The Value of Price Stabilization Policy for Cotton Producers in Burkina Faso

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Selected paper prepared for presentation at the Southern Agricultural Economics Association (SAEA) Annual Meeting, Orlando, Florida, 3-5 February 2013

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Abstract:

Economic returns to Burkina Faso cotton producers from selling to the government parastatal are compared to those that could be obtained by selling on the international spot market. Based on historical prices, for certain levels of risk aversion, the parastatal price would be preferred to the international spot price.

Key words: cotton, Burkina Faso, spot market, risk, local market, parastatal

Introduction

Export crops in Sub-Saharan Africa have traditionally been associated with poor marketing alternatives for producers (Diao and Hazell, 2004). Producers have often been equipped with modern technology at a subsidized price, but the prices paid to producers by the parastatal are typically only a fraction of world prices (Vitale et al., 2011). Noteworthy examples of parastatal export crops in Sub-Saharan Africa include cotton, cocoa, coffee, tobacco, peanuts, and cashew (Dorward et al., 2004). Government intervention and the politicization of agricultural markets has led to noncompetitive and discriminatory marketing outcomes for most of the export crops on the Sub-Saharan Africa sub-continent, favoring urban regions over rural agricultural communities.

"Getting prices right" means that local prices are consistent with international prices and send appropriate signals to producers. Historically the prices paid by parastatals are lower than what could be expected from international spot markets. However, parastatals may have provided some benefits by providing price stability (Timmer, 1986). The parastatal sets the price prior to planting, in May for cotton, whereas the international spot price would not be revealed

until after harvest (November-December). Producers have a strong preference for stable revenue streams because of the fear of negative incomes that can result in household welfare deterioration including difficulties for feeding the family and schooling for children (Abdoulaye and Sanders, 2006). In severe cases, persistent low and negative income will incentivize producers to abandon crops as happened with peanuts in the Casamance of Senegal (Warning and Key, 2002).

Economists have hypothesized that the decreasing marginal utility of income creates an aversion to uncertain and varied income streams (Greene and Baron, 2001). Stable incomes are important for producers because the marginal utility of consumption or the indirect utility of income decreases as income increases.

In West Africa, cotton producers by virtue of the government controlled parastatal, benefit from the guaranteed price provided by the national cotton companies. If they had the opportunity to sell their production on the international market, as often proposed by proponents of liberalization, they would face international price variability. One question is how much benefit has been obtained through the parastatal pricing mechanism that while providing price stability, transmits a disproportionally low share of the world price to producers?

The international spot price is on average higher than the Burkina Faso parastatal price (Figure 2). Previous studies (Tschirley et al., 2009; Baquedano et al., 2010; Baffes, 2005) have found that access to the international market price would be beneficial for cotton producers in Burkina Faso. However these authors have not considered the risk associated with the international market spot price. Including risk in the analysis may provide a different perspective for the comparison between the two pricing systems. When the international spot price is adjusted by subtracting the costs beyond the farm gate (table 1), the difference between the domestic price and the international spot price approximates the cotton companies' rent. Because

producers who are forced to sell at the parastatal price are fully protected against international price risk, at least a fraction of the "theoretical" rent captured by the parastatal could be assumed to be analogous to a risk premium that producers might be willing to pay for the guaranteed price known prior to planting rather than waiting for the price to be revealed after harvest. This implicit benefit could be significant and deserves empirical testing.

Over the last 30 years, the world cotton price, as with many other primary commodities prices, has been highly volatile and declining in real terms (Figure 1). For example between 1980 and 1986 the nominal Cotlook A-Index price declined from a high of $0.94/lb to a low of $0.48/lb. In 1997, the average annual international nominal price was $0.97/lb. In real 2010 dollar term the Cotlook A-Index declined from $3.09/lb in1974 to $1.04/lb in 2010 (Figure 1).

If Burkina Faso cotton producers had the choice to produce cotton and sell after harvest on the international spot market, would it have historically been beneficial for them to do so? Would accounting for risk alter producers marketing decisions? Specifically, how often would the parastatal price have been beneficial to growers? According to the literature, the international spot price would be preferred over the existing parastatal price, but does including risk provide different results?

The purpose of the present paper is to investigate and analyze alternative marketing strategies for cotton producers in Burkina Faso. The marketing comparison focuses on estimating the risk premium associated with the guaranteed price provided by parastatals. More importantly, this paper contributes to the existing literature by explicitly including risk in comparing parastatals to spot markets.

