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THE SEQUENCING OF AGRICULTURAL MARKET REFORMS IN MALAWI

by

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Abstract

The paper analyzes the welfare impacts of alternative sequencing scenarios of agricultural market reforms in Malawi using a profit maximization approach. The simulation results show that, contrary to the sequencing path adopted in the 1980's, Malawi's Government should have liberalized the maize sector first, followed by the groundnut export sector, and once a supply response was generated, input subsidies could have been phased out, without generating a negative impact on producers' welfare and food security.

The Sequencing of Agricultural Market Reforms in Malawi

1. Introduction

In many developing countries, where most smallholder farmers are food insecure and poor, it is crucial to adopt a sequence of agricultural market reform policies that minimize the short-run costs of liberalization and provide a minimum of safety net for the farmer. Otherwise, many farmers may not be able to withstand the shock of adjustment, or may loose their support for market reforms and the structural adjustment programs. One country which provides a good example on the importance of implementing an appropriate sequence of market reforms, is Malawi. Harrigan (1988) argues that poorly sequenced input and output price policies in the 1980's were a major cause of the failure of some of the reform programs in Malawi. For example, she notes that poor sequencing was evident in the removal of input subsidies in advance of maize producer price increases, and in export crop price liberalization in advance of staple food crop liberalization. Harrigan also points out that there was a conflict between the donors' emphasis on export diversification and commercialization, and the government's concern with food self-sufficiency, resulting in inadequately sequenced input and output price policies.

This paper evaluates the welfare impacts of alternative sequencing scenarios of agricultural market reforms in Malawi. It attempts to determine

whether Malawi's government should have liberalized the staple crop sub-sector before or after the export sub-sector, and whether it should have deregulated agricultural output markets before input markets. It is the first study that derives quantitative results to support policy recommendations regarding the sequencing of agricultural market reforms. In the following section we review the literature on sequencing of market reforms. In Section 3 we describe the agricultural sector in Malawi. The sequencing of agricultural reforms in Malawi is summarized in Section 4. Section 5 explains the profit maximization model we use to analyze the alternative sequencing scenarios. The empirical model is estimated in section 6. In section 7, the simulation results are analyzed, and the conclusions are presented in Section 8.

2. Sequencing of Market Reforms: A Review of the Literature

The question of what is the "optimal" speed and sequencing of market reforms is a source of debate in the development literature. Because of the failure of some structural adjustment programs in Africa and the difficult transition that countries of the Former Soviet Union and Eastern Europe are facing, many economists are attempting to formulate an appropriate sequence for monetary, fiscal, trade, and micro-sectoral policy reforms. Two important branches of thought have emerged from this research. The first school of thought argues either for a big bang approach where all sectors are liberalized

simultaneously (Sachs and Woo 1994), or it argues that sequencing does not matter as long as the government is committed to a set of credible and sustainable market reform measures (McPherson 1995). Economists that adhere to this approach believe that there is no "optimal" sequence of economic reform mainly because: a) successful reform is dependent on the special circumstances and the economic structure of the country, and therefore there are no generalizable recipes for successful reform (Sachs and Woo 1994), and b) there is no theoretical basis for deriving an "optimal" reform path (McPherson 1995).

Most economists on the other side of the debate advise for a gradual approach to liberalization, especially in countries witnessing large market rigidities, resource distortions, and macro-economic instability (Edwards (1992a), Rana (1995)). The advise for a gradualistic approach rather than shock therapy is based on lower short-term adjustment costs and smaller political opposition (Little, Scitovsky and Scott (1970), Choksi and Papageorgiou (1986), and Michaely (1986)). Based on the trade policy experience in Latin America for example, McKinnon (1973, 1982, 1991), Frenkel (1982, 1983), and Edwards (1986, 1987, 1992a,b) find that the behavior of the exchange rate is extremely important and therefore that the current account should be liberalized before the capital account to prevent an overvaluation of the real exchange rate. Edwards argues also that to prevent capital flight, international capital controls should be

eliminated only after reforming the domestic financial markets, and that interest rates should not be raised until after the fiscal deficit is under control. These are only "rule-of-thumb" recommendations for trade reform because the successfulness of reform also depends on the initial conditions in the country and the type of domestic policies adopted.

The difference in the sequencing of reforms is seen as an important reason for the relatively greater success of the transitional economies of Asia than of Eastern Europe and the former Soviet Union (Rana 1995). The Asian approach involved the implementation of micro economic reforms earlier than that of macro and trade reforms. In contrast, in some Eastern European countries such as Estonia, Latvia, Poland, and Slovania, the "big bang" approach was adopted while in some other countries, such as Hungary and Romania, reforms were implemented starting with macroeconomic reforms first. The Asia approach typically involved implementing price reform, agrarian reform, and industrial enterprise reform earlier than the implementation of fiscal, monetary, and foreign trade reforms. According to Rana, the Asian experience indicates the importance of the development of market oriented institutions as a first step in market reforms, and the implementation of gradual reforms over "shock therapy", starting preferably with microeconomic liberalization rather than macroeconomic reform.

Although there has been an abundance of research on the appropriate sequencing of trade policy, and whether macro-economic stabilization measures should precede sectoral liberalization efforts, not many economists have examined the issue of the sequencing of market reforms within the agricultural sector. There are three types of market reform sequencing programs that have a direct influence on the agricultural sector. The first one is macro-sectoral policy sequencing which tries to determine whether macroeconomic reforms should precede agricultural sector reform. It is now well documented that macroeconomic policy reform alone is not enough to get an economy back on its feet and that sectoral reform may be useless if it is not accompanied by trade, monetary, and fiscal policy reforms. The second type of agricultural sequencing pertains to the appropriate sequence of liberalization along the agricultural marketing channel. The question here is whether retail markets should be liberalized before wholesale or external trade markets. The third type of agricultural sector sequencing question asks i) whether input markets should be liberalized before output markets, and ii) whether staple crops should be liberalized before export crops.

