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MEXAGMKTS

A Model of Crop and Livestock Markets in Mexico

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and
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The MEXAGMKTS model allows an exploration of the effects on individual commodity markets of Mexico's domestic macroeconomic policies or of the macroeconomic and sectoral policies of Mexico's trading partners.

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This paper — a product of the Agricultural Policies Division, Agricultural and Rural Development Department — is part of a larger effort in PRE to understand the dependence of domestic agricultural markets on domestic macroeconomic policy and the macroeconomic and trade policies of major trading partners. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Cicely Spooner, room N8-035, extension 30464 (61 pages with graphs and tables).

The genesis of the model MEXAGMKTS was the perception that agricultural policies in Mexico (and many other countries) are often second-best responses to the negative side effects of broad macroeconomic and international trade policies.

MEXAGMKTS was designed to allow analysis of the relationship between such agricultural policies and different macroeconomic and international trade regimes. MEXAGMKTS is part of a set of interlinked macroeconomic and sectoral models of Mexico and the United States (with enough specifications for the rest of the world to close the system).

O'Mara and Ingco discuss the historical context in which MEXAGMKTS was developed as well as its economic structure, estimates, and validation. They present a stand-alone, counterfactual application of a trade liberalization scenario for Mexico.

The conclusion: If human consumption is the welfare criterion, trade liberalization improves the average consumption possibilities for the Mexican people. Lower prices for maize and soybeans shift consumption possibilities outward, with an increased price for sorghum offset by efficient input substitution in livestock production.

The cost of this improvement is significantly less domestic production of maize and more variation in producer prices for maize and sorghum. As a result, maize imports may reach very high levels on occasion. For a government that prefers to produce most of a major food grain domestically, this may be a high price to pay. But in the long term, the food security cost of maize imports appear to be much lower.

MEXAGMKTS:
A Model of Crop and Livestock Markets in Mexico

by
Gerald T. O'Mara
and
Merlinda Ingco

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A MODEL OF CROP AND LIVESTOCK COMMODITY MARKETS IN MEXICO (MEXAGMKTS)

I Introduction

The genesis of the model MEXAGMKTS was the perception that agricultural policies in Mexico (and many other countries) are often second best responses to the negative side effects of broad economic policies aimed primarily at macroeconomic and international trade objectives. Given this perspective, it was natural to want to study the relationship of such agricultural policies to differing macroeconomic and international trade policy regimes. The outcome has been a research project that models policy interaction effects by means of controlled counterfactual simulation experiments. The model MEXAGMKTS is a member of a set of interlinked models at macroeconomic and sectoral levels of Mexico and the U.S. (and enough specification of the rest of the world to close the system). This paper discusses the development of MEXAGMKTS in terms of historical context, economic structure, estimation and validation and presents a stand-alone counterfactual application to a trade liberalization scenario for Mexico.

II Historical Perspective

To assess the extent to which agricultural policy in Mexico has been formulated to facilitate broad economic policy objectives, it is useful to briefly review the history of Mexican economic policy over recent decades. For about four decades, Mexican economic policy was strongly inward looking, featuring promotion of domestic manufactures by means of protective tariffs and (later) import quotas. During the

1950s and 1960s, policy encouraged capital formation through domestic savings and tax collection and recourse to foreign capital. Real GDP grew annually at 7.2 percent with per capita GNP rising by 3.7 percent and gross fixed investment at 6.2 percent annually over the period. Domestic prices grew at an annual rate of 4.3 percent, and external borrowing was a stable proportion of GDP over the period. The peso-dollar exchange rate was held at 12.5 (over 1954-76) despite a relative lack of effective exchange controls. It is well known that the economic policy just described imposes implicit taxation on exporting sectors that is a function of the degree of protection to import competing sectors. In the absence of countervailing policy toward exports, such a policy tends to diminish export supply and earnings. The countervailing policy adopted by the Government of Mexico in this period with respect to agriculture was a program of significant public investments in infrastructure (largely irrigation and highway construction) that stimulated agricultural supply by reducing delivered costs to urban and external markets and thus offset the effect of the dominant economic policy on the sector. During this period agriculture and livestock GDP grew at average rates of 3.0 and 2.7 percent, respectively, with yield increases and area expansion contributing about equally to agricultural output growth and growing population and incomes, increasing demand for livestock products. As a share of GDP, sectoral output decreased from 18.6 percent in 1955 to 8.8 percent in 1972. Throughout almost all of this period, Mexico was a significant net exporter of agricultural commodities.[1]

In 1950, the Mexican Congress mandated broad powers to the federal government to regulate domestic prices via administrative fiat internally and through tariffs, quotas and exclusive trading rights with respect to external trade. In the period of the 50s and 60s (and subsequent ones), the prices for maize, beans, wheat sorghum, soybeans (and other oilseeds) were supported by government guarantee prices. Although the ease of access of the small farmer to guarantee prices has varied over time, the guarantee prices have been largely effective in providing a floor to the prices of these commodities.[2] Nonetheless, the real index of farm gate prices fell significantly throughout the period.[3]

The success of the golden age just described contained the seeds of its own destruction as the inevitable inefficiencies of a sustained policy of strong import substitution eroded Mexican competitiveness. By the early 1970s, Mexican agricultural exports were being replaced by agricultural imports. In the normal course of events, Mexico would have been driven by the increasingly inefficient import substitution policy toward a policy of export promotion. However, as events unfolded, Mexico was blessed (cursed?) with the discovery of large petroleum deposits that converted the country into a major exporter of oil. While this temporarily solved the problem of export earnings, it did nothing to deal with the inefficiency of the import substitution policy. In the ensuing era of expanding petroleum exports, aided by sharp increases in real petroleum prices in 73-76 and 79-81, Mexico collected very large natural resource rents. In the now familiar dutch disease fashion, the dissapation of these rents significantly increased the demand for nontradables, pulling resources away from production of tradeables through factor price increases that reduced external competitiveness via their effect on costs. In simple consequence, the export sector became predominantly oil based. In agriculture, the dutch disease pulled labor toward other sectors, especially construction, as the public sector dissapated petroleum rents through massive increases in public investments (which grew at 16.5 percent annually over 73-81). At the same time, the rest of the world was inundated by petro-dollars that Middle Eastern oil producers were unable to absorb domestically.

in a climate of opinion that foresaw ever increasing petroleum prices, the bankers recycling petro-dollars were led to favor investments in countries well endowed with oil reserves. Thus, Mexican policymakers were confronted with an apparently inexhaustible supply of external capital to augment the increased natural resource rents, and all notions of a hard government budget constraint vanished. Necessary policy adjustments such as tax reform, liberalization of tariff and non-tariff barriers to imports, etc. were postponed. Both the increase in petroleum rents and the influx of foreign capital stimulated the supply of money and credit, and the era of price stability ended as inflation increased to 21.4 percent annually (over 1972-81). To add fuel to the fire, in 1977 the government established a system of coverage of foreign debts by the central bank. This allowed Mexican firms to get foreign credit at the same cost as domestic funds, which was tantamount to fixing of the peso-dollar exchange rate to stabilize a system of free convertibility between demand deposits denominated in pesos and dollars (i.e., the so called "mexdollar" deposits).[4]

While agriculture also benefited from the government investment boom, it received less than many other sectors (public investments in agriculture increased at 13.1 percent annually); and the benefits did not offset the dutch disease effects. From 1972 to 1980, an estimated 900,000 workers left the agricultural sector. In consequence, the country was forced to rely heavily on food imports. The income effects from the petroleum boom accelerated a shift in household consumption away from maize and beans toward commodities with high income elasticities, e.g., livestock commodities. In addition, the diffusion of imported technology that lowered the costs of livestock production, i.e., semi-mechanized production of pork, poultry and eggs through selective breeding and carefully designed composite feeds, kept the supply of some livestock commodities elastic. The result of all this was a shift in cultivated acreage toward fodder crops and away from food grains. Toward the end of the petroleum boom period (1979-81), concern over the relative decline of agriculture resulted in initiation of the Mexican Food Program, or the SAM as it was known from its Spanish acronym. This program was promoted politically as a vehicle for restoring food self-sufficiency. The SAM did raise guarantee prices somewhat, but its main thrust was an effort to offset dutch disease effects by reducing farm level costs through input subsidies, especially for credit, fertilizer, seed and pesticides. The credit component channeled the loans from the agricultural development banks into short term crop production, while the subsidized credit through the commercial banks went heavily toward livestock (over 50 percent). Since part of the loans covered worker wages, for small farmers employing self and family labor the development bank lending was a quasi income maintenance program; and when delinquent loans were forgiven, these converted into income transfers. However, credit was biased toward the more commercial northern regions of the country, so that any income transfers to poorer regions were limited. Since the SAM maintained low consumer prices for basic foods, e.g., maize, beans, wheat, meat, milk, eggs, vegetable oils, required producer subsidies were quite large given that the policy of controlled prices provided consumption subsidies to consumers in general. In simple consequence, the SAM resulted in a significant transfer of resources to agriculture, with the transfer as a percent of sectoral GDP ranging from 28 in 1979 to 42 in 1982.[5]

The petroleum boom ended sharply in 1982, with the combination of faltering oil prices and the disinflation initiated by Chairman Volker of the U.S. Federal Reserve Board that had pushed interest rates world wide to very high levels. The crisis that followed from Mexico's resultant inability to service its external debt, with the final push coming from heavy flight of domestic capital as the trend of events became clear, marked the beginning of the present era of debt restructuring and structural adjustment of economic policy. This event coincided with the waning days of the sexenio of President Lopez Portillo, who proceeded to nationalized the Banks in a successful effort to renege on the convertibility of the mexdollar deposits. The immediate result was a total halt to the flow of external credit into Mexico.[6] This in turn forced a sudden and large devaluation of the peso. When the flow of external loans did resume via bilateral and multilateral credits, the conditionality was demanding; and a sustained process of externally driven adjustment began.

The first phase of adjustment came with an IMF mediated stabilization program which featured fiscal austerity that reduced the public sector deficit from 17.6 percent in 1982 to 8.9 percent in 1983, and a restructuring of external debt with commercial banks was negotiated. The large devaluation improved the current account, but the required reduction in expenditures yielded a deepening stagflation. Inflation increased from 58 percent in 1982 to 102 percent in 1983, while real GDP decreased by 5.9 percent between 1982 and 1983. However, from 1983 to late 1987, a combination of government expenditure increases and declining revenues from petroleum resulted in growth of the fiscal deficit relative to GDP. Moreover, up to mid 1985, the rate of depreciation of the peso was exceeded by the rate of inflation, increasing the real exchange rate with the inevitable decrease in non-oil exports.

In July 1985, the de la Madrid administration instituted reform measures which depreciated the peso more rapidly than prices increased, resulting in a 50 percent drop in the real exchange rate over the following year (with an assist from the effects on expectations from the precipitous drop in world petroleum prices in early 1986). The 1985 reforms also started to reverse the policy of global subsidies to consumers on basic foods, and these were largely eliminated by the end of 1986 in favor of a program of subsidies targeted to the poor. This permitted initiating reforms aimed at adjusting producer price guarantees to border price levels. These measures stimulated agricultural exports, the dollar value of which increased 44 percent from 1985 to 1986. More generally, the liberalized policies also sharply stimulated manufactured exports from plants along the border with the U.S. that assemble goods for external markets using duty free imports and favorable U.S. tariffs. As part of the trade liberalization measures, Mexico joined the General Agreement on Trade and Tariffs (GATT) in 1987, resulting in reductions of maximum tariffs from 100percent to 20 percent, and a large reduction in products whose trade was regulated by quantitative restrictions (from almost 100 percent to about 50 percent).[7]

The severity of the impact of the debt and structural adjustment crisis on Mexican welfare needs emphasis. During the four years after 1982, Mexico transferred abroad resources equivalent to US$31 billion (in 1987 prices), amounting to 4 percent of GDP and nearly 25 percent of export earnings. To place them in historical context, they were 1.6 times larger in relation to national income than the reparations paid by Germany after World War I. To achieve this transfer required a cumulative trade surplus of US$48 billion (1987 prices) over five years, amounting to 6.3 percent of GDP. In human terms, this effort required a reduction of 15 percent in per capita consumption between 1981 and 1984. To date, per capita consumption has yet to regain the level of 1981.[8]

The adjustment process in agriculture has featured the gradual elimination of a system of quantative controls on imports and exports that up to 1985 had limited importation of key agricultural commodities to public enterprises (in order to control the impact of trade on the cost of producer and consumer subsidies), movement of of producer support prices toward border prices, reduction of input subsidies, closure of inefficient government processing plants and liberalization of price ceilings on basic consumer foods.