Theoretical framework

Price and yield risk have a strong influence on agricultural producers' decision- making process (Moschini, 2001; Anderson and Dillon, 1992). Because cotton growers cannot know how the cotton price will change after the sowing date, their planting decisions are based on both expected revenue and its variance. In such case, all the risk is measured with the income variance (Markowitz, 1952). The risk preference structure is an element that determines how the producer reacts when facing risk. Risk preference may be measured by the risk aversion coefficient (Arrow, 1971). The risk aversion parameter shows producer's willingness to trade-off lower levels of expected income for reduced income variance (Jalota et al., 2007). Agricultural producers are assumed to be rational and they seek to maximize their expected utility of income (Mapp et al. 1979). Producers that are less risk averse are less willing to trade-off expected income and variability. Highly risk averse producers are more willing to trade-off expected income for reduced variability.

For risk averse producers the marginal utility of income decreases as income increases. Deviations above the mean generate less expected utility than deviations below the mean reduce the expected utility (Bailey et al. 1980). So in an expected utility framework, it follows that for a given level of expected income producers will prefer a portfolio with less variation, about the mean. Freund (1956) suggested that quadratic programming may be used to determine minimum variance plans for a given level of expected income. When approximated by a second order Taylor series, the expected utility is a function of the mean and the variance of income (Levy and Markowitz, 1979). The quadratic formulation allows minimal assumptions about producer's risk preferences (Hazell, 1971). The risk associated with yield variability is ignored in the present

study based on the assumption that the yield expectation variability cannot change the outcomes for producers.

Data description

In the present study two hypothetical marketing channels are considered (the international spot market and the parastatal system). Historical cotton price data over 34 years (1976-2009) were collected from various sources for the two marketing channels. The parastatal price is the national pan-territorial and pan-seasonal price given to producers by the cotton companies. Since 2006 the parastatal price has been negotiated each year and announced publicly prior to the planting period in April. Prior to 2006, the parastatal price was determined by the government. After posting, within year the parastatal price has zero variance. The international spot price is the CIF North Europe or Cotlook A Index price. Monthly Data on the spot price are published by the UN Commission on Trade and Development (UNCTAD). In the present study, the December spot price is used under the assumption that the ginning industry is able to have the cotton lint available for world markets by the end of December each year.

Empirical Model

The Northern Europe cotton market represented by the quotations in Liverpool and Rotterdam is the one where the West African cotton is mainly exported (Cootlook, 2011). However the international cotton market is now more represented by the Cootlook 'A' Index in which even quotation in the US are represented. We assume that producers can sell their production on the international markets or to the parastatal.

An E-V model is specified with a quadratic utility function to determine the optimal marketing strategy. The producer's objective is to maximize the utility of income subject to a land constraint. The model is specified as:

$$MAX\ \Phi = \sum_{j=1}^{3} X_{(t,j)}\ P_{(t,j)}\ - \frac{\gamma}{2} \sum_{j=1}^{3} X^2{}_{(t,j)}\ Var(t,j) \quad (1)$$

Subject to: $\sum_j X_{(t,j)} = 1$ (2)

$$X_{(t,j)} \geq 0 \quad (3)$$

where Φ is the producer's expected utility of income, *t* is the year (time period), *j* is the marketing channel (parastatal and the north Europe spot market), *X(t,j)* is the decision variable (fraction of the production for year *t* optimally sold on market *j*) and *P(t,j)* is the market price for the j^{th} marketing channel in year *t*. *Var(t,j)* is the variance of market channel *j* and γ is the producer's risk aversion parameter. For the range of the producer's risk aversion parameter we followed prior studies on agricultural commodities marketing mainly the study by Rolfo (1980).

When considering spot markets, a major issue for producers is price uncertainty. Producers form price expectations in the spring time to choose the optimal strategy. Since harvest is several months in the future, and further time is required to gin the cotton and ready it for world markets, there can be significant variability within price expectations. Hence, instead of using the actual price an expected price is forecasted based on the historical observations of cotton prices. Each year, the December international spot price (the harvest period) is forecasted in May (the planting period).

A forecast model was developed to estimate the predicted December price series. The model behind the procedure uses a linear time trend as given by the following equation:

$$P_t = \alpha_1 P_{t-1} + \alpha_2\ P_{t-2}\ +\ \alpha_3\ P_{t-3} +\ \ldots +\ \alpha_k\ P_{t-k} + e_t \quad (4)$$

where P_t is the price for the period *t*, *t* is the current month (May of the current year), *k* is time lag index, α_k is an estimated parameter.