Some non-quantitative research has analyzed a few of these issues. Valdés (1993) discusses the outcomes of alternative sequencing scenarios of macroeconomic and sectoral reforms pursued by the governments of Chile and New Zealand. Valdés emphasizes the importance of the real exchange rate and

the need to quickly privatize agricultural input and output markets following international trade liberalization. Booth (1991) argues that bad timing and sequencing of different reforms are considered important factors in explaining the poor performance of structural adjustment programs in Sub-Saharan Africa. He points out that the lack of coordination between different elements of the structural adjustment programs (such as macro and agriculture) is one of the major factors for poor supply response in Sub-Saharan agriculture. Although Booth agrees that a single optimal sequence of reforms can not be suggested for all the developing countries, he believes that common principles can be applied in formulating policy reform. For example, he suggests that one should avoid big delays between the liberalization of foreign trade and exchange rate markets and the removal of restrictions on internal marketing and price fixing arrangements. Ahmed (1995) examines Bangladesh's agricultural input market reform and concludes that liberalization should start in retail markets and move up along the marketing chain to wholesale and external markets. The reasoning behind this recommendation is that the public sector is usually more efficient at the top of the marketing channel than at the bottom, and that the degree of competition of the private sector is much higher in retail markets than in wholesale or external markets.

Thompson (1991) finds that if agricultural crops are close substitutes then it is preferable to liberalize all output prices simultaneously to prevent

undesirable substitution between crops. Thompson also agrees that reform is more likely to be successful if it starts from the consumer level, mainly because there would be less pricing inconsistencies. Duncan and Jones (1993) and the 1994 FAO study on the structural adjustment programs in Sub-Saharan Africa, argue that input and output markets should be liberalized prior to the complete removal of government involvement, because government intervention may be needed at least in the early stages of liberalization. The response to reforms by the private sector is more rapid when appropriate market conditions exist such as an already functioning private sector, access to credit and foreign exchange, high seasonal demand, national security, and a policy framework favorable to private participation. The FAO study recommends the liberalization of domestic financial markets prior to the produce markets, and the liberalization of output markets before input markets in order to reduce the short-term structural problems that small farmers may face in procuring inputs from private channels.

The results of most of these studies underline the importance of the sequencing of agricultural market reforms for the success of liberalization. The short-run impacts of different sequencing scenarios are important because the ability of many developing countries to absorb the costs of adjustment are very limited. This is especially true for many poor African countries which rely on one or two commodities for most of their foreign exchange earnings, which are not

politically stable, and where external shocks are quite frequent such as severe droughts.

3. The Agricultural Sector in Malawi

Malawi's economy is heavily dependent on the agricultural sector. More than 85% of Malawi's population resides in rural areas and 80% of its total labor force works in agriculture. The agricultural sector generates around 90% of the country's foreign exchange earnings. Agricultural GDP provides approximately 35% of Malawi's total GDP and is divided into two sub-sectors: the estate sub-sector which produces about 20% of the agricultural GDP and the smallholder sector which produces the remaining 80%. Estate land occupies around 12% of arable land, the rest is used by smallholders, the majority of which (55%) have farms of less than 1 ha in size (Harvard Institute for International Development, 1994). The growth of the agricultural sector has been very sluggish, increasing at about 1.6% per year from 1980 to 1994, which is about half the population growth rate (The World Bank 1995). The dual nature of the agricultural sector has been reinforced by (i) discrimination against the smallholders with respect to choice of crops, access to inputs and marketing opportunities, and (ii) by allowing the estate sector to freely produce and market its products.

The estate sub-sector in Malawi produces mainly export crops including tobacco, tea, and sugar which constitute around 95% of total agricultural

exports. Since 1980, burley tobacco has dominated expansion of the estate sub-sector. Estate farmers also produce a limited quantity of food-crops such as maize and groundnuts, but mainly for home consumption. Smallholders, who constitute the majority of rural residents, grow mainly maize for subsistence. Maize production constitutes more than two-third of the total smallholder agricultural production. In most years, Malawi is self-sufficient in maize, and could even export maize, but the frequent occurrence of droughts limits Malawi's ability to rely every year on its own production to meet domestic demand. Smallholders are therefore constantly facing food insecurity accentuated by increasing land pressure and declining farm size (Govindan and Babu 1996). Other crops grown by smallholders are groundnuts, cassava, rice, millet, sorghum, beans, and a few cash crops such as tobacco, tea and cotton. Inter-cropping is common and most agriculture production is rainfed which accentuates the devastating effects of the drought. There is only one growing rainy season per year which extends from November until March. All fertilizers used in Malawi are imported and the government has been encouraging the use of high analysis fertilizer to save on transport and foreign exchange costs. According to the World Bank (1995), less than 45% of all smallholders use fertilizers, mainly due to low income, small land holding size, and poor access to credit.

4. History of Market Reforms in Malawi

Prior to 1981, smallholder agricultural production and marketing in Malawi were heavily controlled by the government. Smallholder farmers were not allowed to grow burley or flue-cured tobacco, tea, or sugar. The parastatal, the Agricultural Development and Marketing Corporation (ADMARC), distributed inputs **to** and purchased output from smallholder farmers at guaranteed fixed prices, announced prior to the planting season (Harrigan 1988). Maize producer prices were set between a regional export parity price and the import parity price. The difference between these two prices was quite significant due to the large transportation costs to and from Malawi. Input prices were also subsidized which contributed to the leakage of smallholder subsidized inputs to the estate sector. On the other hand, export crops such as cotton, tobacco, and groundnuts were heavily taxed. Producer prices were raised every few years but in a very ad-hoc manner. Figures 1 and 2, and Table A, show that real maize prices were quite erratic while groundnut real prices witnessed a downward trend until 1982.