III The Strategic Role of Agriculture in Mexican Economic Policy

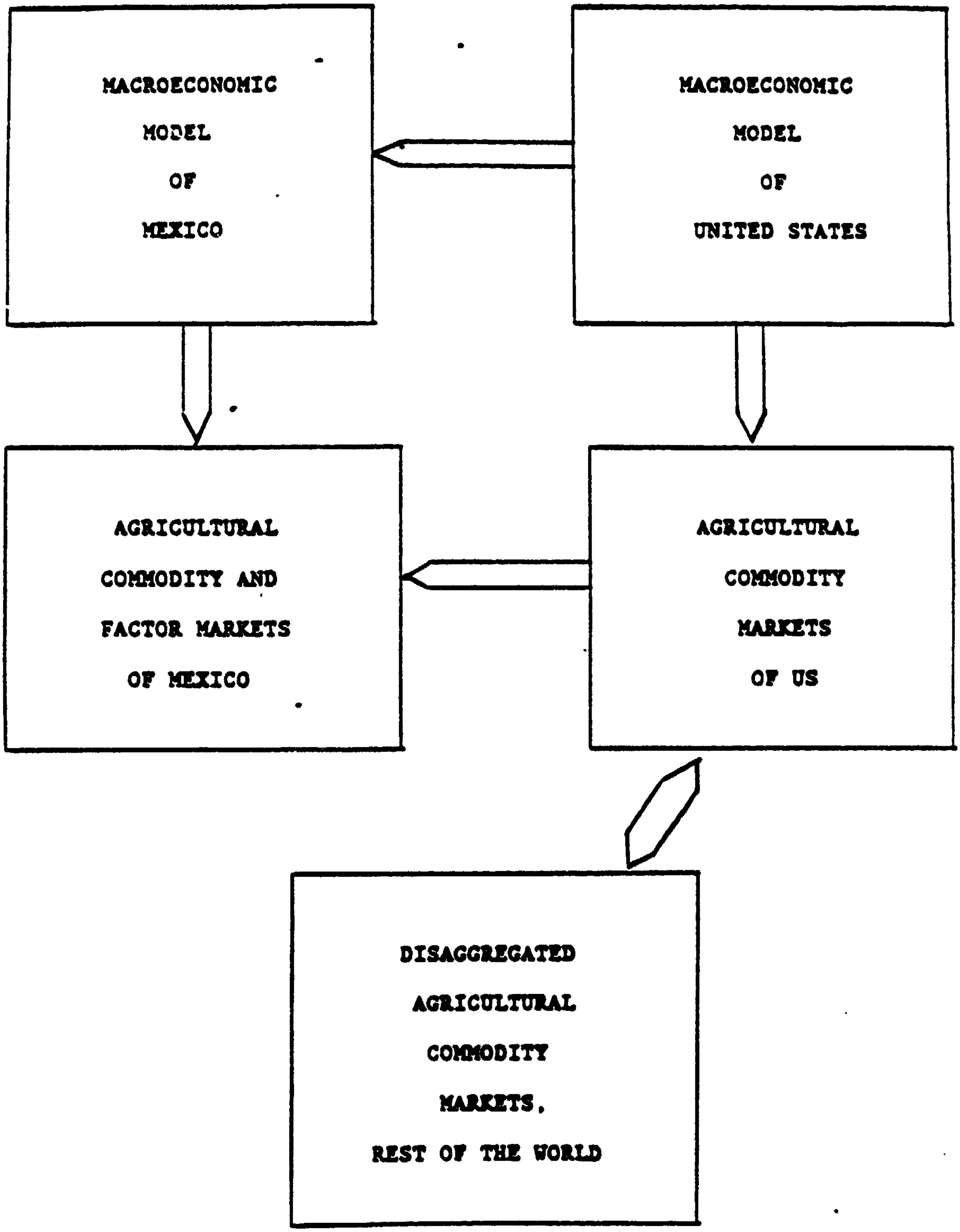
For almost forty years, the major thrust of Mexican policy toward agriculture has been to keep the terms at which agriculture trades with the rest of the economy favorable to urban consumers. This policy of cheap food to city dwellers was essentially aimed at stabilizing the real wage cost of blue collar workers and civil servants at a relatively low level. Such a policy facilitated import substituting industrialization and promoted peaceful industrial labor relations. However, as already noted, a sustained import substituting policy insulates the economy from external competition, losing the stimulus toward cost reduction and market diversification that trade provudes. Similarly, a sustained pro-urban bias tends to induce excessive urbanization, as the bloated size and heavy pollution of Mexico City attest. The cornerstone of the policy creating the urban-industrial complex in Mexico has been the use of pricing of food commodities to stabilize the real incomes of urban workers. The major safety net for the small farmer and rural workers has been migration (to the cities or the U.S.) and emigrant remittances to relatives left behind.[9] The system of essentially fixed producer and consumer prices for basic foods imposed the necessity of government supply adjustment as quantity control instrument to manage disequilibria in food and feed grain markets. The system works as follows: in the fall when major crops are harvested, the predominant public agency in food supply operations, CONASUPO, can estimate with some accuracy the supply available from domestic production over the next year. Combining this information with estimates of food demand at existing prices produces an estimate of excess supply or demand, and hence an indication of the quantities to offer for export or to order for import. Any errors in the initial estimates of surplus or shortage (at existing prices) can be met by varying the level of government held inventories. Since the system provides no incentive for private investments in storage facilities or the holding of inventories, and even though trade in basic foods is no longer a government monopoly, the government supply adjustment mechanism is still an essential part of the food distribution sytem.

IV Role and Structure of MEXAGMKTS Model

The objective of this model is to provide a simulation tool at the disaggregated level of individual agricultural commodity markets that will permit experiments exploring the effect on those markets of policies at the domestic macroeconomic or international (i.e., trading partner) macroeconomic and sectoral levels. The effects are to be transmitted by changes in variables that are specified as exogenous determinants of quantities demanded or supplied. In turn, the values of these linkage variables are determined in upstream models in an experimental framework of recursive causation. The structure of this framework is given in Figure 1. Note that MEXAGMKTS receives values of linkage variables from both the Mexican macroeconomic and the US (and rest of the world) agricultural markets models.

Model design specifies the interaction of markets for several important food/feed crops with markets for representative livestock commodities. Inputs are the primary factors of labor and capital and the intermediate inputs of fertilizer and feed crop commodities. Land is omitted from the specification through the use of supply functions whose key arguments are price variables. This approach is taken since the set of markets modeled does not include the markets for all agricultural commodities and important substitution relationships between factor inputs, especially land, exist between the markets modeled and those omitted. In addition, the supply of agricultural labor is linked to markets for unskilled labor nationwide (and even internationally). Thus, the wage of labor is a key linkage variable whose value is determined in the Mexican macroeconomic model.

Figure 1: Schematic of Pattern of Major Interactions Hypothesized as an Analytical Framework



V Functional Specification of MEXAGMKTS Model

This section presents a functional specification of the model. A detailed specification of individual equations complete with parameter estimates is given in Appendix A. The specification starts with basic index sets and continues with descriptions of va' ables and equations:

Index Sets

Symbol	Description	Set Members
c	Food/Feed Crops	/maize, sorghum, soybeans/
i	Factor Inputs	/capital, labor, fertilizer/
a	Animal Stocks	/cattle, pigs, broilers, layers/
l	Livestock Comm.	/beef, pork, poultry, eggs, milk/

Variables

Name	Description
PR(c)	Production of crop c
FD(c)	Animal feed demand, crop c
HD(c)	Human food demand, crop c
GSADJ(c)	Government supply adjustment, crop c
RPG(c)	Real price guarantee, crop c
RBP(c)	Real border price, crop c
PCC(c)	Per capita human consumption, crop c
P(i)	Real price of factor i

PCON	Per capita human consumption, all commodities
POF	Index of the relative price of food
POP	Population of Mexico
INV(a)	Stocks in Mexico of animal type a
INVUS(a)	Stocks in US of animal type a
QP(l)	Production of livestock commodity l
PCL(l)	Per capita consumption, livestock commodity l
NEXP(l)	Net exports, livestock commodity l
PP(l)	Real producer price, Mexico, livestock comm. l
PPUS(l)	Real producer price in US, livestock comm. l
RP(l)	Real consumer price, Mexico, livestock comm. l
PTORT	Real consumer price, Mexico, maize tortillas

The variables P(I), PCON and POF are linkage variables from the Mexican macroeconomic model; and the variables RBP(c), INVUS(a) and PPUS(l) are linkage variables from the US (and rest of the world) agricultural markets model. The variables RPG(c) are agricultural policy variables, while the variables P(I) and NEXP(l) may also be policy variables. The variable POP is exogenous. All other variables are endogenous.

Equations

Number	Type	Functional Specification
3	Crop production	PR(c) = PR(RPG(c), P(I))
3	Animal feed demand	FD(c) = FD(RPG(c), INV(a))
1	Human food demand	HD(c) = HD[POP*PCC(PTORT,PCON,POF)]
3	Gov't supply adj.	QSADJ(c) = FD(c) + HD(c) – L[PR(c)]

4	Animal Stock Demand	INV(a) = INV(RPG(c),P(l),PP(l), L[INV(a)])
5	Livestock comm. prod	QP(l) = QP(PP(l),RPG(c),P(l), INV(a),L[QP(l)],Time)
5	Per cap cons, lvstk commodity l	PCL(l) = PCL(RP(l),POF,PCON, L[PCL(l)])
1	Net exports, lvstk commodity l	NEXP(l) = NEXP(PPUS(l),INVUS(l))
2	Consumer Price,lvstk commodity l	RP(l) = RP(PP(l), L[RP(l)])
5	Market clearing, lvstk commodity l	QP(l) - NEXP(l) = POP*PCL(l)
1	Consumer price of tortillas	PTORT = PTORT[RPG("maize")]

The thirty-three equations listed solve for thirty-three endogenous variables. Consumer prices are determined as a function of producer prices for only two livestock commodities, beef and pork. For all other livestock commodities, a time series of producer prices was not available. In these cases, the market clearing equation solves for a consumer price. The notation L[.] indicates a lagged value of the variable shown inside the brackets.

Model parameters were estimated using multivariate linear regression methods (OLS and 2SLS) using data from the Mexican Ministry of Agriculture and Water Resources (on crop and livestock production, prices, stocks, imports and exports), the Mexican Central Bank (price indices), Ministry of Programming and Budgeting (national accounts), the Mexican National Institute of Statistics and Geography, and the Foreign Agricultural Service of the US Department of Agriculture. Parameter estimates are given with the exact listing of model equations presented in Appendix A.

The economic interpretation of model equations is straightforward. The crop production equations are econometric supply functions which specify crop supply as a function of output and input prices. The feed demand equations specify food demands as a function of crop price guarantees and animal stocks. Human crop demand (for maize) is specified as the product of population and per capita demand, where the latter is determined by total per capita consumption, relative price index for food, and the retail price of tortillas, which is a function of the price guarantee for maize. The supply adjustment equations determine the quantities of imports or exports required to sustain the fixed guarantee. In brief, the equations relating to field crops embody the government supply adjustment process for market equilibration described above.

The livestock oriented equations are direct applications of microeconomic theory. Animal stocks are specified as a function of producer prices for livestock commodities, crop price guarantees, input prices and lagged stocks. Production of livestock commodities is specified as a function of producer prices, feed crop price guarantees, animal stocks and lagged production. Per capita consumption of livestock commodities is determined by consumer prices for livestock commodities, total per capita consumption, relative price for food and lagged per capita consumption of the livestock commodity. Net exports of livestock commodities are specified as a function of producer prices and animal stocks in the US. Market clearing for livestock commodities is accomplished by determining the price which equates quantity demanded with quantity supplied.