After the estimation, the forecast procedure uses the following equation to predict the next December price depending on the trends identified from the times series. The forecast equation is as follow:

$$P_t = \ (a + b_t)\ s(t) + \varepsilon_t \quad (5)$$

where P_t is the next December forecasted price, a and b are trend parameters, s(t) is the time trend , t is the time and ε_t the error component.

The forecast procedure generates the mean forecasted December price, the 95% confidence interval, and the standard deviation of the mean (SAS online support).

The forecast model was run for each of the 34 years using the previous years' monthly prices prior to May, starting by January 1976, to have the December forecasted price. The standard deviation is squared to have the variance of the spot price. The variance of the spot price is the principal component of price variability risk.

The sum of the marketing, domestic transportation, ginning, and the sea freight costs is the theoretical difference between the parastatal price and the international market price. These costs are subtracted from the spot market price to adjust the international price to the parastatal price. The two prices series are presented in figure 2.

Results

Spot marketing on the northern Europe market is compared to marketing via the parastatal using a mean variance model to determine the most profitable marketing strategy. The spot market was not always the optimal marketing strategy selected by the E-V model even though the spot market offers the higher price on average over the period 1976-2009 (table 2). Because of price risk and uncertainty, risk neutral producers would have marketed 15% of their production with the parastatal to maximize their expected income (table 1). With the risk neutral

preference, the average cotton revenue can fluctuate by 20% because its standard deviation is \$77.18 ha^{-1} for a mean of \$377.45 ha^{-1} (table 2).

Risk averse producers would optimally prefer the parastatal market that protects them against price uncertainty. However, risk averse producers lose part of their expected revenue as they sell an increasing part of their production with the parastatal. As producers sell more of their production with the parastatal their certainty equivalent decreases. The decrease in the certainty equivalent as risk aversion increases can be interpreted as if less risk averse producers are willing to accept more than highly risk averse ones to maintain a certain level of certainty for their expected income. Conversely the risk premium that is the difference between the expected revenue of the risk neutral producer and the revenue of another producer who has a higher level of risk aversion, increases as the risk aversion increases (table 1).

For values of the risk aversion parameter greater than or equal to 100 (higher level of risk aversion), all the production would be sold with the parastatal system to minimize income variance. At this level of risk aversion, the annual expected revenue is around \$281.97 ha^{-1} (table 2). This represents a 25.3% reduction in the expected revenue compared to the average revenue of risk neutral producers across the period 1976-2009. Meanwhile, the risk averse producer reduces the standard deviation of the expected revenue to zero.

Combining spot marketing and the parastatal pricing system would generally help producers increase their expected utility of income compared to the prevailing marketing practices. The only exception is the highly risk averse producers. As far as producers can bear a certain level of risk, they can improve their expected revenue and minimize income variability. For example, for risk neutral preferences cotton income increases by 36% compared to the parastatal pricing system over the 1976-2009 period (table 2). The expected revenue of highly

risk averse producers is the same as with the domestic pricing system because they sell 100% of their production on the domestic market to significantly reduce the variability associated with the international spot price.

It seems reasonable and consistent with other studies (Ouatara et al. (1992), Patillo and Soderbom, (2000)) that producers would be willing to reduce their expected revenue by 20% to significantly reduce variability, including avoiding low and negative incomes. Ouatara et al. (1992) found a reduction of 26% for the expected income for cocoa producers in Ivory Coast to reduce the income variance by 11%. In the present study the income reduction ranges between 5 and 20%. Importantly, with the expectation model presented here the variability of revenue is reduced to zero at high levels of risk aversion.

Because the use of the parastatal was found to be much greater over the last twelve years, we now take a deeper look at that time period.