In response to severe external shocks and resulting macro-economic imbalances, Malawi embarked in 1981 on a series of structural adjustment and macro-economic stabilization programs supported by donor organizations. To meet the conditionalities of these programs, Malawi adopted a flexible exchange rate policy, attempted to restructure its parastatals, and moved slowly towards

liberalizing its price and marketing policies, especially in the agricultural sector. From 1984 to 1987, nominal maize prices remained fixed resulting in declining real maize prices while considerable price increases were implemented for smallholder export crops, until they almost reached parity level. Therefore, pressured by the structural adjustment programs, parity pricing for exportable crops occurred in advance of liberalization of the market for food crops. This combined effect led farmers to shift production out of improved maize and into groundnuts. In 1987, the country ended up with a large maize deficit and a groundnut surplus (see figures 3 and 4). In addition, in order to reduce the drain on the government budget and halt ADMARC's financial problems, the government adopted in 1983 the fertilizer subsidy removal program (FSRP) which was designed to gradually phase out fertilizer subsidies. Consequently, at the same time that fertilizers prices were liberalized, smallholder maize prices remained fixed resulting in a severe loss in relative gross margins for smallholders. Table 1 presents a summary of the agricultural policy changes that occurred from 1981 until the present.

In 1986, Malawi's economy deteriorated due to falling tobacco and tea export prices, severe droughts, and the cut-off of transport routes through Mozambique. In 1987, a new series of World Bank programs and loans were initiated. In the agricultural sector, this meant freeing smallholder output markets for all crops except for cotton and tobacco. However, although private

trading was allowed, producer prices were still fixed by the Government. Maize producer prices were raised by 36% in the 1987/88 cropping season and area and production of smallholder hybrid maize more than doubled while production of groundnuts kept falling until 1995. In

