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PRICE EXPECTATIONS AND SUPPLY RESPONSE IN ZIMBABWE: IMPLICATIONS FOR FOOD SECURITY

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This study empirically investigates the relationship between price expectations and farm supply response in Zimbabwe. In particular, we examine the effect that the timing of official maize price announcements has on the price responsiveness of commercial maize producers. The implications of the results for food security are discussed.

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PRICE EXPECTATIONS AND SUPPLY RESPONSE IN ZIMBABWE: IMPLICATIONS FOR FOOD SECURITY

The relationship between price uncertainty and farm supply response is well established in the domestic risk literature (Johnson; Schultz; Just; Newberry and Stiglitz), yet it has received little empirical treatment. This is especially true in Sub-Saharan Africa where price instability and its effects on aggregate production growth are particularly acute. Although the influence of price risk on African producer behavior and domestic food grain supply have received considerable theoretical attention (Lele), empirical measurement relating the degree of price uncertainty to supply responsiveness has been lacking (Askari and Cummings). The case of Zimbabwe offers an opportunity to examine the effect of the timing of official maize price announcements on producer supply response and resource allocation. This study examines the hypothesis that the area responsiveness of farmers to maize price is both higher and less variable when floor prices are known before planting (certainty) as opposed to after planting (uncertainty). The empirical results and potential implications for food security are subsequently discussed.

Theoretical Discussion

Agricultural price policies are often intended to reduce production risk. While a major portion of this risk is due to yield uncertainty, price policy may be designed to reduce price uncertainty. Price uncertainty comes from the producer's lack of knowledge at planting time about the price he will receive at harvest time. He therefore must form an expectation of the future price. And because perfect information is not available, some degree of resource misallocation can be expected. The policy rationale is that by bringing future price information into the present (with greater certainty of the price that will obtain in the future), productive resources can be more efficiently allocated and hence aggregate output increased (Johnson).

However, farmers may not be induced to expand production of food grains or invest in new productive technology unless they are given some assurance that output expansion will not prove unprofitable because of price declines (Norman; Shaffer et. al.). The problem is particularly acute in areas of Sub-Saharan Africa with low price elasticities of demand for staple food crops; in such cases, increases in output will lead (other things equal) to a relatively larger price decline. Knowledge that this outcome is possible will generally dampen supply responsiveness to price changes. Furthermore, farm investment in new technology is linked to the stability in returns to new technology (Norman; Sanders et. al.). In this way, greater uncertainty and instability in price movements may impede long-term food production growth.

Theoretical results show that the optimal level of production for a competitive firm facing risky output prices is less than the production level of a competitive firm under certainty conditions (Robison and Barry). The effect of output price risk is to shift the firm's marginal cost curve upward. Although the effect on output is unambiguously less, the effect on price responsiveness is considerably more complex. Accordingly, we present some empirical evidence on the effect of reduced price uncertainty on the price responsiveness of aggregate commodity supply.

The Model

Effective policy analysis must be supported by reliable models which are representative of agents' behavior. Econometric models are often constructed to portray this behavior, and since the structure of such a model is largely derived by solving an optimization problem, the parameters of the model reflect optimal decision rules. The estimated coefficients of most economic models are not invariant to changes in policy regimes. If economists wish to analyze policy changes, such as the timing of official price announcements, then it is necessary to identify how policy changes alter the basic model, i.e. how agents will behave as their environment changes (Lucas).

Several studies have attempted to estimate supply responsiveness in Zimbabwe's maize subsector (Muir; Mudimu; Shapouri et.al.) but none have adequately accounted for the effects of the 1976 Grain Marketing Board's[1] price policy changes on the parameter estimates of the model.

Annual data were available for the 1964-84 period. These data were provided by the Agricultural Marketing Authority of Zimbabwe. In our analysis, we use only commercial sector data. Communal sector agriculture was the object of considerable post-independence infrastructural change which cannot be accurately disaggregated from the effects of price policy changes for these reasons, the estimation is confined to the commercial sector.