1998-2009 period

The period from 1998 to 2009 was a period of low international prices. The domestic price was higher than the forecasted international spot price in four years over the period, i.e. in one year out of three the parastatal price was actually higher than the forecasted international spot price. During this most recent period, risk neutral producers would contract 33% of their production to the parastatal (table 3). The expected revenue of risk neutral producers was \$346.7 ha^{-1} with a standard deviation of \$33.85 ha^{-1}. The expected revenue of highly risk averse producers was \$309.7 ha^{-1}. It is 10% lower than the expected revenue of risk neutral producer. For moderate risk aversion (risk parameter 1), the expected revenue is \$310.3 ha^{-1} with a standard deviation of \$0.44 ha^{-1}. At this level of risk aversion the risk premium is \$36.4 ha^{-1}. The revenue of highly risk averse producers is risk free because its standard deviation is zero. The certainly equivalent

of highly risk averse producer is \$309.7 ha^{-1} and the risk premium is \$37.1 ha^{-1}. Compared to the parastatal system, the increase of the expected income with the combination of the international spot market and the parastatal price was only 11% for risk neutral producers. The 1998 - 2009 period was a period of progressive decline in the cotton world price. The local companies were probably using the price stabilization fund (supported by international donor agencies) to insure a higher price to producers.

Over the last twelve years, if producers had implemented our model's results, risk neutral producers would have earned lower revenue if they had contracted with the parastatal. For four years risk neutral producers would have the same revenue in both channels and they would have had higher revenue only in three years. The risk averse producers might have used any of the two channels and made approximately the same level of revenue. However, for the periods during which the international price was high (for example 1976-1984) risk neutral producers would have been better off by using the spot price for all the years. Because the parastatal price was dominated by first order stochastic dominance by the international price the parastatal option was not chosen in these periods for risk neutral producers.

Over the last twelve years, if producers had implemented our model's results, risk neutral producers would have earned higher revenue with the domestic price (table 4). For 4 years risk neutral producers would have the same revenue in both channels and they would have had higher revenue only in three years. The risk averse producers might have used any of the two channels and made approximately the same level of revenue (Table 4). However, for the periods during which the international price was high (for example 1976-1984) risk neutral producers would use the spot price for all the years and made higher revenue. Because the domestic price was

dominated in first order dominance by the international price the domestic marketing option was not chosen in these periods for risk neutral producers.

Conclusion

The present study investigated the potential benefit of two marketing channels for cotton producers in Burkina Faso in face of world price uncertainty using historical price data. The 34-year period between 1976 and 2009 was covered in the present study. An E-V model was specified with a quadratic utility function to approximate producer's expected utility of income. The single equation and single constraint model was based on producer decision variable that is the ratio of the production to be allocated to each marketing channel.

The result suggests that contrary to what one may expect the parastatal pricing system was not always the inferior marketing channel when compared to the international spot pricing systems. During periods of high international cotton spot price the spot market is the best marketing channel to be used by producers even though international spot market price incurs risk. The periods over which the international spot marketing price was better than the parastatal pricing system are the period between 1976 and1984 and the period from 1994 to 1997.

The present study showed that there is a real need for the price stabilization policy to continue being implemented in the cotton sector in Burkina Faso. The cotton companies system may not be the best way to support the sector but a guarantee fund may be an alternative solution through the Ministry of Agriculture. Other price stabilization policies such as price insurance mechanism may provide alternative price support system for the cotton sector in Burkina Faso.

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Table1: Local, actual and forecasted spot prices CFA F/Kg of seed cotton and actual yield ((Kg/ha)

Year	Local price	Actual spot price	Forecasted spot	Yield	Year	Local price	Actual spot price	Forecasted spot	Yield
1976	40	123.93	110.30	717.0	1993	85	72.98	83.21	748.1
1977	40	71.86	156.15	551.2	1994	115	309.80	183.56	789.2
1978	55	94.55	80.06	853.7	1995	115	293.45	282.99	694.5
1979	55	87.25	74.77	937.5	1996	165	245.28	193.49	1044.2
1980	55	121.54	79.76	820.9	1997	180	257.38	254.34	1171.4
1981	55	81.99	107.15	886.5	1998	180	154.10	201.72	961.5
1982	62	114.44	109.18	1061.2	1999	185	105.08	185.14	876.8
1983	62	217.56	133.04	1026.7	2000	185	283.74	236.69	1026.8
1984	70	176.98	200.31	1132.7	2001	170	130.62	201.80	1040.8
1985	90	75.46	174.49	1238.7	2002	200	277.04	158.29	965.3
1986	100	87.37	113.87	1441.9	2003	175	242.37	194.36	1083.6
1987	100	100.77	159.69	1315.2	2004	185	95.47	230.42	1041.2
1988	95	73.70	99.79	902.9	2005	210	139.12	163.51	1126.2
1989	95	126.59	141.98	940.1	2006	175	146.81	153.36	965.7
1990	95	121.05	139.77	1068.9	2007	167	193.62	165.91	877.4
1991	95	68.83	134.00	1005.5	2008	164	130.41	216.14	1003.1
1992	95	56.99	95.12	944.9	2009	159	230.43	190.13	866.7

The local price is the price given to producers by the parastatal companies; the actual spot price is the December cotlook A index price converted using the nominal exchange rate and the ginning ratio; the forecasted spot price is obtained using the simple linear time trend forecast model.