Figure 1. Maize Prices in Malawi, 1967-93

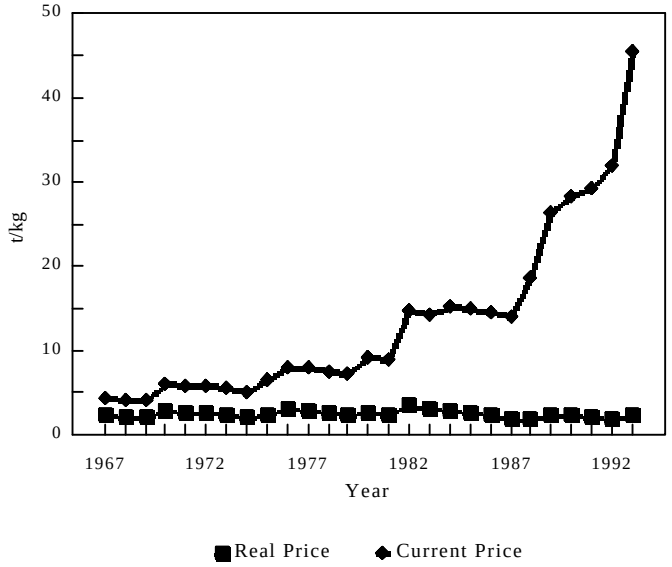


Figure 2. Groundnut Prices in Malawi, 1967-93

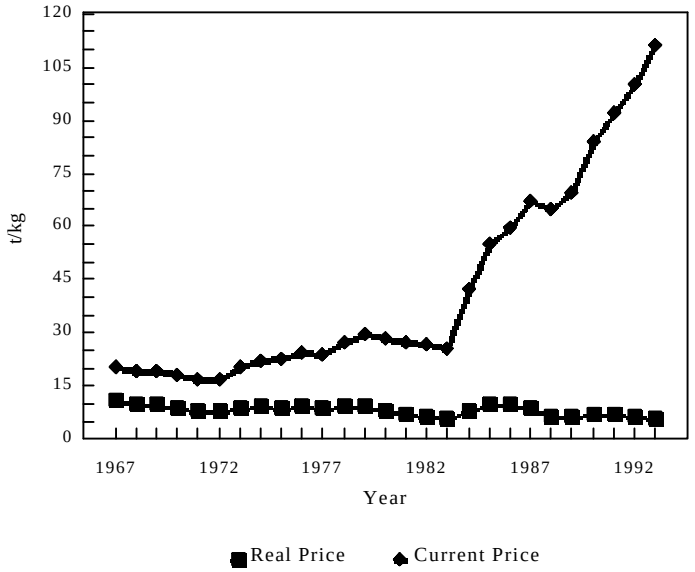


Figure 3. Maize Production in Malawi, 1967-93

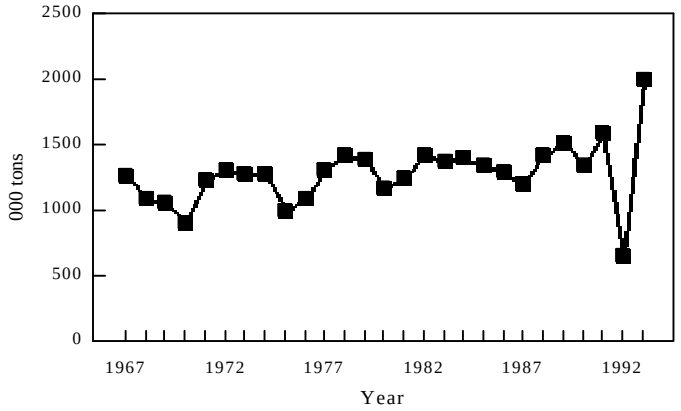


Figure 4. Groundnut Production in Malawi, 1967-93

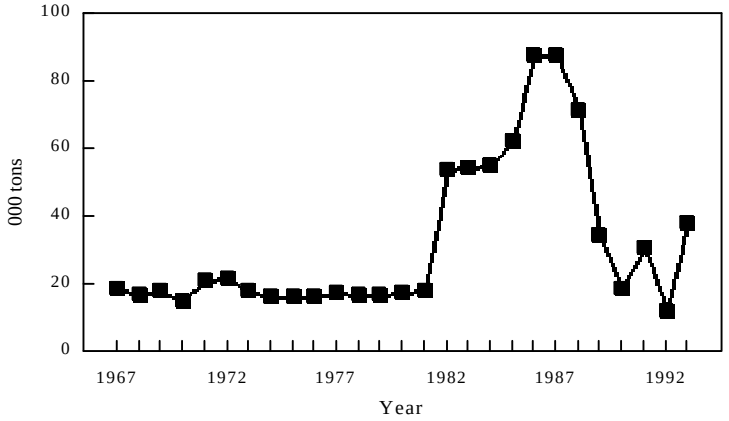


Table 1 : Agricultural Policy Changes in Malawi 1981-1996

Year	Government Policy Changes	Effect on Fertilizer, Maize, and Groundnut Prices
Prior to 1981	Smallholder production and marketing controlled by ADMARC	Subsidization of smallholder inputs; Guaranteed maize producer prices; Taxation of export crop prices such as groundnuts.
1981-1986	-Structural adjustment and stabilization programs: Export diversification and promotion strategy; -Initiation of the Fertilizer Subsidy Removal Program (FSRP).	Slow move towards flexible exchange rate policy, restructuring of parastatals, and progressive liberalization of agricutural pricing and marketing policies; Constant nominal maize prices, liberalization of groundnut export prices. Gradual decrease in smallholder fertilizer subsidies;
1986-1987	Deterioration of the economy (drought, war in Mozambique, falling tobacco and tea export prices)	Large maize deficit and groundnut surplus; Falling profit margins for smallholders.
1987-1993	New structural adjustment programs and loans	- Liberalization of output markets for all crops except cotton and tobacco; - FSRP suspended: increase in fertilizer subsidies; - Increase in the maize to groundnut relative real price ratio.
1993-1996	Further market reforms	Resumption of the FSRP (fertilizer subsidy eliminated by 1995/96); Liberalization of maize seed production and marketing; Crop prices set free expect for maize price band; Private sector allowed to trade freely in agricultural input and output markets but ADMARC still dominant player.

addition, between 1991 and 1993, the government imposed a ban on private groundnut exports because ADMARC was not able to compete with the private sector.

On the input side, the aggregate rate of fertilizer subsidization fell from 30.5% in 1983/84 to 19.8% to 1987/88 (World Bank). However, by 1987,

fertilizer subsidies were resumed because the government did not want to burden smallholders with sharply rising fertilizer costs resulting from escalating transport costs and devaluation of the Kwacha. By 1988/89, fertilizer subsidy rates had increased by 50% (see figure 5). In May 1993, a policy was announced to open up smallholder fertilizer markets (both imports and distribution) to the private sector. In 1993/94, the FSRP resumed and resulted in a 11% subsidy rate in 1994, a 5% subsidy rate in 1994/95, and a 0% subsidy rate in 1995/96. However, in the 1995/96 growing season, emergency relief seed and fertilizer bags were distributed freely to almost 40% of smallholders due to the severe drought of the previous year. Production and marketing of hybrid seed maize was liberalized in 1995/96.

Since April 1995, all input and output prices were set free except for a maize price band. ADMARC sets maize floor prices for smallholders and a ceiling price for consumers, and maize exports are prohibited unless national requirements are met. Private traders are allowed to trade freely within the price band and ADMARC acts as buyer of last resort for staple food crops as well as manager of strategic reserves. ADMARC has been implementing a divestiture program and has been closing uneconomic markets, nevertheless, it is still the dominant player in agricultural marketing.

Figure 5. Fertilizer Prices in Malawi, 1967-93

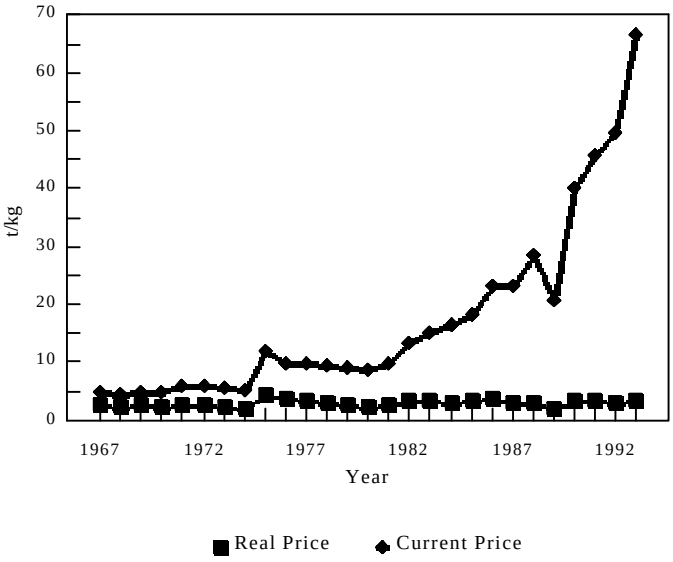
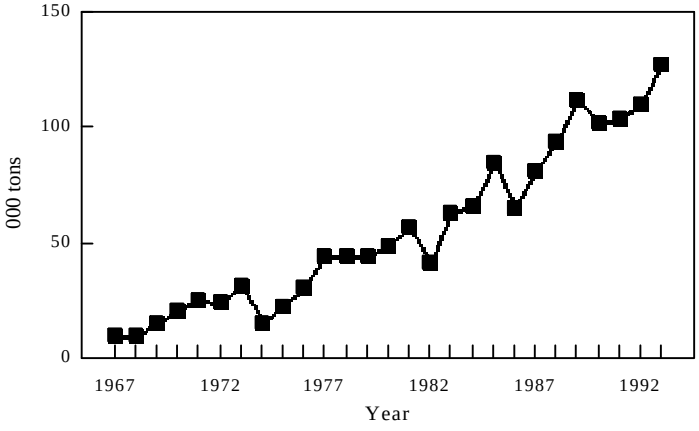