From 1964 to 1975, maize prices were announced after planting. From 1976 to 1982, producer floor prices were announed before planting, and thus were known with certainty at planting time. Prices were again announced subsequent to planting after 1982, but the implication of this system was that the previous year's price would be the new minimum price (Riley; Mudimu). Hence, minimum maize prices prevailing from 1976 to the present are assumed to be know with greater certainty than before 1976. In our statistical analysis, these price data were combined with the current price of nitrogen series (the largest cash input expense) to generate a gross margin variable. This gross margin variable is a proxy for profitability which serves to more accurately reflect production incentives.

The most important substitute crop in the commercial sector over the test period is tobacco. Tobacco is bought and sold via an auction market mechanism, which remained in effect over the two periods.

The dependent variable used in the analysis is area cultivated to maize. This was chosen over total output since area is not affected by changes in weather and thus provides a more accurate representation of farmer production decisions. Our results, however, may underestimate aggregate supply response somewhat due to a potential yield response to price incentives.

Four regressions are estimated:

Area Response in the 1964-75 Period

(1) $AREA = B_0 = B_1 * \hat{GMM} + B_2 * GMT(-1) + B_3 * AMAIZE(-1)$

where:

AREA = hectares planted to maize, commercial sector;

$\hat{GMM}$ = expected gross margin on maize, i.e. the difference between expected maize floor prices (Z$/ton) and current nitrogen fertilizer prices (a proxy for cost of production, converted into Z$/ton of maize);

GMT = gross margin on tobacco; the difference between average annual tobacco prices (Z$/ton) and fertilizer prices (converted in terms of Z$/ton of tobacco).

Since official maize prices and thus margins are not known at planting time during this period, producers must form an expectation of price. Following McCallum a rational expectations formulation is used to obtain consistent parameter estimates. As market participants do not posses information on the current values of exogenous variables when forming expectations, only lagged exogenous variables are included on the list of first-stage regressors.

Area Response in the 1976-84 Period

(2) $AREA = b_0 + b_1 * GMM + b_2 * GMT(-1) + b_3 * AMAIZE(-1)$

Since maize floor prices are now known with reasonable certainty, expected maize margin (GMM) is simply the pre-planting price minus known current fertilizer price. Tobacco prices are determined by auction mechanism as discussed earlier.

The parameter estimates of equations 1 and 2 are shown in table 1. The calculated price elasticity of maize area is different between the two regimes. During the 1964-75 period, the elasticity estimate was 0.21 and not significantly different from zero at the 5 percent level. By contrast, during the 1976-84 period the elasticity was 0.45 and highly significant. The elasticities for both periods were calculated at the price and quantity means during their respective periods. A further distinction between these two periods can be seen by looking at the "importance" of the lagged area planted variable. During the first period (equation 1) the impact of the lagged dependent variable is considerably greater than during the second period (equation 2). This may imply that during the first period, maize planting decisions were based more on past operating procedures than during the latter period. By contrast the contribution of lagged area planted to the explanatory power of equation 2 is minimal.

Despite these apparent differences, a hypothesis that $a_1 = b_1$ could not be rejected at the 5 percent level of significance. In fact, a Wald test of the joint hypothesis of equal coefficents between the two equations also could not be rejected. In addition, a Goldfeld-Quandt test for homoscedasticity was performed, the results of which suggested that we could not reject the hypothesis of homoscedasticity.

None of the above tests suggested that the data for the two periods could not be pooled. In light of several advantages, we choose to pool the data for the two periods and estimate a single regression. By pooling the data we not only gained degrees of freedom but also reduced considerable multicollinearity which was introduced in equation 1 through the use of TSLS. Equations 3 and 4 were estimated over the entire sample period.

Area Response in the 1964-84 Period

(3) $AREA = c_0 + c_1*GMM^{\Delta} + c_2*GMT(-1) + c_3*AREA(-1)$

Area Response in the 1964-84 Period with Intercept and Slope Shifter

(4) $AREA = d_0 + d_1*GMM^{\Delta} + d_2*GMT(-1) + d_3*AREA(-1) + d_4*D + d_5*DGMM$

Where:

GMM^{Δ} $= \hat{GMM}$ from 1964-75; GMM from 1976-84

D =0 from 1964-75; 1 from 1976-84

DGMM =0 from 1964-75; GMM from 1976-84

Equations 3 and 4 were specified to test whether the government price policy of announcing official prices before planting time had an impact on area responsiveness, i.e. $d_4 = d_5 = 0$. Since the calculated F statistic of 4.77 exceeds the critical value of 3.68 (5 percent level), the hypothesis that $d_4 = d_5 = 0$ was rejected. Based on equation 4, the estimated short-run price elasticity of maize area is 0.18 during the 1964-75 period and 0.43 from 1976-84. The calculated long-run elasticities are 0.56 and 1.22, respectively. Clearly, during the period of pre-planting announced prices, maize plantings were more price sensitive.