Model Validation

The aim of validation is to demonstrate that the model can acceptably reproduce historically observed outcomes. Since the objective of model construction was to develop a tool for simulating policy interaction effects, the period for validation should be the periods over which these effects are to be studied. This requirement effectively limits the validation period to the relatively recent past given that the data base used in model estimation contains some time series that go back only to 1972. For this reason, and because available information is as yet incomplete for the most recent years, the 1974-85 period was selected for model validation.

Given that the ultimate objective is counterfactual simulations of policy interactions, the model should be capable of simulation over a number of years with only initial historical values for endogenous variables as input data to the model. Of course, the behavioral relationships defined by the parameterized model equations will embody the expectations of economic agents as conditioned by historical experience and rational expectations based on that experience. Hence, the validation test selected was simultaneous solution of model equations over the twelve years 1974-85, with only initial historical values for 1972-73 used to provide data for predetermined lagged endogenous variables. Historical values were used for policy and exogenous variables in the validation test.

The simulated values of endogenous variables and their actual historical values are ploted together over 1974-85 in Figures 1 to 33 of Appendix B. In general, simulated values track historical values quite well. Of course, the parameterized equations do make use of dummy variables (that temporarily shift intercepts) to explain shocks that are outside both the deterministic functional relationships specified in model equations and the asymptotic normality posited for stochastic error terms. Where the simulated values track history less well, there is invariably an explanation. A case in point is the government supply adjustment variables which represent policy variables that are assumed to be set to validate the real price guarantees to farmers by the government. Yet it is evident that these variables are adjusted discontinuously not only in response to agricultural policy but also to cope with government fiscal constraints and concerns over the effect of food prices on the welfare of key groups. That is, market clearing prices may diverge from the price guarantees by means of ad hoc supply channels or queuing may emerge temporarily. The same arguments apply to the prices for beef, pork and milk, which on occasion are temporarily manipulated by government officials acting to affect the prices of foods important to the welfare of favored urban groups. Thus, temporary quotas on beef exports have been imposed to damp expected beef price increases. Similarly, an important fraction of milk consumption is supplied by imports of powdered milk, which are under the control of government; and variations in milk imports can be used to manipulate milk prices. Such discontinuous and poorly documented government actions are difficult to formally incorporate in model equations, and yet they do have real effects on prices and quantities in livestock commodity markets. Finally, there is the possibility of errors in the data sources. For example, the sharp drop of over 50 percent between 1983 and 1984 in stocks of broilers in conjunction with a reported increase in poultry production is highly unlikely.

VI Application of MEXAGMKTS to Counterfactual Trade Liberalization Scenario

As an initial application, MEXAGMKTS will be used to simulate a trade liberalization scenario that has been urged upon Mexico by multilateral and bilateral lenders. This experiment consists of dropping the system of guarantee prices for the field crops maize,sorghum and soybeans and letting the world market determine the domestic prices for these commodities. Conceptually, this experiment envisions the end of international trading and storage operations by CONASUPO to validate the politically determined guarantee prices. Of course, there would still be international trading in maize, sorghum and soybeans; but it would be by private firms or even by CONASUPO at international prices and without subsidy. Since the experiment is counterfactual, simulation over the entire 1974-85 period is of interest as a test of the alternative policy under a variety of economic conditions. Operationally, the experiment is implemented by simply substituting the real border price (RBP) variables for the real price guarantee (RPG) variables; and interpreting the supply adjustment variables as profit maximizing trade at world prices by private traders or even by CONASUPO.

Experimental Results

The results from the experiment are most easily interpreted by noting that only three exogenous variables are changed, the prices of maize, sorghum and soybeans. Since the changed variables are prices, the resource allocation impact is determined by the change in two relative prices, using one commodity as numeraire. This comparison is given in Table 1. Thus, the maize price decreases from 1.51 to 1.06 sorghum units; and the soybeans price drops from 2.67 to 2.23 sorghum units when averaged over the period 1974-85. That is, the guarantee prices over the period have on average overvalued maize and soybeans in terms of social opportunity costs.

Table 1: Comparison of Relative Guarantee and Border Price of Maize and Soybeans in Sorghum Units, 1974-85*

	Maize	Soybeans
Guarantee Price	1.509	2.670
Border Price	1.056	2.229

* Rate are average values of variables over 1974-85 period.

For this reason, it is no surprise that the experimental results presented in Table 2 show on average that maize production decreases by 28%, soybeans production is down by 4% and sorghum production increases by 9%. Similarly, on average maize and soybeans feed demands increase by 13.5% and 1.5% respectively, while sorghum feed demand decreases by 1.4%. On average, the decrease in maize price increases per capita human consumption by 3.8% and total maize consumption by 7.6%. All of these changes imply on average a large increase in maize imports of 3.7 million metric tons annually or 349%, and a decrease of 0.4 million metric tons annually or -31% in sorghum imports, with very little change in soybean imports.

Since all three crops are important sources of animal feed, and can be substituted at the margin, it is not surprising that large changes in their relative prices induce only small changes in livestock production and consumption. Annual average results for beef and pork are given in Table 3. Note that on average production and per capita consumption of both beef and pork change by less than 1%. Beef exports are unchanged year by year since these are largely driven by prices and stock levels in the U.S.

Table 2: Comparison of Trade Liberalization Case With Base Case, Field Crops, 1974-85*

VARIABLE	UNITS	BASE CASE	TRADE LIBERALIZATION	PERCENT CHANGE
Maize Price	pesos/KG	4.671	3.843	-17.7
Sorghum Price	pesos/KG	3.144	3.640	15.8
Soybeans Price	pesos/KG	8.394	8.112	-3.4
Maize Feed Demand	1000 MT	4297	4876	13.5
Sorghum Feed Demand	1000 MT	5626	5547	-1.4
Soybeans Feed Demand	1000 MT	1021	1036	1.5
Maize Production	1000 MT	11115	7953	-28.4
Sorghum Production	1000 MT	4583	4989	8.9
Soybeans Production	1000 MT	579	558	-3.6
Per Capita Food Cons. of Maize	KG	109.3	113.5	3.8
Total Maize Consumption	1000 MT	11,792	12,686	7.6
Maize Supply Adjustment	1000 MT	1072	4816	349.3
Sorghum Supply Adjustment	1000 MT	1269	877	-30.9
Soybeans Supply Adjustment	1000 MT	625	649	3.8

* Data are average values of variables shown over 1974-85 period. MT indicates metric ton(s). Price variables are in 1980 prices.

Table 3: Comparison of Trade Liberalization Case With Base Case, Beef and Pork, 1974-85*

VARIABLE	UNITS	BASE CASE	TRADE LIBERALIZATION	PERCENT CHANGE
Beef Production	1000 MT	1193.8	1189.3	-0.4
Beef Export	1000 MT	64.0	64.0	0
Beef Producer Price	Pesos/KG	50.2	54.2	8.0
Per Capita Beef Consumption	KG	16.4	16.3	-0.6
Cattle Stocks	million head	29.487	31.180	5.7
Pork Production	1000 MT	1169	1172	0.3
Pork Producer Price	Pesos/KG	62.1	57.1	-8.1
Per Capita Pork Consumption	KG	16.9	16.9	0
Pig Stocks	million head	16.425	16.453	0.2

* Data are average values of variables shown over 1974-85 period. MT denotes metric tons(s). Price variables are in 1980 prices.

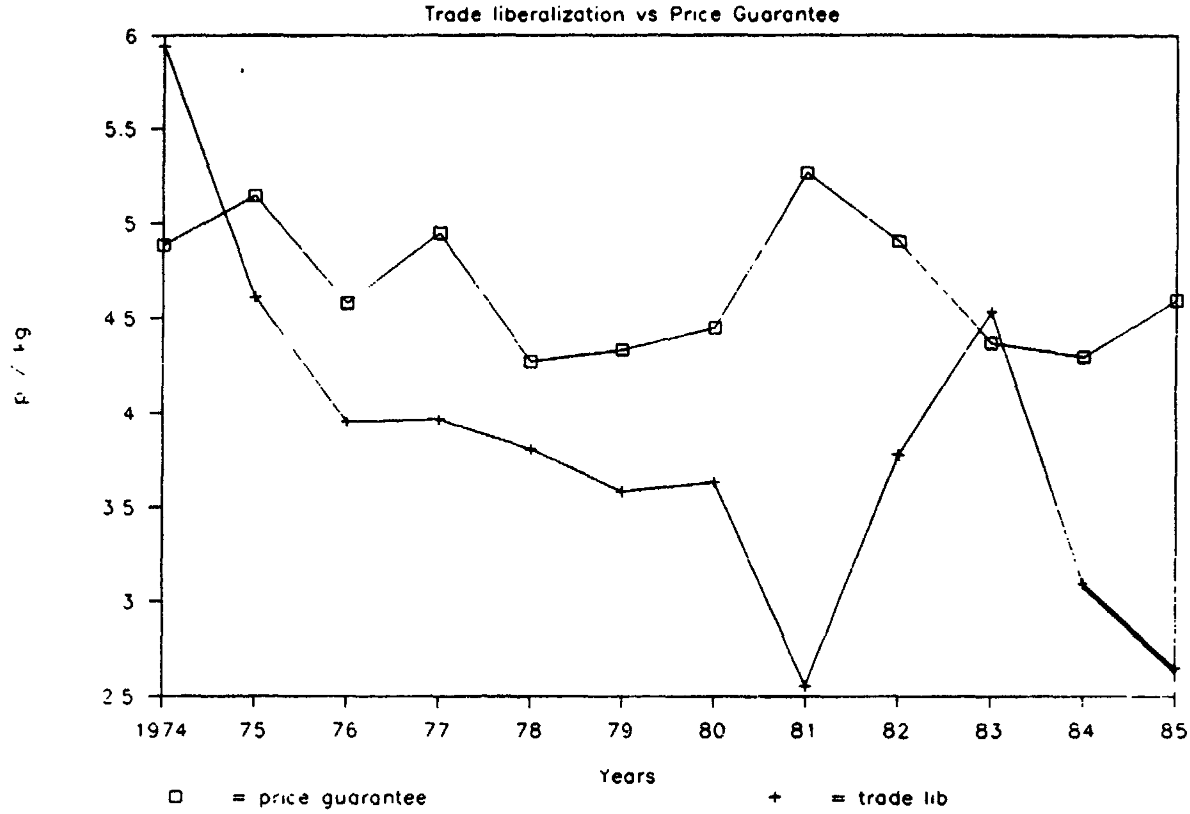
Of course, the averages over the period 1974-85 include several policy regimes as well as significant rise and fall in overall per capita consumption, which increased by 20.6% from 1974 to 1981 and then decreased by 15.3% from 1981 to 1985, with consumption in 1985 ending at virtually the same level as in 1974. Thus, it is instructive to examine time series results for key variables over the period. Charts 1 to 6 present such time series comparing a base case (historically given price guarantees) with the counterfactual trade liberalization for maize prices, production, feed demand, per capita direct human consumption, total demand and crop supply adjustment. Clearly the border price for maize has fluctuated more than the maize price guarantee. This difference induces similar variation in production, consumption and crop supply adjustment. Under trade liberalization, maize imports reach a peak level of 13.4 million metric tons in 1983, owing to low production the previous year and high demand in 1983. Thus, under trade liberalization, maize imports could be expected to show significantly greater variance

Charts 7 to 10 present time series comparisons of the two cases for sorghum prices, production, feed demand and crop supply adjustment. Once again, significant variation in the border price for sorghum induces corresponding variations in sorghum production; but feed demand shows less variation owing to high correlation between the border prices for maize and sorghum. Sorghum crop supply adjustment is highly variable, but due to greater domestic production at border prices, the reduced sorghum imports do not reach peak levels as large as under price guarantees. Charts 11 to 14 present time series data for soybeans analogous to the time series for sorghum. While soybeans prices are more variable (but lower on average), soybeans production, feed demand and crop supply adjustment under border prices show quite similar patterns and levels as under price guarantees.