Figure 6. Fertilizer Use in Malawi, 1967-93



5. The Profit Maximization Model

The objective of the model is to compare the producer welfare effects of different agricultural market reform sequencing scenarios. We assume that smallholder farmers want to maximize profits over time, given their expectations about government input and output price policies. The profit maximization model focuses only on the smallholder sector because smallholder farmers produce most of the agricultural products in Malawi, and because they are the main target of the agricultural market reform efforts. The two most important competing crops in the smallholder sector are maize and groundnuts. Maize and groundnuts generate around 90% of the total revenues of smallholder agriculture and they absorb more than 90% of total smallholder input use. Therefore, to simplify the profit maximization model, we concentrate on these two crops and on the two most widely used inputs, fertilizer and labor. We also assume that land is a binding constraint and that the representative farmer wants to maximize his discounted stream of profits over time. For simulation purposes, we use a time horizon of three years so that we can simulate the impact of the sequential liberalization of maize, groundnut, and fertilizer prices on total profits. That is the farmer maximizes:

$$\Pi \quad \pi^t \quad \delta\pi^{t\ 1} \quad \delta^2\pi^{t\ 2}\ , \qquad \textbf{(1)}$$

where δ refers to the discount factor, and π^t , π^{t+1} , and π^{t+2} are the farmer's profits in periods t, t+1, and t+2. From theory, we know that maximizing Π is equivalent to maximizing π^t, $\delta\pi^{t+1}$, and $\delta^2 \pi^{t+2}$ separately. Therefore the maximization problem is reduced to the following:

$$\begin{aligned} Max\ \pi^k \quad & p_m^k\, y_m^k \quad p_g^k\, y_g^k \quad p_f^k\, x_f^k \quad w_l^k\, x_l^k \\ s.t.\ & f\,(y_m^k,\ y_g^k,\ x_f^k,\ x_l^k,\ z) \quad 0. \end{aligned} \tag{2}$$

for k=t, t+1, or t+2, and where p_m^k and p_g^k are the expected prices of maize and groundnuts in period k, y_m^k and y_g^k are the desired maize and groundnut quantities produced at time k, p_f^k and w_l^k are the fertilizer prices and wage rates in period k, x_f^k and x_l^k are the quantities of fertilizers and labor used in the production of maize and groundnuts at time k, and z is a vector of fixed inputs quantities or shift variables.

Substituting the solution to the maximization problem (2) in the profit function yields the indirect profit function, π^*, which is a function of the following variables:

$$\pi \quad \pi\,(p_m^k,\ p_g^k,\ p_f^k,\ w_l^k,\ z). \tag{3}$$

In order to empirically estimate the changes in the producers' profits due to changes in policies, we need to specify a functional form for the profit function. An appropriate functional form for the present study is the normalized

quadratic function which allows us to estimate jointly the maize and groundnut supply functions, and the fertilizer and labor demand functions. The normalized quadratic functional form has been used in previous multiproduct supply and input demand models (see Shumway (1983), Bapna et al. (1984), Bautista (1986), and Shumway et al. (1988) among others). One of the major advantages of this functional form is that it allows us to derive a system of linear output supply and input demand equations with appropriate theoretical restrictions. This permits us to estimate directly the impact of price changes on the output supply, input demand, and profit levels. With such a system, linear homogeneity with respect to prices is imposed and one of the input prices can be used as a numéraire to normalize the profit and price variables. If we choose the wage rate as the numéraire, the profit function in equation (3) can be specified as follows:

$$\pi \quad \pi/w_l \quad a_0 \quad \sum_i a_i p_i \quad 1/2\sum_{i,j} b_{ij} p_i p_j \quad \sum_{i,n} b_{in} p_i z_n \qquad \textbf{(4)}$$

$$\text{for } i, j \quad m, g, f \text{ ; with } b_{ij} \quad b_{ji}$$

where a_0, a_i, and b_{ij} are parameters to be estimated, $p_i^* = p_i / w_l$ and $p_j^* = p_j / w_l$ are the normalized prices for either maize, groundnuts, or fertilizers, and z refers to the remaining structural variables. By the envelope theorem, the output supply and input demand equations can be derived as functions of the

normalized input and output prices and the level of fixed inputs and shift variables:

$$\begin{array}{ccccccccc} y_m & a_m & b_{mm}(p_m/w_l) & b_{mg}(p_g/w_l) & b_{mf}(p_f/w_l) & b_{mw}W & b_{ma}A & \epsilon_m & \\ y_g & a_g & b_{gm}(p_m/w_l) & b_{gg}(p_g/w_l) & b_{gf}(p_f/w_l) & b_{gw}W & b_{ga}A & b_{gd}D & \epsilon_g \\ x_f & a_f & b_{fm}(p_m/w_l) & b_{fg}(p_g/w_l) & b_{ff}\ (p_f/w_l) & b_{fw}W & b_{fa}A & \epsilon_f & \end{array} \quad \textbf{(5)}$$

where W is weather measured by a dummy to distinguish drought years, A is the land area under maize and groundnuts, D is a dummy to take account of a sudden upward shift in groundnut supply response from 1982 to 1987 (see figure 4), and ϵ_i is the error term. To estimate the above system of equations, we use Zellner's generalized least squares method. The labor demand equation is dropped from the system because the wage rate is used to normalize other prices. The estimated equations yield the predicted values of output supplies and input demands. For the specific periods of interest, t and t+1, and t+2, the predicted values of output supplies and input demands can be calculated using the relevant data and estimated parameters. Different sequencing options for market reform are incorporated through changes in output and input prices. The predicted values of output supplies and input demands can then be obtained for the different sequencing scenarios. The difference between the predicted values corresponding to the reference period and those obtained from the changes in price policies indicate the possible responses in output supplies and

input demands. Similarly, the predicted values of quasi rents can be obtained by incorporating appropriate changes in prices in equation (4).

The estimated parameters can also be used to derive the output supply and input demand elasticities through the following expressions:

$$\begin{aligned} &\textit{Own price elasticities}: \ \eta_{ii} \quad b_{ii} \ (p_i \ / \ y_i) \\ &\eta_{ll} \quad \Sigma_{j\ 1}^{n\ 1} \eta_{lj} \ , \ i \neq j, \ l \\ &\textit{Cross price elasticities}: \ \eta_{ij} \quad b_{ij} \ (p_j \ / \ y_i) \\ &\eta_{lj} \quad (p_j \ / \ w_l \ x_l) \ \Sigma_{i\ 1}^{n\ 1} b_{ij} \ p_i \end{aligned} \qquad \textbf{(6)}$$

where η_{ii} and η_{ij} refer to own and cross-price elasticities of maize supply, groundnut supply, and fertilizer demand, and η_{ll} and η_{lj} refer to own and cross-price elasticities of labor demand.