Table 2: Comparison between the international European spot market and the domestic pricing system over the period 1976-2009

γ	Domestic Pricing ratio*	International Spot ratio*	Average revenue** ($US/ha)	STDEV of revenue ($US/ha)	Certainty equivalent*** ($US/ha)	Risk premium‡ ($US/ha)
0	0.15	0.85	377.45	70.18	-	-
0.001	0.20	0.80	377.43	65.48	377.16	0.02
0.1	0.61	0.39	340.05	23.79	340.05	37.40
1	0.92	0.08	294.21	3.31	294.21	83.24
5	0.98	0.02	285.15	0.68	285.15	92.30
50	0.99	0.001	282.09	0.02	282.09	95.36
100	1.00	0.00	281.97	0	281.97	95.54

***The ratios are obtained through the E-V model using the data for the period between 1976 and 1984. **The revenue is computed using the ratios, the prices of the two marketing channels and adding them. *** The certainty equivalent is equivalent to the income that risk averse producer is willing to accept rather than a higher revenue that is subject to risk. ‡The risk premium is the difference between the certainty equivalent and the revenue of the risk neutral producer.*

Table 3: Comparison between the international European spot market and the domestic pricing system from 1998 to 2009

γ	Domestic Pricing Ratio*	International Spot Ratio*	Average revenue** ($US/ha)	STDEV of revenue ($US/ha)	Certainty equivalent ($US/ha)***	Risk premium‡ ($US/ha)
0	0.33	0.67	346.7	33.85	-	-
0.001	0.41	0.59	346.7	30.76	346.7	0.0
0.1	0.92	0.08	315.6	4.33	315.6	31.2
1	0.99	0.01	310.3	0.44	310.3	36.4
5	1	0	309.7	0	309.7	37.0
50	1	0	309.7	0	309.7	37.0
100	1	0	309.7	0	309.7	37.0

****** The ratios are obtained through the E-V model using the data for the period between 1976 and 1984. **The revenue is computed using the ratios, the prices of the two marketing channels and adding them.*

**** The certainty equivalent is equivalent to the income that risk averse producer is willing to accept rather than a higher revenue that is subject to risk.*

‡ *The risk premium is the difference between the certainty equivalent and the revenue of the risk neutral producer.*

Table 4: Actual and expected revenue for risk neutral producer ($US/ha)

Year	Forecasted spot price * Combination	Actual spot price** Combination	Domestic price only	Actual spot only
1998	338.14	258.33	301.73	258.33
1999	283.03	160.63	282.81	160.63
2000	423.71	507.93	331.18	507.93
2001	366.18	237.01	308.47	237.01
2002	336.59	336.59	336.59	466.24
2003	367.17	457.87	330.60	457.88
2004	418.26	173.30	335.81	173.30
2005	412.32	412.32	412.32	273.16
2006	294.63	294.63	294.63	247.17
2007	255.46	255.46	255.46	296.18
2008	378.01	228.07	286.82	228.07
2009	287.30	348.19	240.26	348.19
Average	346.73	305.86	309.72	304.51
STDEV	57.15	109.71	44.86	115.90

**The forecasted spot price is combined with the domestic market using the proportion suggested by the E-V model*. ** the actual spot price is *combined with the domestic market using the proportion suggested by the*