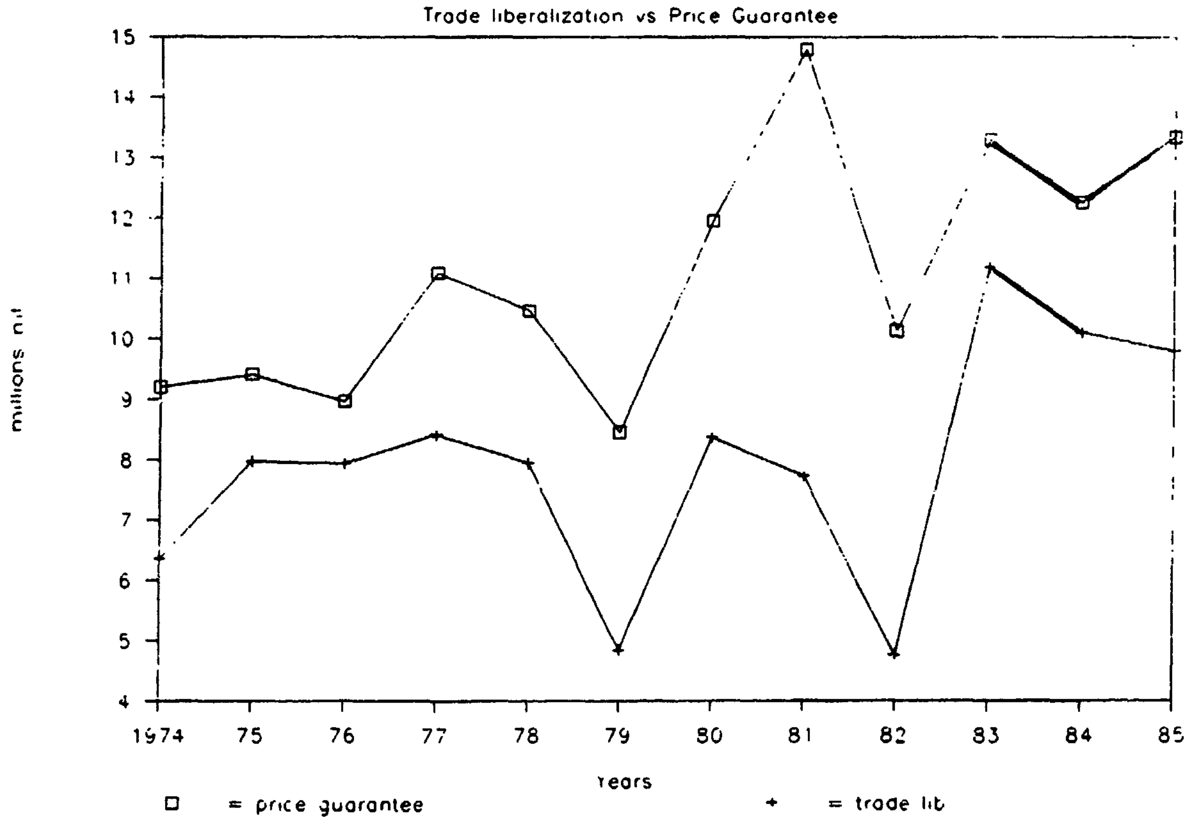
Assessment of Results

If human consumption is the welfare criterion, then trade liberalization results in improved consumption possibilities on average for the Mexican people. This result is essentially due to lower prices for maize and soybeans directly and indirectly shifting consumption possibilities outward, with the effect of an increased price for sorghum offset by efficient input substitution in livestock production. The cost of this improvement is significantly less domestic production of maize and increased variability in producer prices for maize and sorghum. In consequence, maize imports may reach very high levels on occasion. This can be viewed as high cost on the part of a government that prefers to produce domestically all or at least most of the domestic demand for a major food grain such as maize. However, over the longer term, when per capita incomes are growing significantly and substitution against maize in favor of preferred foods by a predominantly urban Mexican population has reduced direct maize consumption to much lower levels, the food security cost of maize imports would appear to be much lower.