6. Data Description

The output supply and input demand equations are estimated for Malawian smallholder agriculture using annual data from 1967 to 1993 (see Table A). The data on crop prices and production as well as labor use are available from the Ministry of Agriculture and Land Development (MOALD) and from the *Malawi Agricultural Statistics* Annual Bulletin, 1993 (Government of Malawi (GOM), 1993). Fertilizer use and prices as well as wages are from

Mosley (1993). All prices are converted to 1970 constant prices by using the Consumer Price Index as the deflator. Data on labor and wages are not available for the period 1991-1993, and therefore we extrapolate estimates for these years.

7. Empirical Results and Policy Simulations

The results of the estimation of the system of output supply and input demand equations are presented in Table 2. The parameters maintain the symmetry and homogeneity restrictions. The explanatory power of the equations varies from an adjusted R^2 of 0.45 for the maize supply function to an adjusted R^2 of 0.90 for the groundnut supply equation. The Durbin-Watson statistic ranges from 1.34 to 1.88. More than 60% of all the estimated parameters are significant at the 1% level and all the parameters have the expected signs. The dummy for the drought years is significantly negative indicating that drought did have an important negative impact on maize and groundnut production during the years 1980, 1981 and 1992. In the groundnut equation, we notice that the dummy for 1982-87 is positive and significant, which supports the fact that, apart from prices, government policies during this period caused a positive shift in groundnut production. The land area variable has a positive and significant influence on output supplies and input demand.

The elasticities computed at the sample means are presented in Table 3. The estimated own-price elasticity for maize is 0.26, which is consistent with previous studies on Malawi (Govindan and Babu 1996). The own-price elasticity for groundnuts is estimated as 1.20. The cross-price elasticities of maize and groundnuts with respect to each other indicate that both crops are substitutes in nature. The output supply elasticities with respect to input prices are negative as expected. The own price elasticities for fertilizer and labor demand are estimated at -0.23 and -0.15, respectively, consistent with earlier studies on Malawi (Govindan and Babu 1996) and other developing countries (Sadoulet and de Janvry 1995). The negative input cross price elasticities suggest the substitute nature of inputs used in Malawi agriculture, a pattern also observed in Argentina, Egypt, and U.S. agriculture (Fulginiti and Perrin 1990). The elasticities of input demand with respect to output prices are positive, indicating that an increase in output price is associated with increased input demand.

Table 2. Parameter Estimates of Output Supply and Input Demand Equations

Dependent variable	Intercept	Normalized prices of			Weather[1]	Area[2]	Groundnut Dummy
		Maize	Groundnut	Fertilizers			
Maize supply	-598.69 (550.27)	2354.30 (526.03)	-27.29 (42.27)	-431.37 (85.26)	-312.23 (95.01)	1.26 (0.42)	
Groundnut supply	-52.12 (22.24)	-27.29 (42.27)	86.56 (13.70)	-78.01 (21.87)	-5.39 (3.87)	0.04 (0.01)	47.92 (2.62)
Fertilizer demand[3]	150.40 (36.22)	-431.37 (85.26)	-78.01 (21.87)	70.00 (55.37)	-9.83 (6.23)	-0.09 (0.03)	

Note: Figures in the parentheses are standard errors
[1] Dummy variable used to represent the drought years
[2] Land area under maize and groundnut
[3] Input demand is specified in negative units (see last equation in the system of equations (5))

Table 3. Output Supply and Input Demand Elasticities (calculated at the sample means)

Elasticity of	with respect to the price of			
	Maize	Groundnut	Fertilizer	Labor
Maize supply	0.26	-0.01	-0.06	-0.19
Groundnut supply	-0.12	1.20	-0.43	-0.65
Fertilizer demand	1.09	0.63	-0.23	-1.50
Labor demand	0.17	0.05	-0.07	-0.15

In order to analyze the welfare implications of different price policy sequencing scenarios on smallholder farmers in Malawi, four different simulations are conducted. With the help of predicted values obtained from the estimation, we can simulate some hypothetical scenarios based on these results. The simulations are performed for two different periods to test whether the results are sensitive to the choice of the period or whether they can be

generalized despite the rapid changes in the policy environment. The simulations involve liberalizing the prices of fertilizer, maize, and groundnuts, in four alternative sequences. The first period under consideration is 1984 to 1986. During this period, maize nominal prices were held fixed at 12.2 tb/kg while fertilizer and groundnut nominal prices were gradually increased in an attempt to decrease fertilizer subsidies and liberalize export crops for smallholders. The deviation between the official producer prices and market prices for maize is around 25% from 1984-86, and therefore a 25% increase in maize prices is considered for the simulations of maize market liberalization. For groundnuts, official groundnut prices are compared to world market prices because groundnut is an exported crop. During 1984-86, the nominal protection coefficient (NPC) for groundnut was equal to 0.74 (World Bank 1995), which means that we simulate groundnut market liberalization by a 26% increase in its price. The fertilizer subsidy during this same period is estimated at 27% (Sahn and Van Frausum 1995) and therefore a 27% increase in fertilizer prices is used to simulate the liberalization of fertilizer markets.

The second period considered is 1987 to 1989. The deviation between the official producer price and the market price for maize was close to 25% during this period. Hence, the simulated liberalization for maize involves a 25% increase in maize prices. For groundnuts, the NPC declines to 0.66 during

1987-89 implying a 34% increase in groundnut price for simulation purposes. The fertilizer subsidy during this period is equal to 24% (Sahn and Van Frausum 1995) and therefore we increase fertilizer prices by 24% to simulate its liberalization. The four different policy sequencing options that are simulated for the two periods are presented below:

Simulation 1: In simulation 1, fertilizer prices are liberalized in the first year, followed by maize market liberalization in the second year, and groundnut price liberalization in the last year. The changes in output supplies, input demands, and quasi rents due to this sequencing of market reforms are presented in the first set of columns of Tables 4 and 5 for the periods 1984-86 and 1987-89, respectively.

Simulation 2: For simulation 2, the fertilizer market is liberalized first, followed by groundnut price liberalization in the second year, and maize market liberalization in the final year. The changes in crop supply, fertilizer demand, and quasi rents are presented in the second set of columns of Tables 4 and 5 for the years 1984-86 and 1987-89. This simulation follows closely the sequence of price policies that Malawi adopted in the 1980's.

