in developing countries by providing empirical evidence on the determinants of producer prices and farmers' ability to deal with price risks. The three essays that comprise this dissertation focus on three different topics relevant to coffee growers' welfare. Different methodology is used in each case to produce the evidence.

The main results of the cointegration analysis and error-correction model that use time series data for selected coffee producing countries are the following. First, the long-term cointegration between producer prices and international coffee prices improved following the structural reforms in most countries. Second, the reforms significantly increased the share of producer price in the world market price. Third, both short-term price transmission and speed of adjustment are significantly higher in the post-liberalization period. Fourth, producer prices adjust faster to changes in the world market price today than prior to the reforms, and the effect is stronger in countries where reforms were far-reaching. Fifth, asymmetric price transmission is detected in some cases, taking the form that price increases are transmitted slower than price declines.

The general finding on the relationship between market structure and producer prices, based on cross-section data from India, is that competition in marketing matters in some, but not all cases. The first conclusion is that lack of competition among growers has a negative effect on producer prices for Robusta coffee, the more homogeneous of the two types of coffee produced in India, but not on Arabica prices. Second, fewer traders operate in remote areas, and therefore farms that are located far from town can not easily switch buyers. Third, marketing arrangements have less implications for Arabica prices than the altitude at which the coffee is grown: Better quality coffee is grown at higher altitude and fetches higher premium. Fourth, university-educated growers receive higher prices. Fifth, marketing channels affect producer prices differently depending on the type of coffee: Robusta growers receive higher prices if they sell directly to exporter; for Arabica growers all outlets are equivalent, unless they sell to coffee curers, which pay significantly less than other buyers. Lastly, producers of washed Robusta receive much higher prices, if they are members of a cooperative

The main result of the last essay that investigates the relationship between risk aversion and risk mitigation strategies is that risk averse farmers do use informal strategies to reduce uncertainty. In particular, risk averse farmers are more likely to join cooperatives and less likely to hold stock. In addition, I find that risk averse growers are more likely to default on their loans than other farmers and less likely to reduce expenditure, which is consistent with the consumption smoothing objective. These findings are also consistent with the usual findings in the literature on risk sharing. On the other hand, risk averse farmers do not make greater use of income diversification through crop mix or off-farm employment, contrary to the intuition. Finally, I find that, under certain assumptions, Robusta growers receive lower prices on average if they are risk averse.

5.2 Policy implications

The policy implications of this research are rather intuitive. The results of this dissertation indicate that the structural reforms in the coffee sector overall were successful in achieving the goals that they pursued. Whether or not they left producers better off, is a different matter. Clearly, a more dynamic response of domestic prices to changes in international markets benefits producers when the world prices are on a rise and hurts them when prices are falling. As coffee growers are almost certainly risk averse, this implies that any initiatives promoting producer welfare need to include price risk management. This explains why formal markets for risks are on the rise in coffee producing countries.

The role of state in this context is being redefined. Rather than being involved directly in market functioning, the successors to coffee boards are now focusing on providing services that would expand the reach of these markets and ease the access of farmers to the risk management products, in particular for the poorer and less informed segments of growers. The principal challenge is to facilitate the use of markets (domestic and international) to achieve the same objectives as stabilization programs set out, but in an efficient and sustainable fashion. Thus, the role of the coffee authorities today should be providing extension services and technical assistance to farmers, and to promote market-based risk management instruments. This requires identification and education of viable producer organizations or local institutions that would be able to disseminate risk-management instruments.

The results of this dissertation also indicate that farm risks and rural credit are interlinked, since coffee growers are not able to repay loans at the time of a price fall, in particular if they are risk averse. This lends empirical support to appropriateness of the proposed pilot programs that link price insurance to rural financing. The approach tested in these pilots is conditioning rural credit on purchase of price insurance. Another result is that cooperatives have an important role to play, both for risk pooling, exploiting economies of scale in marketing and collective bargaining to achieve higher prices.

Finally, since competition among traders matters for producer prices, policy-makers should encourage competition and remove the remaining barriers to entry into the marketing sector. Dissolution of marketing boards does not automatically mean that the marketing sector becomes perfectly competitive. In the recent years the tendency in commodity markets has been towards concentration and collusion in marketing. Laws promoting competition in farm product markets, which either do not exist or are not properly enforced in many developing countries, should be strengthened.

5.3 Directions for future research

This dissertation analyzed some of the issues that affect producer prices of coffee. There are several related areas worth investigating in the future, both from the point of view of methodology to enhance the treatment of the problems outlined in this dissertation and addressing additional questions related to functioning of domestic coffee markets.

In terms of methodology an obvious extension of the model presented in Chapter 3 would be to assume a more flexible form of the production function to derive more general results regarding the impact of trader competition on producer prices. In this case the analysis will probably have to concentrate on deriving comparative static results for price elasticity and price transmission to facilitate construction of various tests, following an approach similar to the one developed by Holloway (1991), rather than assessing the explicit relationship between producer prices and world prices as it is done here. In Chapter 4, a further next step in assessing the risk aversion parameter would be to use numerical integration and introduce assumptions on the utility function to evaluate the risk aversion parameter numerically. In addition, an experiment involving lotteries would be useful to corroborate the findings on risk aversion among coffee growers in India.

A number of model extensions could be pursued to further develop the model of oligopsonistic competition among market intermediaries. First, it would be interesting to model explicitly the behavior of traders, assumed to be exogenous in this dissertation. The market structure could be made endogenous, and entry of traders could be modeled by making specific assumptions, for example on the fixed costs in coffee trading. The presence of asymmetric information between traders and growers could also have implications for the market structure. The search costs associated with asymmetric information regarding the quality of coffee sold by different growers would affect the equilibrium. To analyze this type of interaction a model spatial competition among traders would need to be developed. Another possible extension is to disaggregate the downstream sector into various activities, for example transport, processing and exporting. The effect of vertical integration of these activities on producer prices and marketing margins would be an important contribution. Another extension of the model developed in Chapter 3 would be to make the selection of marketing channels by coffee growers endogenous. Furthermore, a related question is the extent of market power of the multinationals that trade coffee: an exploration into the joint effect of oligopsony in domestic markets and oligopoly in global markets on producer prices would be an interesting contribution. In short, enhancing the theoretical treatment of market structure and the underlining dynamics in domestic commodity markets based on industrial organization approach would be helpful in furthering the analysis of the problems outlined.

To go further in the analysis of policies that affect coffee growers it would be useful to analyze the relationship between the market reforms in producing countries and the collapse of International Coffee Agreement (ICA). In many countries market liberalization took place as the same time as the ICA was abandoned, which in turn had important implications for the international price of coffee. An obvious question would therefore be whether the reforms contributed to the collapse of the Agreement and to the subsequent decline in the world price. A related issue is that of trade policy: Since market liberalization coincided with greater trade openness (for example, the countries that joined WTO were required to lower domestic tariffs on coffee), it would be interesting to assess the implications of these dynamics for growers.

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