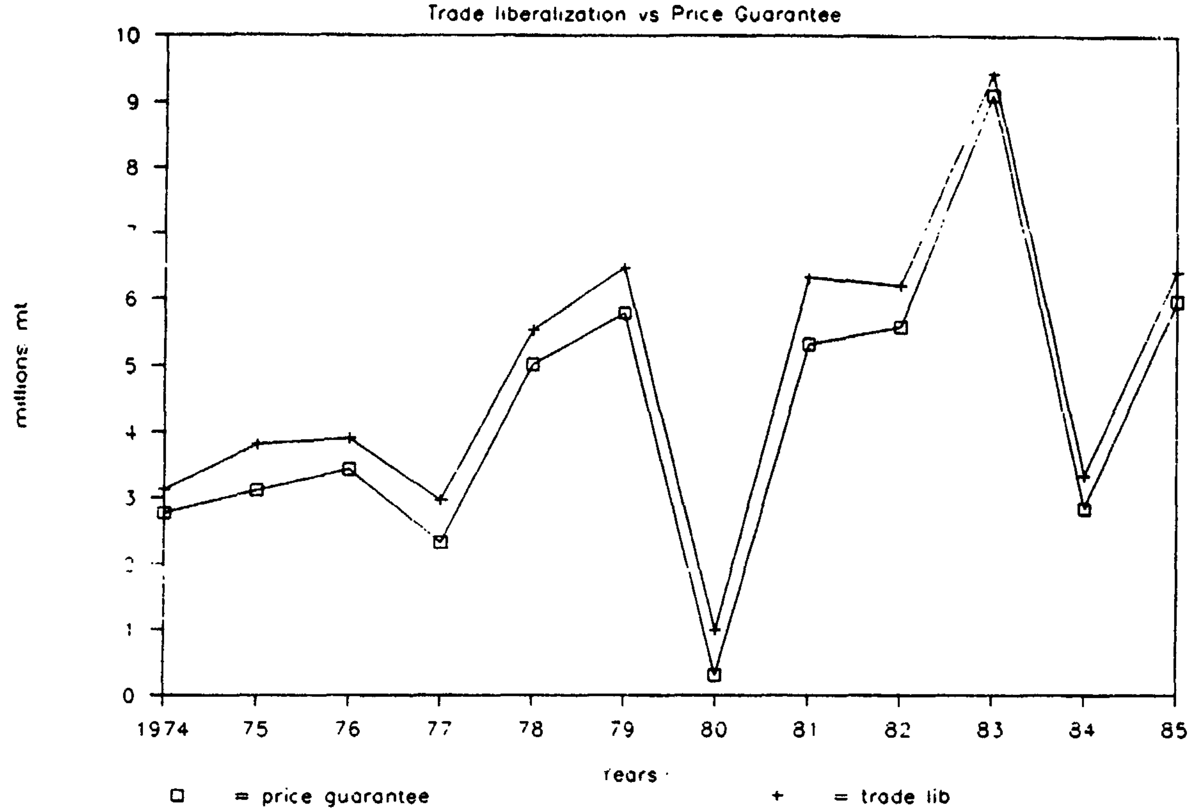
1:Price Incentives Maize



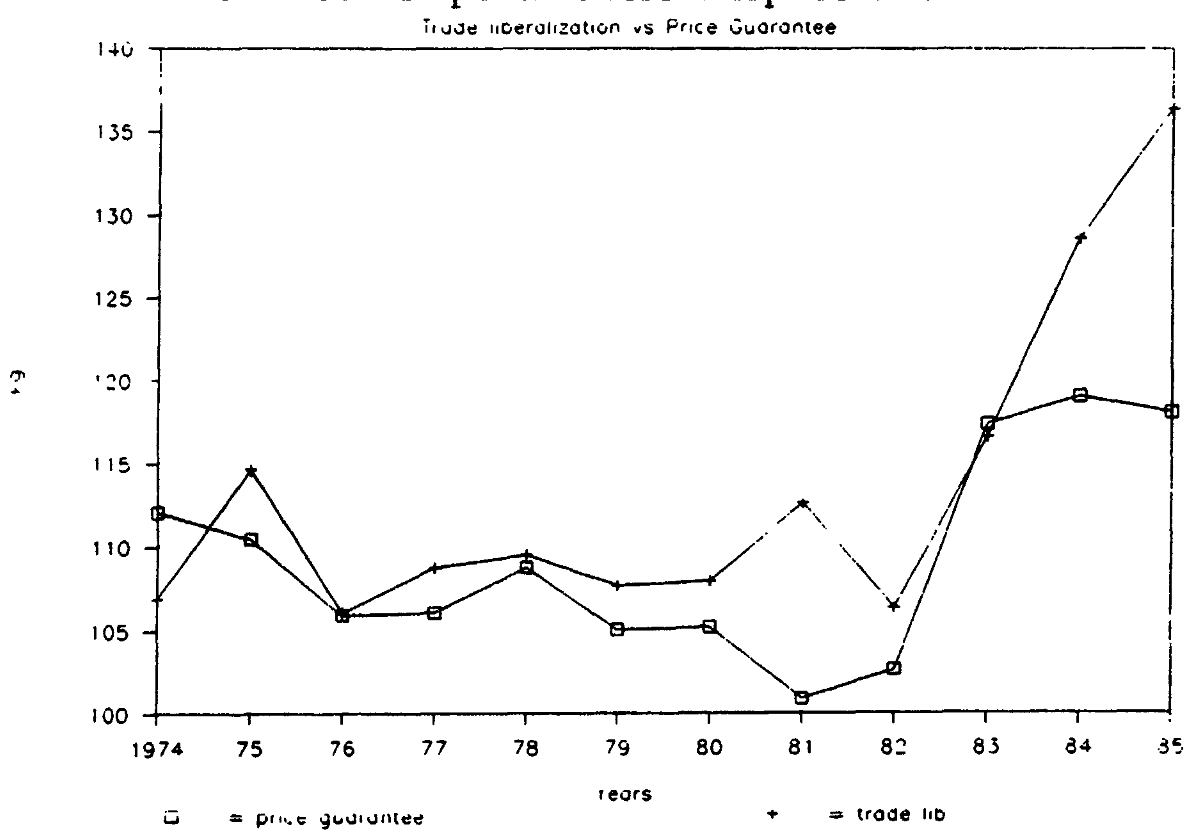
2: Production Maize



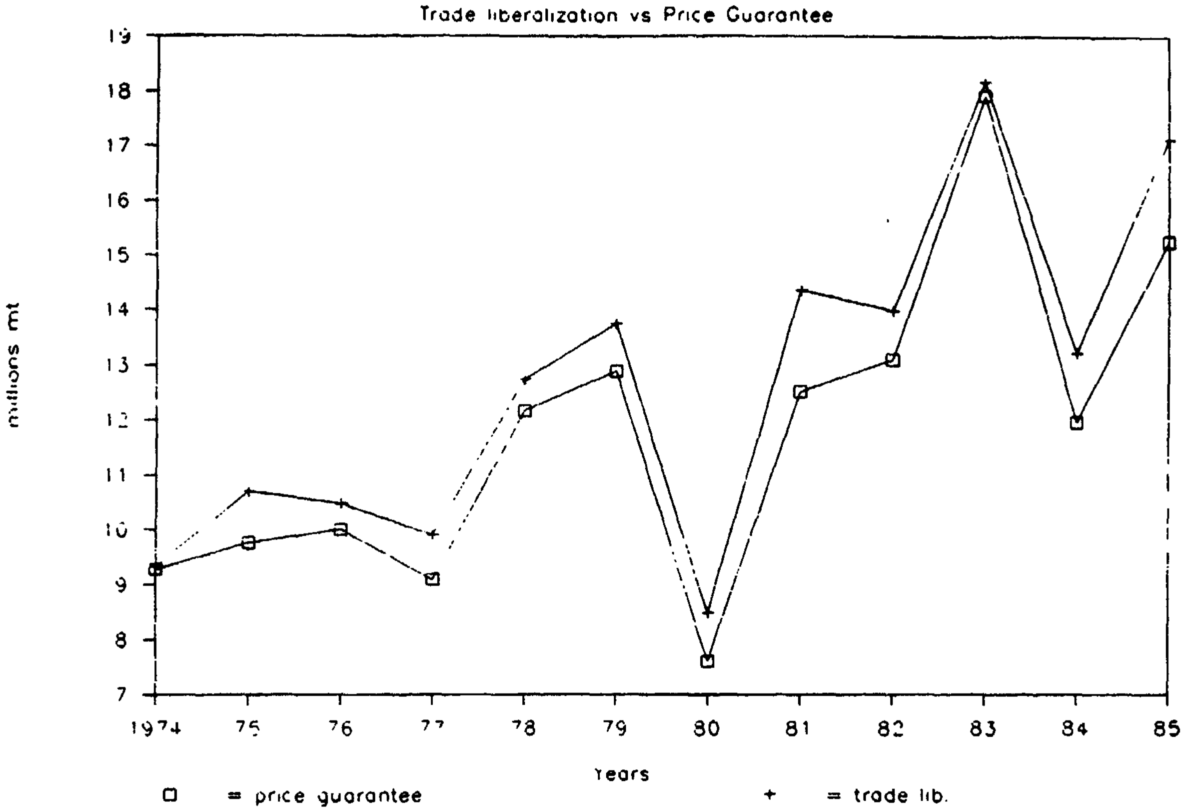
3: Feed demand Maize



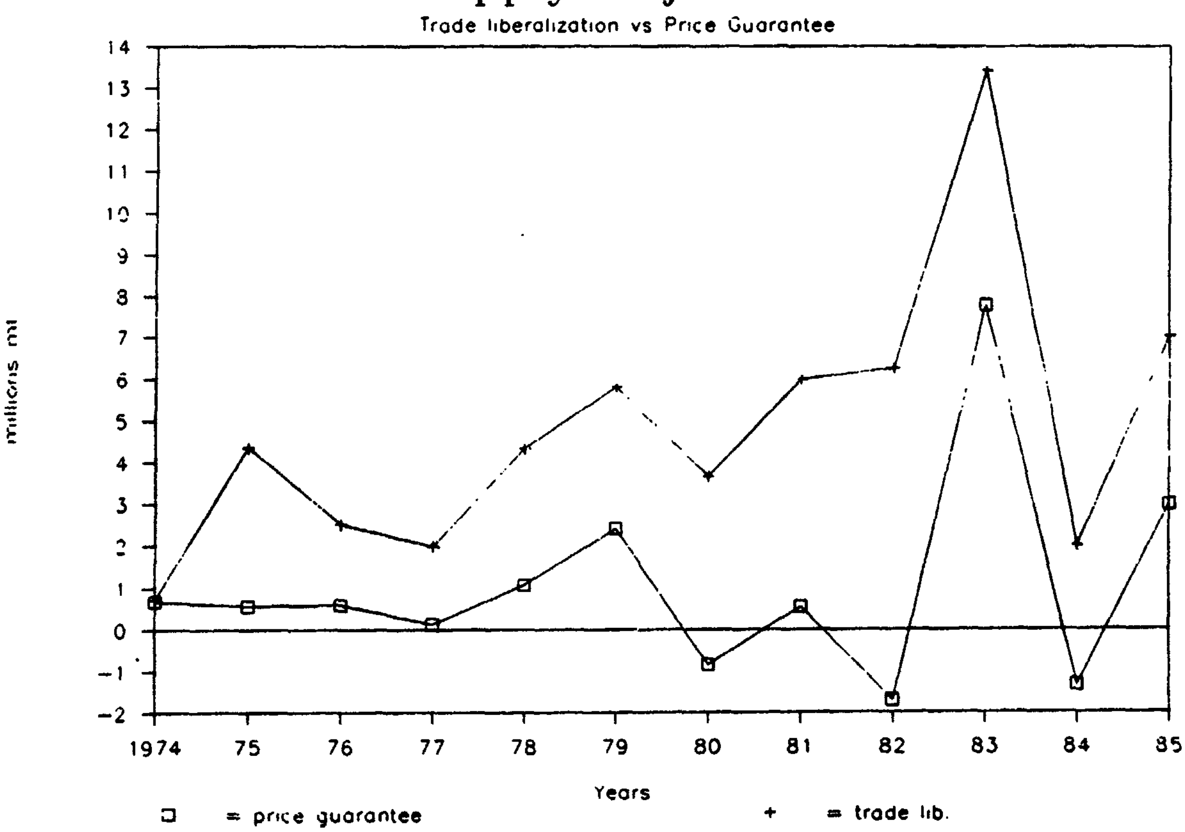
4: Per Capita consumption Maize



5: Total Demand Maize

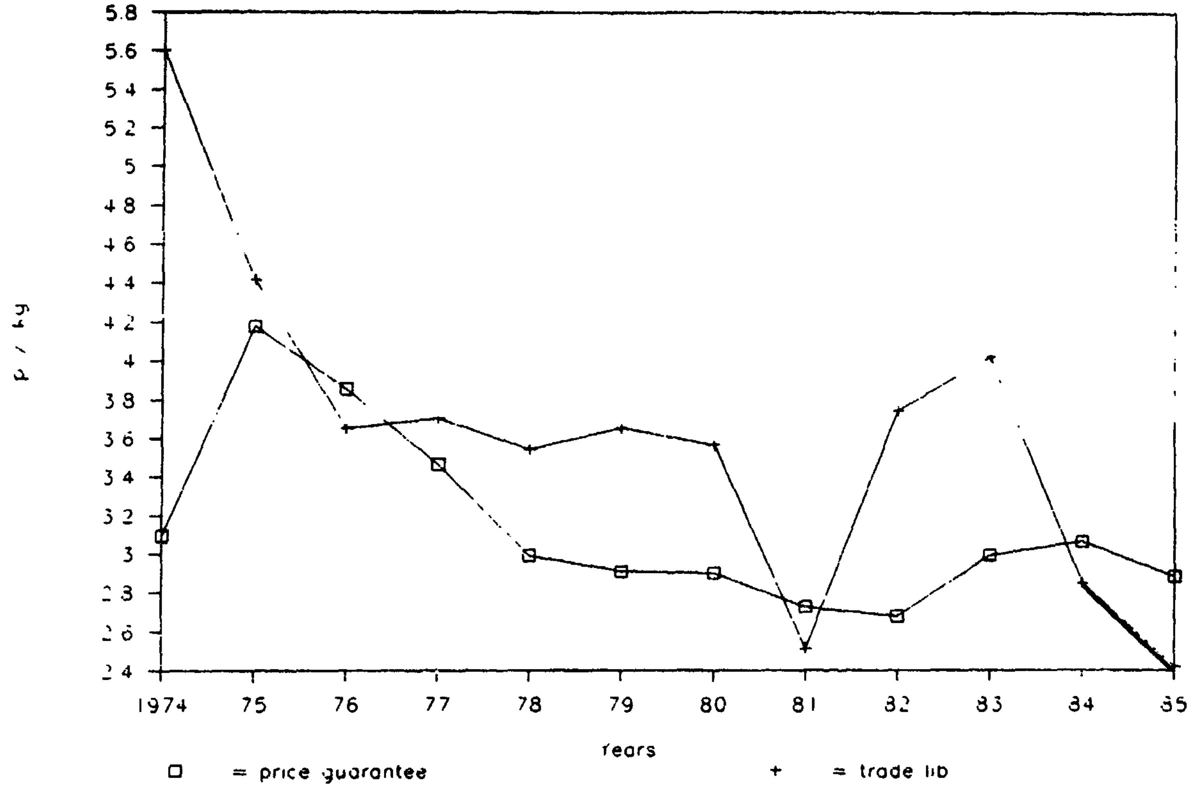


6: Gov. supply adjustment Maize



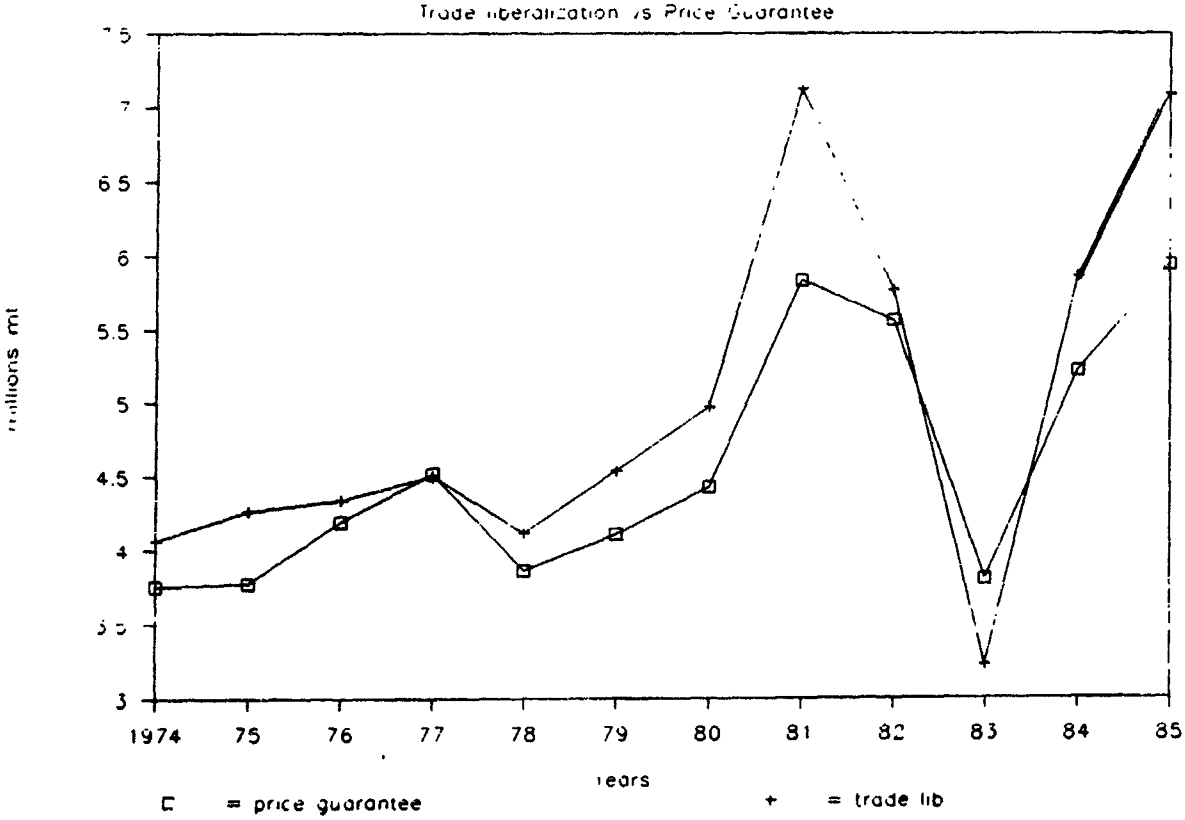
7: Price incentives Sorghum

Trade liberalization vs Price Guarantee

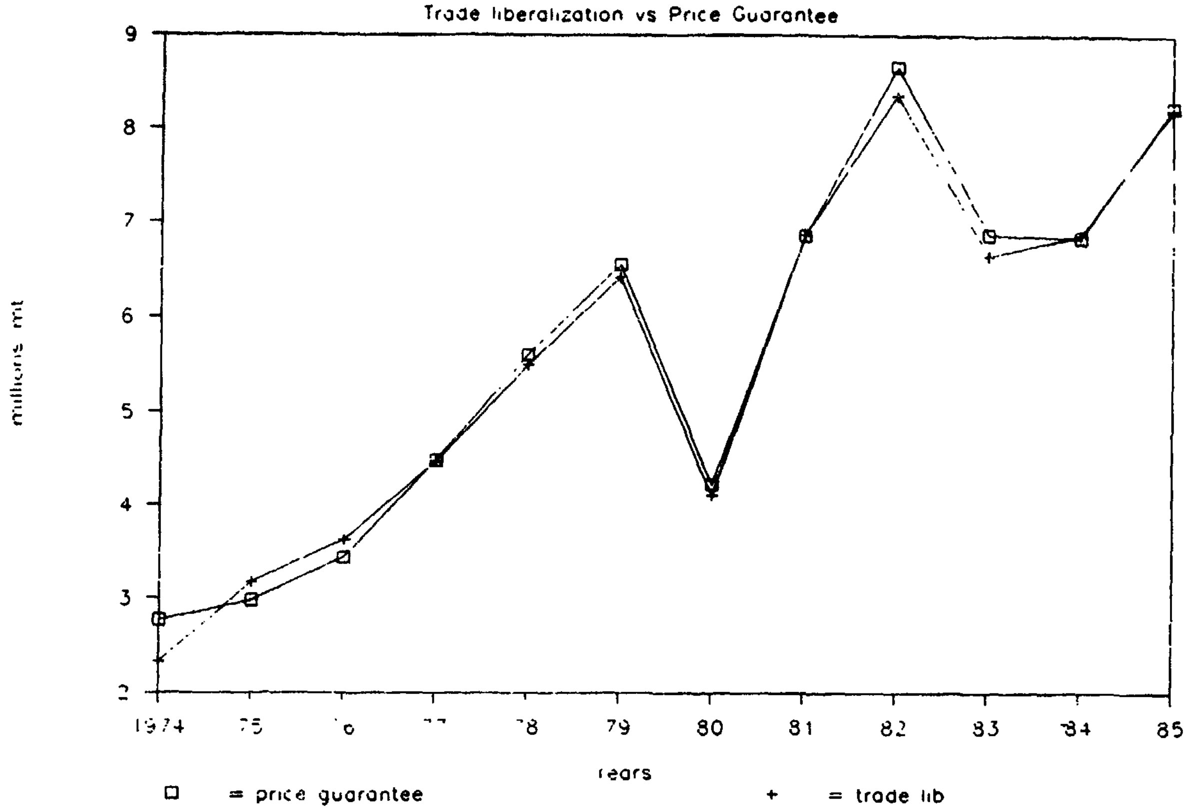


8: Production Sorghum

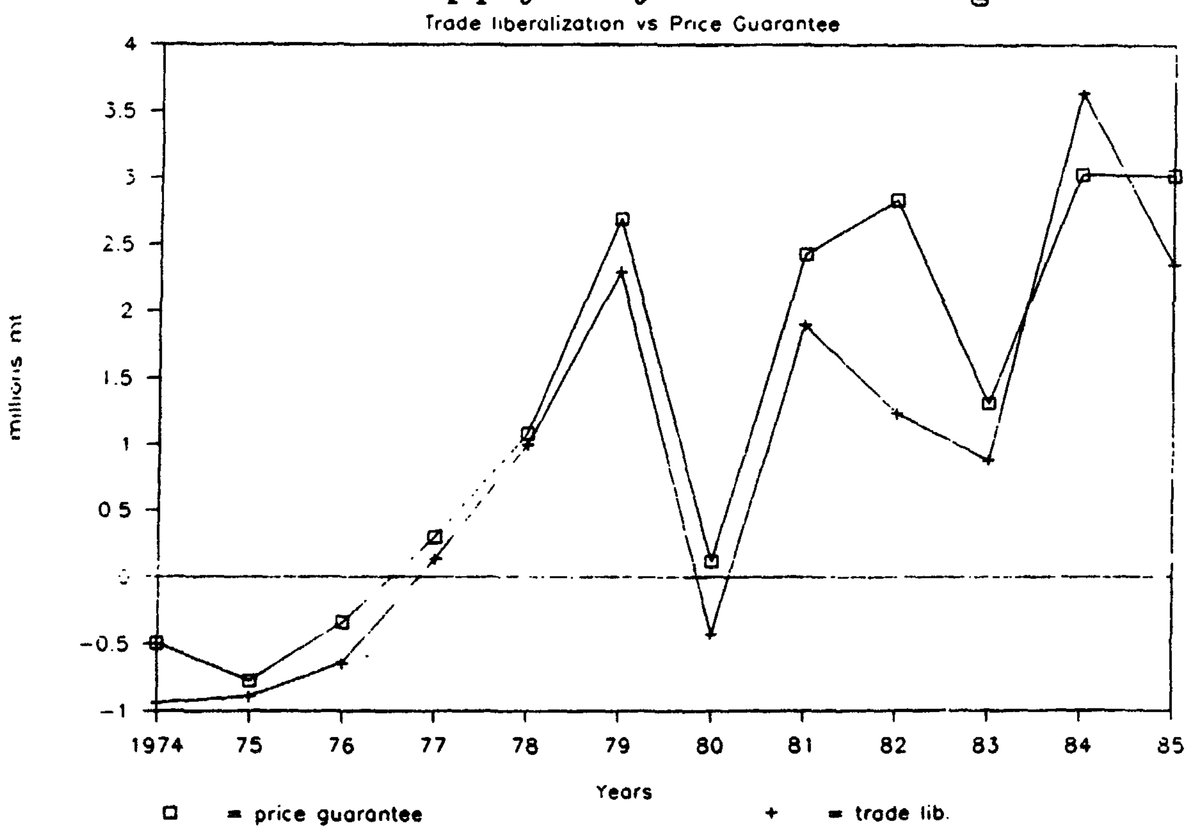
Trade liberalization vs Price Guarantee



9: Feed demand Sorghum

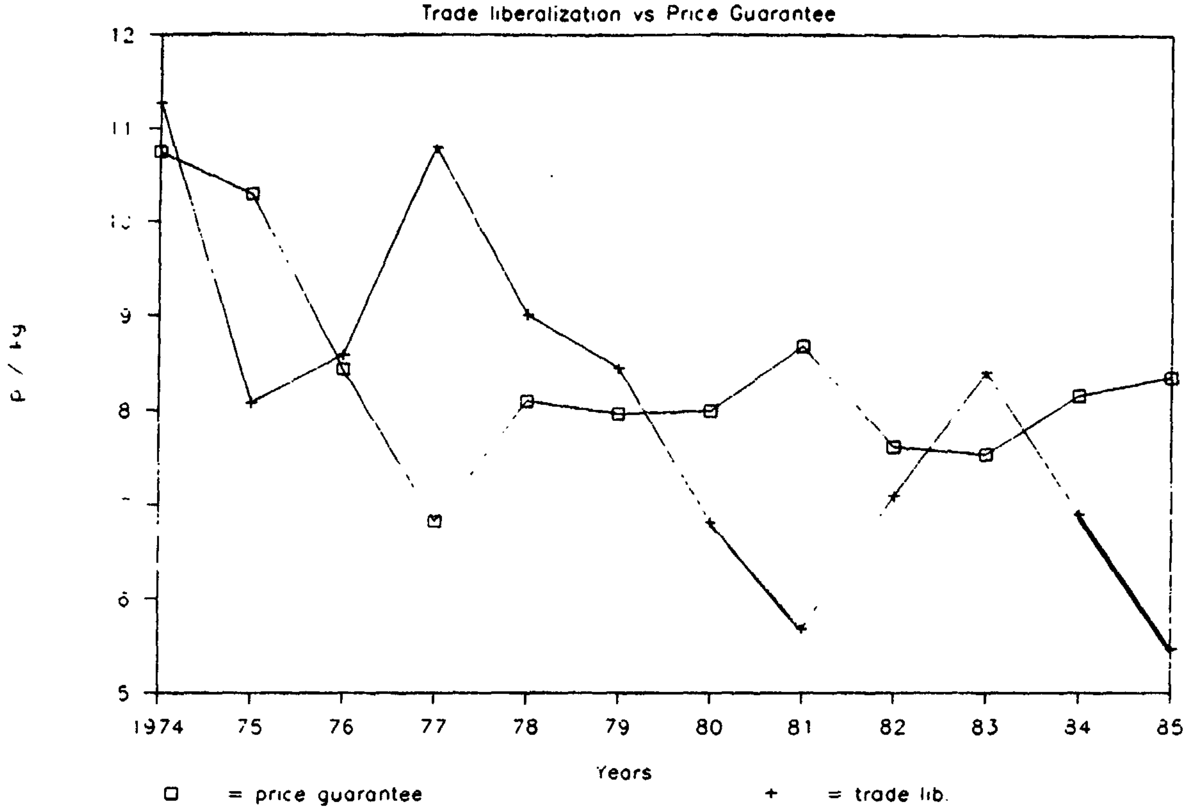


10: Gov. supply adjustment Sorghum



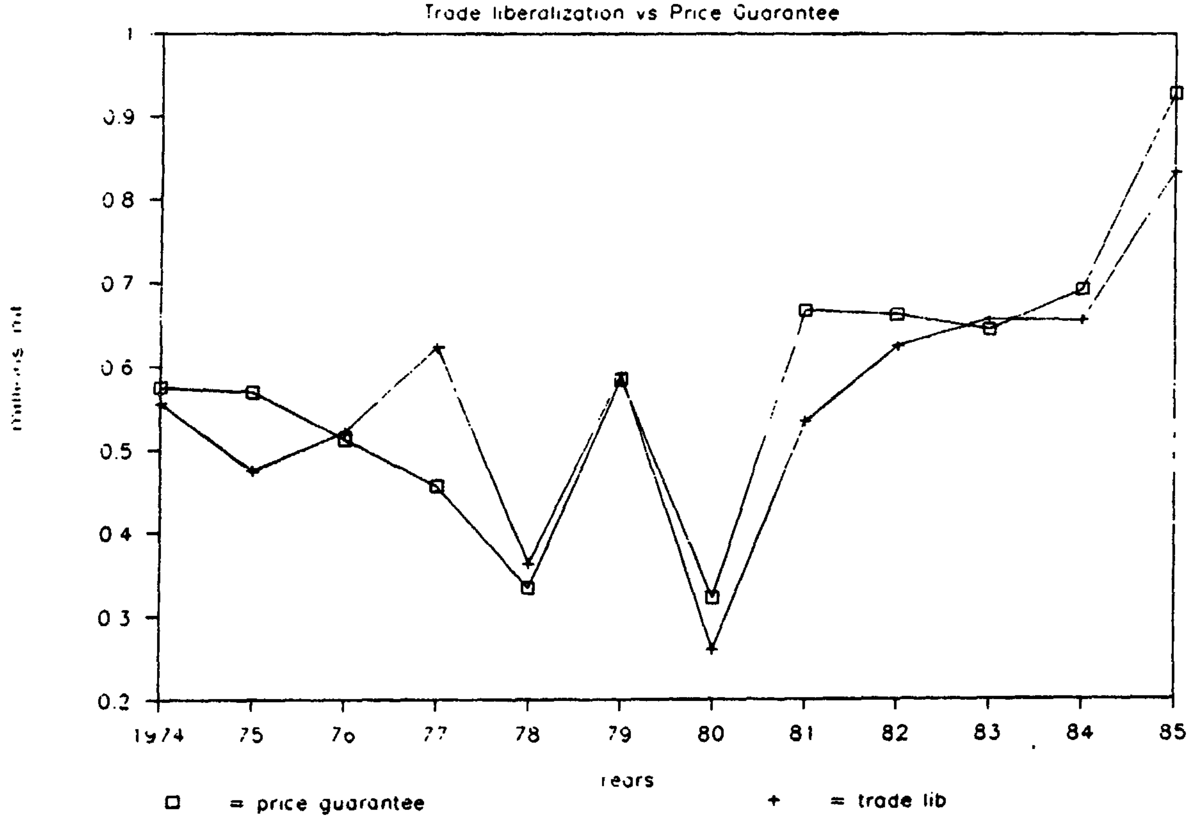
11: Price incentives Soybeans

Trade liberalization vs Price Guarantee

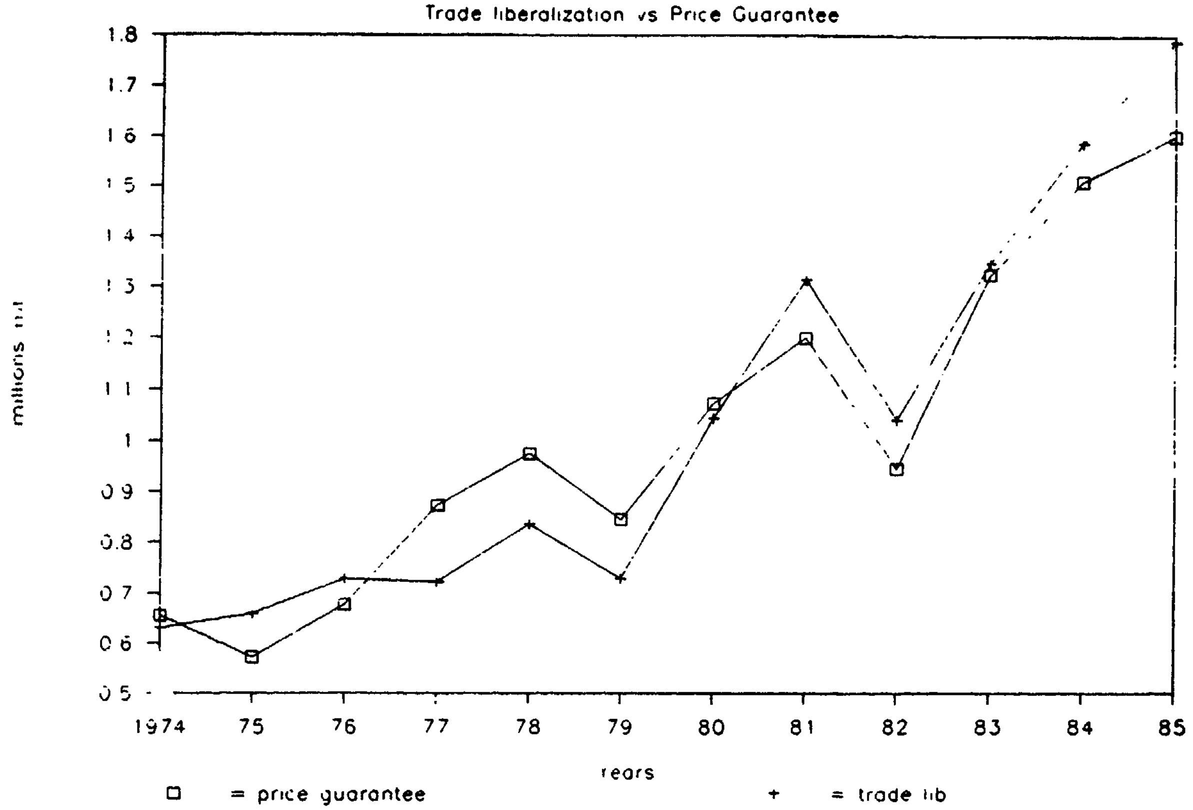


12: Production Soybeans

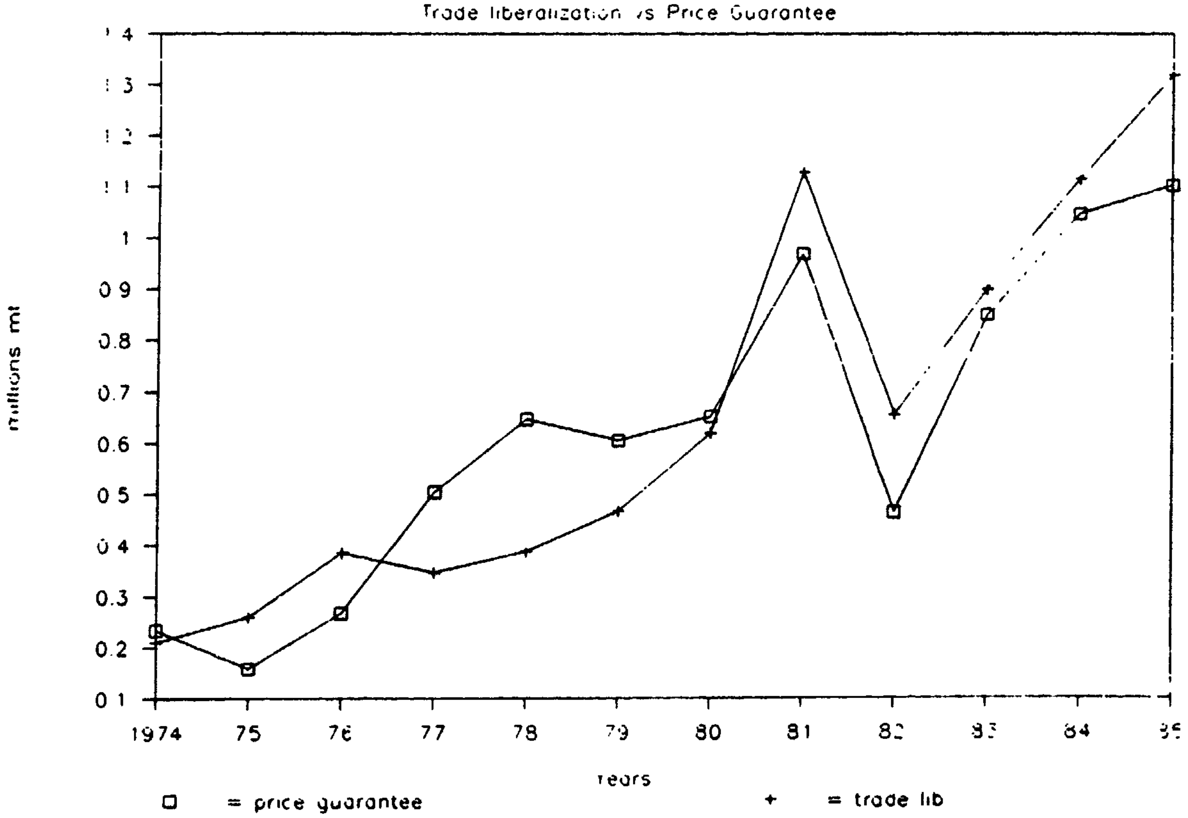
Trade liberalization vs Price Guarantee



13: Feed demand Soybeans



14: Gov. supply adjustment Soybeans



Footnotes

1. This paragraph is based largely on Villa Issa.

2. World Bank 1989a, pp. 4-5.

3. Shwedel, pg. 12.

4. Gil Diaz, pg. 255.

5. World Bank 1989b, pg. 3.

6. Gil Diaz, pg. 256.

7. World Bank 1989b, pp. 3-4.

8. World Bank 1989b, pp. 4-5.

9. Fishlow, pp. 243-44.

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Gil Diaz, F.,1985,"Changing Strategies," Chapter 9 in P.B.Musgrave, ed., op. cit.

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APPENDIX A

Parameter Estimates of MEXAGMKTS Model*

Field Crops

PRODUCTION EQUATIONS

(1) QMZ = 3824.654 + 6303.713 * RPGMZ/RPGSOR
(2.51) (7.07)

- 5212.328 * PASULF/RGPMZ
(5.59)

- 1015.144 * RA/RPGMZ - 2240.446 * DV74