Simulation 3: In this third simulation, maize markets are liberalized in the first year. In the subsequent year, groundnut markets are liberalized, and in the third year fertilizer markets are liberalized. The changes in output supplies, input

demand, and quasi-rents are presented in the third set of columns of Tables 4 and 5 for the two respective periods.

Simulation 4: In the last simulation, groundnut markets are liberalized in the first year. In the following year, maize markets are liberalized, and in the last year fertilizer markets are liberalized. The changes in supply response and producer welfare are presented in the last set of columns of Tables 4 and 5 for the two consecutive periods.

The results of the policy simulations are presented as the percentage change between the predicted values of the estimated equations and the values obtained in different simulations. The results for both periods show that an increase in fertilizer prices in year 1 (simulations 1 and 2), leads to a decline in the production of maize and groundnuts, and a decline in the demand for fertilizers during the initial period. In the second period, when liberalization of fertilizer prices is followed by maize price liberalization (simulation 1), maize production increases, groundnut production falls, and the demand for inputs increases. On the other hand, if, in the second period, fertilizer liberalization is followed by groundnut price reform (simulation 2), then maize production decreases, while groundnut production and input demand increases during that period. In the third simulation, the increase in maize prices in year 1, leads to a rise in maize production, a fall in groundnut production, and an increase in the demand for fertilizer during that year. Whereas in year 2, when groundnut prices

are also liberalized, both crops' outputs increase and the demand for fertilizer rises. For the fourth simulation, in year 1, when groundnut prices are liberalized, maize production falls, groundnut production rises, and input demand increases. In year 2, the results are the same as for simulation 3, i.e. both output supply and input demand rise.

Notice that in the last year of all four simulations, the impacts on output supply and input demand are the same, because both maize, groundnut, and fertilizer prices are liberalized. Therefore, the only difference in the simulation results is due to the difference in the response of input demands and output supplies in years 1 and 2, when liberalization is simulated in different sequences. These findings support the argument that sequencing is important for short-run adjustment.

Table 4. Results of Policy Simulations for the Period 1984-86 (% change)

	Simulation 1			Simulation 2			Simulation 3			Simulation 4		
	1984	1985	1986	1984	1985	1986	1984	1985	1986	1984	1985	1986
Maize supply	-1.53	4.58	3.83	-1.53	-1.74	3.83	7.09	5.78	3.83	-0.24	5.78	3.83
Groundnut supply	-5.36	-5.90	9.11	-5.36	10.28	9.11	-1.59	13.72	9.11	14.61	13.72	9.11
Fertilizer demand	-5.93	19.24	34.90	-5.93	11.72	34.90	30.99	41.54	34.90	16.25	41.54	34.90
Quasi Rent (mil K)	38.95	49.07	45.81	38.95	41.66	45.81	49.57	51.93	45.81	41.00	51.93	45.81
Discounted Quasi-Rents (mil K)	120.22			113.55			133.41			124.84		

Table 5. Results of Policy Simulations for the Period 1987-89 (% change)

	Simulation 1			Simulation 2			Simulation 3			Simulation 4		
	1987	1988	1989	1987	1988	1989	1987	1988	1989	1987	1988	1989
Maize supply	-1.61	4.93	6.71	-1.61	-2.20	6.71	5.61	6.39	6.71	-0.42	6.39	6.71
Groundnut supply	-4.67	-7.59	36.01	-4.67	15.72	36.01	-1.04	20.40	36.01	21.29	20.40	36.01
Fertilizer demand	-5.63	18.04	35.17	-5.63	14.66	35.17	22.08	44.07	35.17	25.77	44.07	35.17
Quasi Rent (mil K)	29.08	35.84	45.25	29.08	29.89	45.25	36.18	38.46	45.25	32.42	38.46	45.25
Discounted Quasi-Rents (mil K)	97.99			92.63			107.45			103.69		

Simulation 1: Sequence of liberalization: Year 1: fertilizer price; Year 2: maize price; Year 3: groundnut price
Simulation 2: Sequence of liberalization: Year 1: fertilizer price; Year 2: groundnut price; Year 3: maize price
Simulation 3: Sequence of liberalization: Year 1: maize price; Year 2: groundnut price; Year 3: fertilizer price
Simulation 4: Sequence of liberalization: Year 1: groundnut price; Year 2: maize price; Year 3: fertilizer price

The results in the last year for both periods indicate that the liberalization of all prices leads to an increase in maize and groundnut production and a rise in the demand for fertilizers. The rise in fertilizer prices when crop prices are liberalized does not induce a decline in fertilizer demand in Malawi. Various analyses show that fertilizer use by smallholders is primarily constrained by inadequate supplies, because fertilizer sales have been increasing despite rising fertilizer maize price ratios (see figures 5 and 6).

To calculate the discounted quasi-rents for the three periods, we use a discount rate of 11%, which is the official discount rate used by the Government of Malawi. The comparison of the discounted quasi-rents for the four different sequencing scenarios shows that simulation 3 leads to the largest quasi-rents (133 million Kwacha (K) and 107 million K for the periods 1984-86 and 1987-89 respectively). This means that maize market liberalization followed by groundnut market liberalization and later by fertilizer price reform leads to a higher welfare for producers. The next best alternative is simulation 4, where discounted quasi-rents for the two periods in question are equal to 125 million K and 104 million K, and where again output prices are liberalized before input prices, but groundnut price reform precedes maize price reform. The worst scenario is where fertilizer subsidies are removed first followed by the liberalization of groundnut prices and then the liberalization of maize prices (Simulation 2), which is exactly the sequence that the government opted for during the period 1984-86. This

scenario leads to the lowest discounted quasi-rent for both periods (114 million K and 93 million K). Simulation 1 - where fertilizer prices are liberalized first but where maize price liberalization precedes that of groundnuts - leads to higher profits than simulation 2, but generates lower income than simulations 3 and 4 where input prices are liberalized last.