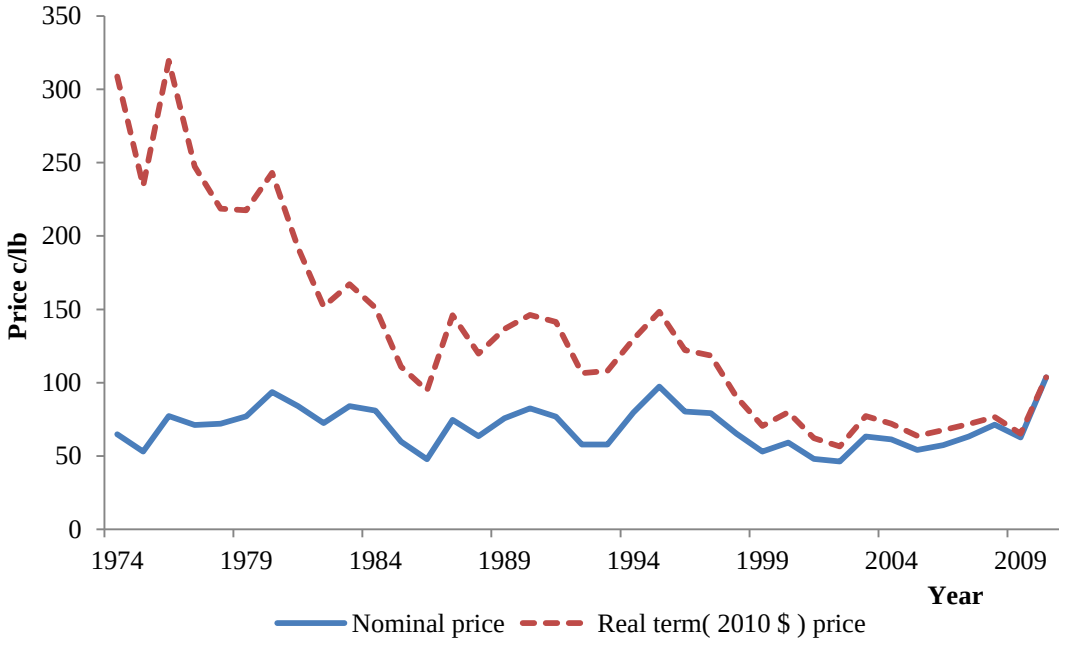

Figure 1: Nominal and real Cotlook A index price
Source: FaoStat

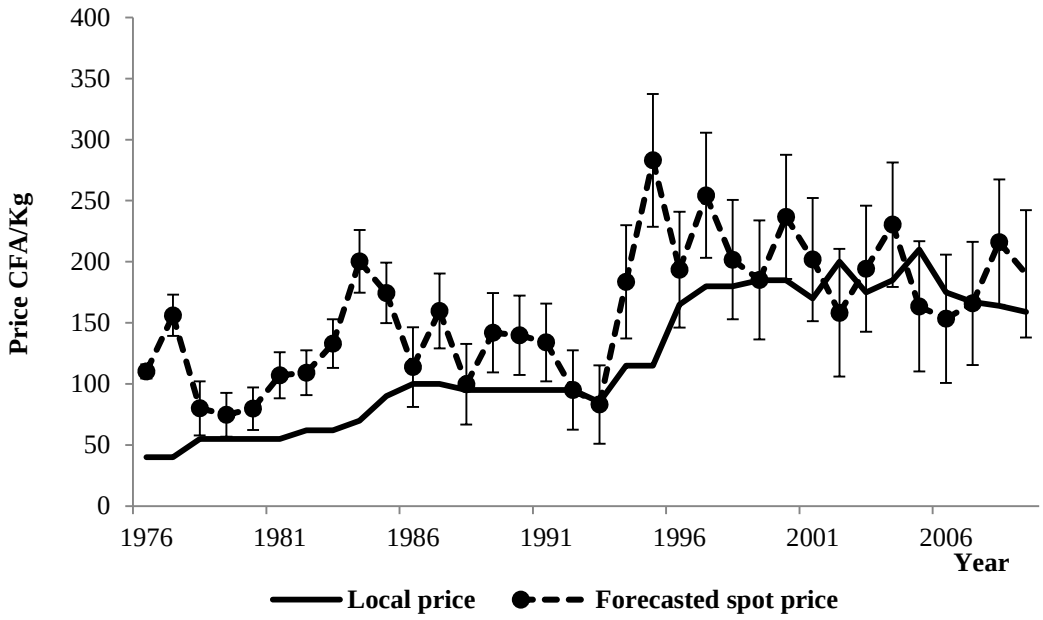

Figure 2: Forecasted spot and domestic prices

*****_Data sources: domestic price (World Bank), Spot price (UNCTAD)_

***** _The domestic price is the national producer's price at the farm gate. The forecasted spot price is the December expected price forecasted with a simple linear time series model. The errors bars represent one standard deviation above the mean and one standard deviation below the mean for the spot price._