(-2.17) (-3.42)

- 2819.367 * DV79 - 4638.160 * DV82
(-4.20) (-6.23)

Adjusted R-squared = 0.907 S.E.E. = 631.7
Durbin-Watson stat.= 1.55 F Statistic = 33.57

(2) QSOY = 802.286 + 23.2710 * RPGSOY/RPGSOR
(4.22) (0.38)

- 1323.960 * PASULF/RPGSOY
(-7.45)

- 203.515 * DV78
(-2.01)

- 298.593 * DV80 + 211.536 * DV85
(-2.91) (2.00)

Adjusted R-squared = 0.817 S.E.E. = 98.1
Durbin-Watson stat.= 1.79 F Statistic = 18.86

(3) QSORG = 582.334 + 1787.943 * RPGSOR/RPGMZ
(0.30) (1.24)

+ 1990.426 * RPGSOR/RPGSOY
(1.36)

*T-statistics in parenthesis

− 1796.383 * PASULF/RPGSOR − 1255.545* RA/RPGSOR + 53961.7 * RWA/RPGSOR
(−3.16) (−3.17) (3.50)

+ 1336.551 * DV81 − 3115.970 * DV83
(2.85) (−4.05)

+ 1200.843 * DV85
(3.07)

Adjusted R-squared = 0.943 S.E.E. = 319.84
Durbin-Watson stat.= 2.00 F Statistic = 41.98

APPARENT CONSUMPTION EQUATIONS

(4) LOG(PCMZ) = 4.505972 − 0.1121084 * LOG (RPPPTOR)
(62.74) (−6.02)

+ 0.1044262 * LOG (FCPI/CPI)
(0.65)

− 0.587719 * LOG (RPRCON)
(−13.57)

Adjusted R-squared = .923 S.E.E. = .02187
Durbin-Watson stat.= 0.66 F Statistic = 80.72

(5) FDMZ = 3449.993 − 36.24571 * RPGMZ
(1.35) (−0.78)

− 0.2638665 * INVPK + 0.127766 * LAYERS
(−2.00) (4.25)

− 1661.472 * DV77 − 4668.022 * DV80
(−2.36) (−6.28)

+ 3909.853 * DV83 − 2309.449 * DV84
(5.37) (−3.15)

Adjusted R-squared = 0.898 S.E.E. = 666.1
Durbin-Watson stat.= 1.56 F Statistic = 26.04

(6) CSOY = − 498.37155 − 3.758784 * RPPSOY (−1)
(−1.97) (−1.81)

+ 0.0860116 * INVPK + 0.492718 * CSOY (−1)

(5.50) (4.64)

+ 316.47655 * DV74 - 238.8793 * DV79
(3.00) (-2.58)

- 427.0929 * DV82
(4.37)

Adjusted R-squared = 0.97 S.E.E. = 89.2
Durbin-Watson stat.= 1.75 F Statistic = 102.76

(7) CSORG = - 1688.958 - 32.70934 * RPGSOR
(-2.96) (-2.75)