The simulation results presented above support Harrigan's findings that staple food crop prices ought to have been liberalized first in Malawi, followed by export crop prices, and finally by input prices. To promote an adequate and least cost response, the government should have freed maize prices first allowing the farmers to increase their supply response and secure enough food for themselves. This should have been followed by groundnut price liberalization to increase cash income, and then once farmers can increase their food security and cash income, the government could have more easily liberalized fertilizer prices without causing an adverse effect on production. By liberalizing fertilizer prices first, the government squeezed the margin of profit of the farmers with no compensatory mechanisms, which resulted in lower food security.

8. Conclusion

The simulation exercise described in this paper was an attempt to answer the question: "What was the optimal sequencing of agricultural market reforms in Malawi." The results of our simple profit maximization model show that in the 1980's, by reducing the fertilizer subsidy, promoting export crop production, and

neglecting the main food commodity, producers' welfare in Malawi declined. Due to the many constraints that smallholders face, an increase in the price of groundnuts induced farmers to switch away from maize production which is not very desirable because imported maize is much more expensive given the geographical location of the country. In a country like Malawi with severe land constraints, limited technology and access to other agricultural services, and where farmers are still subsistence producers, it becomes very important to increase the productivity of the staple food crop through the use of improved seed varieties and fertilizers before cash crop and input prices are liberalized. To give the incentives to increase production without reducing the demand for appropriate input technology and preventing short-term losses for food insecure farmers, output prices of the main commodity should be liberalized first, followed by cash crop prices, and then once a supply response has been initiated, input subsidies can be gradually phased out, allowing the farmer to base the choice of his input mix on non-distorted output prices.

The results of this study provide many implications for other countries undergoing similar types of market reforms. Sequencing is especially important for low-income countries where the poor usually shoulder most of the short-run costs of adjustment. For future work, a good exercise would be to look at two countries with similar levels of development and agricultural policies and compare the successfulness of the different sequencing paths they have

adopted to reform their agricultural sector. One can also compare countries with the same sequencing of reforms, but different institutions, infrastructure, and other structural conditions to determine whether these factors matter. This is important because, analysis has shown time and again, that sequencing of price reform is neither sufficient nor sustainable to generate a supply response. Unless price reform is accompanied also by reform in the institutional structure of the agricultural sector such as reform in property rights over land, legal reform, development of market institutions, ready access to credit, timely delivery of inputs, adoption of appropriate technology, and build-up of adequate infrastructure, then market reform will not be successful.

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Table A. Data Series on Production, Input Use, and Prices, Malawi, 1967-93

Year	Production in 000 mt		Input use		Current prices in tambala/kg				Real prices in tambala/kg				Area under Maize and Gnut (000 ha)
	Maize	Gnut	Fertilizer (000 mt)	Ag. labor(000)	Maize	Gnut	Fertilizer	Wages	Maize	Gnut	Fertilizer	Wages	
1967	1270	19	9.83	42.2	2.00	9.00	2.10	27.67	2.50	11.25	2.63	34.11	1278
1968	1090	17	9.91	48.3	2.00	9.00	2.23	28.33	2.22	10.00	2.48	31.05	1298
1969	1060	18	15.56	53.7	2.00	9.00	2.38	27.00	2.22	10.00	2.64	29.59	1223
1970	900	15	20.73	57.4	3.00	9.00	2.44	29.33	3.00	9.00	2.44	28.93	1297
1971	1240	22	24.83	63.7	3.00	9.00	3.06	30.67	2.73	8.18	2.78	27.50	1347
1972	1310	22	24.05	70.3	3.00	9.00	3.06	31.67	2.73	8.18	2.78	28.39	1389
1973	1280	18	31.74	80.4	3.00	11.00	3.06	32.00	2.50	9.17	2.55	26.30	1349
1974	1280	17	14.81	93.0	3.00	13.00	3.06	36.00	2.14	9.29	2.18	25.36	1239
1975	1000	17	22.35	103.9	4.00	14.00	7.44	35.33	2.50	8.75	4.65	21.78	1239
1976	1090	17	30.47	154.7	5.00	15.00	6.11	37.33	3.13	9.38	3.82	23.01	1250
1977	1320	17	44.36	168.9	5.00	15.00	6.11	41.00	2.94	8.82	3.59	23.79	1400
1978	1420	17	43.94	182.3	5.00	18.00	6.11	48.00	2.63	9.47	3.22	24.92	1411
1979	1390	17	43.85	181.1	5.00	20.00	6.11	48.33	2.38	9.52	2.91	22.70	1220
1980	1170	18	49.14	157.2	6.60	20.00	6.11	53.00	2.75	8.33	2.55	21.78	1350
1981	1250	18	57.20	158.1	6.60	20.00	7.22	62.67	2.44	7.41	2.67	22.89	1450
1982	1420	54	41.74	197.2	11.10	20.00	10.00	82.33	3.70	6.67	3.33	27.07	1315
1983	1370	55	63.25	177.7	11.10	20.00	11.67	73.67	3.26	5.88	3.43	21.37	1319
1984	1398	55	65.79	189.3	12.20	34.00	13.13	79.00	3.02	8.42	3.30	19.30	1281
1985	1350	62	84.78	190.6	12.20	45.00	15.00	88.00	2.74	10.10	3.37	19.47	1369
1986	1290	88	64.74	185.1	12.20	50.00	19.44	88.00	2.40	9.83	3.82	17.06	1392
1987	1200	88	81.81	179.8	12.20	58.00	20.00	96.67	1.92	9.11	3.14	14.97	1388
1988	1420	72	94.47	197.8	16.60	58.00	25.56	101.67	1.95	6.80	3.00	11.76	1411
1989	1510	35	111.88	214.1	24.00	63.00	18.89	110.33	2.50	6.57	1.97	11.35	1392
1990	1342	19	102.20	229.3	26.00	77.00	36.67	130.33	2.43	7.18	3.42	9.99	1434
1991	1589	31	104.44	237.3	27.00	85.00	42.23	111.20	2.23	7.02	3.49	9.19	1388
1992	657	12	110.08	245.3	30.00	94.00	46.62	124.17	2.01	6.35	3.15	8.39	1179
1993	1999	38	127.69	253.3	43.00	105.00	63.01	134.34	2.43	5.93	3.56	7.59	1340