Implications

Given the regression results, the government policy of setting a price floor prior to planting appears to have enabled commercial farmers to respond more strongly to price incentives. To the extent that expected price and actual future price are identical, this suggests that farm resources are allocated in ways that enhance both farm output and incomes, compared to a risky price regime. Moreover, if one assumes that commercial farmers attempt to allocate resources to enterprises of highest net returns, Johnson (1947) suggests that greater price predictability may enhance agricultural productivity, by allowing farmers to generate a high value of output from a given bundle of production resources.

At first glance, it might be plausible to expect that the improvement in price certainty simply results in a shift of resources into maize production at the expense of other crops. However, this is not likely because dramatic acreage increases also occurred in the past decade for several other competing crops such as soybeans and cotton, which also underwent price policy changes similar to that of maize.

How do these results relate to the Zimbabwean smallholder? Several factors suggest that the degree of price responsiveness to improved price certainty will not be as high in the peasant sector as in the commercial sector. First, smallholders face a number of environmental and marketing constraints not found in the realtively better-endowed commercial lands. Infrastructural development in most rural areas in Sub-Saharan Africa is seldom as developed as in Zimbabwe's commercial sector. Second, to the extent that smallholder behavior is guided by subsistence needs in addition to income generation, one would expect supply responsiveness to a particular crop to be somewhat reduced. These differences might be expected to change in the magnitude of the above conclusions, but probably not the conclusions themselves.

Conclusions

In this paper we empirically investigate the relationship between price expectations and farm supply response in Zimbabwe. Specifically, we examine the effect that the timing of official maize price announcements has on the price respoonsiveness of commercial maize producers. During the 1964-75 period of post-planting announced prices, the short- and long-run area planted price elasticities were 0.18 and 0.56, respectively. However, during the 1976-84 period of pre-planting announced prices, the short- and long-run price elasticities were 0.43 and 1.22, respectively. Clearly, during the latter period (when output price was certain) the responsiveness of area planted to price was substantially larger than during the former period (when output prices were unobservable at planting time).

These results, by themselves, say nothing about the desirability of government price announcements before planting time. Such a policy involves a number of trade-offs and its viability as a means to stimulate farm productivity and output crucially depends on the strength of the marketing institutions involved in its implementation. The opportunity costs, both in terms of financial and scarce management resources must be thoroughly weighed.

On the other hand, chronically food deficit countries must examine what options are at there disposal to improve domestic food production growth. Especially for regions where technological breakthroughs appear distant, the costs of not providing greater price certainty to stimulate domestic output may be high. The case of Zimbabwe suggests that direct government participation in food grain markets is not inherently inimical to the welfare of producers in Africa (Riley; Child et.al.; Blackie) and that increased price certainty may hold important food security implications for chronically food-deficit countries in desperate need of stimulating long-term domestic food production growth.

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Table 1. Regression Results on Maize Area Planted

Equation	Estimation Period	Estimation Technique	C	AREA(-1)	GMT(-1)	$\widehat{GMM}$	GMM	GMM^{Δ}	D	DGMM	R^2	Durbin's h Statistic
1	1964-84	TSLS	96.02	0.69	-6.71	26.09					.88	-0.97
			(96.02)	(0.14)	(2.90)	(43.82)						
2	1976-84	OLS	74.57	0.44	-5.30		51.22				.89	0.14
			(37.31)	(0.27)	(3.45)		(10.03)					
3	1964-84	OLS	77.23	0.68	-7.29			37.56			.86	0.64
			(32.79)	(0.08)	(1.58)			(10.82)				
4	1964-84	OLS	116.29	0.65	-7.17			22.61	-65.68	25.67	.91	-1.40
			(65.55)	(0.09)	(1.52)			(31.02)	(61.83)	(33.22)		

Standard Errors are in Parentheses