+ 0.112894 * LAYERS + 0.021291 * INVPL
(30.11) (5.77)

- 1811.813 * DV80 + 1416.877 * DV82
(-7.95) (5.94)

+ 456.5398 * DV84
(1.42)

Adjusted R-squared = 0.992 S.E.E. = 205.6
Durbin-Watson stat.= 2.02 F Statistic = 389.01

(8) GSADJMZ = ((PCMZ * POPMX) + FDMZ) - QMZ(-1)

(9) GSADJSOY = CSOY - QSOY (-1)

(10) GSADJSRG = CSORG - QSORG (-1)

LIVESTOCK

Inventory Equations

(11) (INVBF + 0.808656 * INVBF (-1)) = 217.90137
(2.71) (0.31)

+ 325.51426 * (RPPBIF + 0.808656 * RPPBIF (-1))
(0.42)

- 11.296258 * (RPGSOR + 0.808656 * RPGSOR (-1))
(-1.46)

- 4.3088294 * (RPGSOY + 0.808656 * RPGSOY (-1))
(-0.98)

+ 9.0227243 * (RA + 0.808656 * RA (-1))
(3.02)

+ 1.0452562 * (INVBF (-1) + 0.808656 * INVBF (-2))
(69.20)

- 8383.3127 * DV84
(-38.23)

Adjusted R-squared = 0.997 S.E.E. = 168.3
Durbin-Watson stat.= 2.56 F Statistic = 702.77

12) INVPK = 4010.862 - 8.9002 * RPGSOY
(5.39) (-2.19)

- 6.6498 * RA + 2.7197 * QPORK
(-2.17) (6.68)

+ 0.623816 * INVPK (-1)
(10.17)

Adjusted R-squared = 0.997 S.E.E. = 169.4
Durbin-Watson stat.= 2.40 F Statistic = 1626.95

(13) INVPL = 43222.701 - 6287.935 * RPPL
(13.26) (-2.57)

- 456.7551 * RPGSOR + 0.1020571 * LAYERS
(-9.08) (2.90)

+ 0.742257 * INVPL (-1) - 17677.386 * (DV74)
(26.72) (-41.55)

- 2153.751 * DV80
(-5.32)

Adjusted R-squared = 0.999 S.E.E. = 359.42
Durbin-Watson stat.= 2.38 F Statistic = 3150.2

(14) LAYERS = 63757.046 - 133265.8 * RRPEGG
(2.23) (-2.27)

+ 110.4371 * RPGSOR + 104.1838 * RA
(0.32) (0.85)

+ 0.447476 * LAYERS (-1)
(2.16)

+ 10881.124 * DV85
(1.58)

Adjusted R-squared = 0.901 S.E.E. = 6451.0
Durbin-Watson stat.= 2.47 F Statistic = 35.47

PRODUCTION EQUATIONS

(15) QBEEF = 340.58839 + 1142.3021 * RPPBIF
(0.67) (1.11)

− 2.563302 * RPGSOY − 11.393876 * RPGSOR
(−0.51) (−1.06)

− 0.4928845 * QBEEF (−1) + 317.40623 * DV750N
(1.81) (1.99)

Adjusted R-squared = 0.884 S.E.E. = 109.43
Durbin-Watson stat.= 2.44 F Statistic = 30.01

(16) QPORK = − 1093.3987 + 79.70103 * RPPPK (−1)
(−6.82) (0.50)

− 0.0179536 * RPGSOR
(−0.01)

+ 0.11130400 * INVPK + 130.3309 * RWA + 220.95487 * DV720N
(25.14) (2.21) (7.10)

Adjusted R-squared = 0.995 S.E.E. = 32.118
Durbin-Watson stat.= 1.02 F. Statistic = 806.35

(17) QPOUL = −216.35777 + 110.00079 * RPPL
(−2.58) (1.93)

−.12573382 * RPGMZ − .88108621 * RPGSOR
(−0.16) (−1.00)

−.0005243469 * INVPL (−1) + 30.729323 * TIME
(−3.57) (18.00)

Adjusted R-squared = .992 S.E.E. = 10473.8
Durbin-Watson stat.= 2.29 F Statistic = 330.47

(18) QEGG = − 5659.5696 + 3619.5390 * RRPEGG
(−1.10) (0.61)

− 2785.3064 * RWA + 3740.6202 * LOG (TIME)
(−2.32) (2.61)

+ 0.5648 * QEGG (-1) + 0.04344 * LAYERS (-1)
(2.68) (1.19)

- 1286.1825 * DV83
(-2.22)

Adjusted R-squared = .983 S.E.E. = 489.08
Durbin-Watson stat.= 2.13 F Statistic = 190.98

(19) QMILK = 1449.0987 + 4361.1022 * RRPMLK (-1)
(2.48) (1.03)

- 500.3579 * RPPBIF (-1) - 3.825378 * RPGSOY
(-1.32) (-1.21)

- 4.082516 * RPGSOR + 0.690960 * QMILK (-1)
(-0.52) (14.83)

+ 930.72136 * DV72ON
(5.78)

Adjusted R-squared = 0.992 S.E.E. = 120.57
Durbin-Watson stat. = 2.22 F Statistic = 339.60

APPARENT CONSUMPTION EQUATIONS

(20) PCBEEF = - 5.307912 - 2.204489 * RPPBIF + 7.437456 * FCPI/CPI
(-0.81) (-2.76) (1.40)

+ 33.796285 * RPRCON + 4.27162 * DV75ON + 2.3460114 * DV82
(3.79) (9.04) (3.80)

Adjusted R-squared = 0.971 S.E.E. = .476039
Durbin-Watson stat.= 2.05 F Statistic = 86.76

21) PCPORK = 15.43536 - 2.2501471 * RRPPK
(2.48) (-1.00)

+ 0.582376 * RRPBIF - 19.090772 * FCPI/CPI
(0.33) (-3.28)

+ 26.127416 * RPRCON + 0.508653 * PCPORK (-1)
(2.27) (6.08)

+ 4.543265 * DV72ON
(6.51)

Adjusted R-squared = 0.986 S.E.E. = 0.673739
Durbin-Watson stat. = 1.90 F Statistic = 229.86

PCPOUL = - 9.777559
(-2.09)

22) - 1.384054 * RPPL + 28.19108 * RPRCON
(-1.27) (5.17)

+ 5.742136 * FCPI/CPI + 1.896671 * DV8385
(2.01) (5.60)

Adjusted R-squared = 0.953 S.E.E. = 21026
Durbin-Watson stat. = 2.18 F Statistic = 61.78

(23) PCMILK = 68.06657 - 246.4123 * RRPMLK
(0.96) (-1.42)

+ 9.788775 * FCPI/CPI + 87.38052 * RPRCON
(0.19) (1.63)

+ 17.2685 * DV72ON + 7.114482 * DV74
(3.85) (1.22)

+ 14.509293 * DV80
(2.85)

Adjusted R-squared = 0.915 S.E.E. = 4.4837
Durbin-Watson stat. = 1.57 F Statistic = 35.05

(24) PCEGG = -33.781311 - 199.3879 * RRPEGG + 174.7206 * FCPI/CPI
(-0.43) (-3.66) (2.94)

+ 13.9487 * RPRCON + 0.603033 * PCEGG (-1) - 45.7619 * RPPL
(0.16) (3.86) (-1.49)

- 14.55626 * DV7783 + 21.54716 * DV80
(-3.32) (3.65)

Adjusted R-squared = 0.978 S.E.E = 4.0184
Durbin-Watson stat.= 2.99 F Statistic = 75.7083

NET EXPORTS EQUATION

(25) NEXBF = 435.6774
(5.80)

+ 5.34345 * BFPUS - 0.0080932 * TCWUS
(3.86) (-6.52)

- 78.069355 * DV79ON
(-9.04)

Adjusted R-squared = 0.893   S.E.E. = 12.753
Durbin-Watson stat. = 2.45   F Statistic = 45.58

PRICE RELATIONSHIP EQUATIONS

(26) RRPBIF = 0.431475
(6.13)

+ 0.860271 * RPPBIF + 0.105955 * DV7982
(6.10) (3.38)

+ 0.384182 * DV79 - 0.35843 * DV8286
(5.44) (-12.92)

Adjusted R-squared = 0.92   S.E.E. = .04925
Durbin-Watson stat. = 1.80   F Statistic = 70.36

(27) RRPPK = - 0.041131 + 0.76637 * RPPPK
(-0.39) (4.25)

+ 0.5864828 * RRPPK (-1) + 0.3421 * DV81
(7.99) (7.89)

- 0.158332 * DV8286
(-6.58)

Adjusted R-squared = 0.945   S.E.E. = .0385
Durbin-Watson stat. = 2.30   F Statistic = 100.09

(28) (RPTOR + 0.5973 * RPTOR (-1)) = 0.7759813
(2.70) (.09)

+ 1.136192 * (RPGMZ + 0.5973 * RPGMZ (-1))
(5.94)

+ 17.84001 * (DV7677 + 0.5973 * DV7677 (-1))
(7.08)

- 22.051494 * (DV830N + 0.5973 * DV830N (-1))
(-10.77)

- 10.36614 * (DV8082 + 0.5973 * DV8082 (-1))
(-5.28)

Adjusted R-squared = 0.887   S.E.E. = 4.3587
Durbin-Watson stat. = 2.59   F-statistic = 30.82

MARKET CLEARING EQUATIONS

(29) QBEEF = (PCBIF * POPMX) + NEXBF

(30) QPORK = (PCPRK * POPMX)

(31) QPOUL = (PCPL * POPMX) * 1000

(32) QEGG = (PCEGG * POPMX)

(33) QMILK = (PCMILK * POPMX) / .947 - IMMLK

DEFINITION OF VARIABLES

A. Endogenous Variables

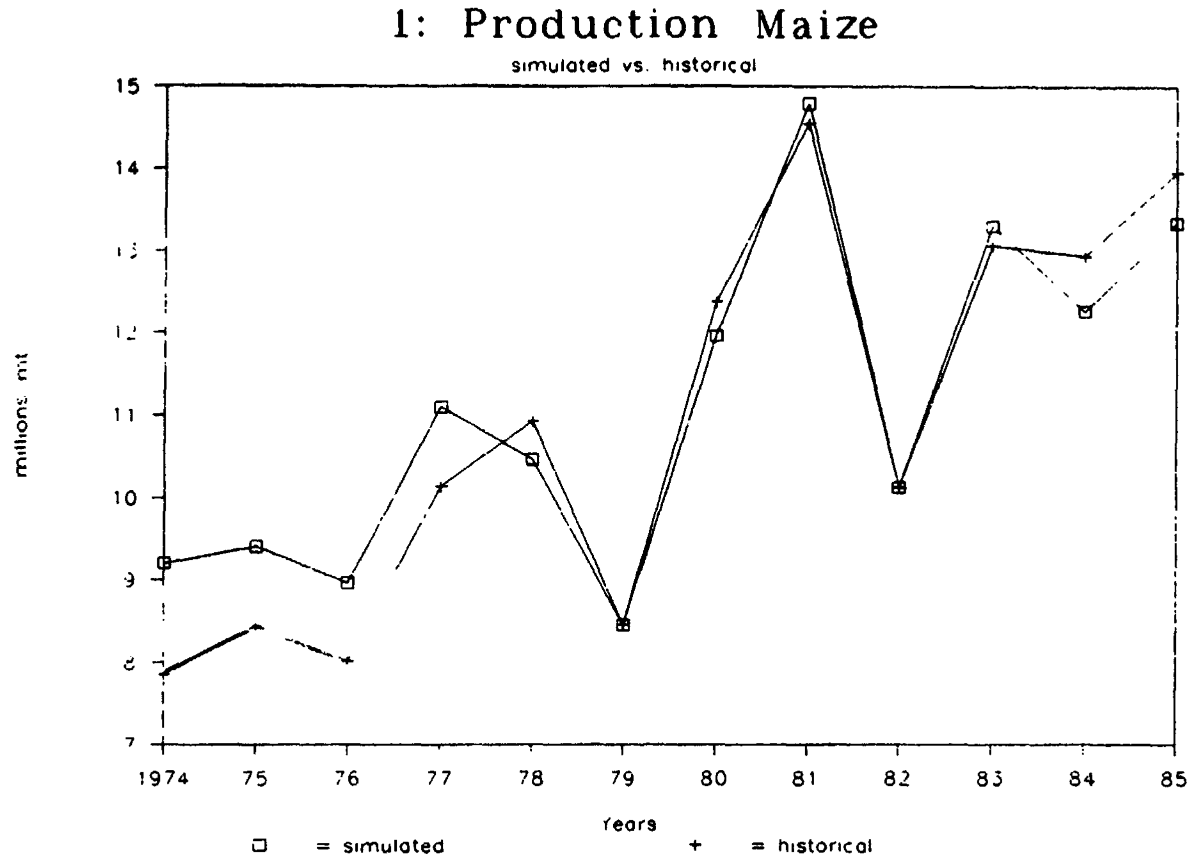
QMZ = Maize Production, 1000 mt.
QSOY = Soybean Production, 1000 mt.
QSORG = Sorghum Production, 1000 mt.
FDMZ = Maize Feed Use, 1000 mt.
PCMZ = Per capita food use of maize (kg/person)
CSORG = Sorghum apparent consumption, 1000 mt.
CSOY = Soybeans apparent consumption, 1000 mt.
GSADJMZ = Govt supply adjustment, maize, 1000 mt.
GSADJSOY = Govt supply adjustment, soybeans, 1000 mt.
GSADJSRG = Govt supply adjustment, sorghum, 1000 mt.
INVBF = Inventory of Beef cattle, 1000 head.
INVPL = Inventory of Hogs, 1000 head.
LAYERS = Inventory of Layers, 1000 head.
INVPL = Inventory of Broilers, 1000 head.
QBEEF = Beef production, 1000 mt.
QPORK = Pork production, 1000 mt.
QPOUL = Poultry production, 1000 mt.
QEGG = Eggs production, million eggs
QMILK = Milk production, 1000 mt.
PCBEEF = Per capita apparent consumption of beef, kg/person.
PCPORK = Per capita apparent consumption of pork, kg/person.
PCPOUL = Per capita apparent consumption of poultry, kg/person.
PCEGG = Per capita apparent consumption of eggs, eggs/person.
PCMILK = Per capita apparent consumption of milk, liters/person.
NEXBF = Net exports of beef, 1000 mt.
RPPBIF = Beef producer price, deflated by WPI, 100 pesos/kg.
RRPBIF = Beef consumer price, deflated by CPI, 100 pesos/kg.
RPPPRK = Pork producer price, deflated by WPI, 100 pesos/kg.
RRPPK = Pork consumer price, deflated by CPI, 100 pesos/kg.
RPPL = Poultry consumer price, deflated by CPI, 100 pesos/kg.
RRPEGG = Egg consumer price, deflated by CPI, pesos/egg.
RRPMLK = Milk consumer price, deflated by CPI, 100 pesos/liter.
RPTOR = Tortilla price, deflated by CPI, .1 pesos/kg.

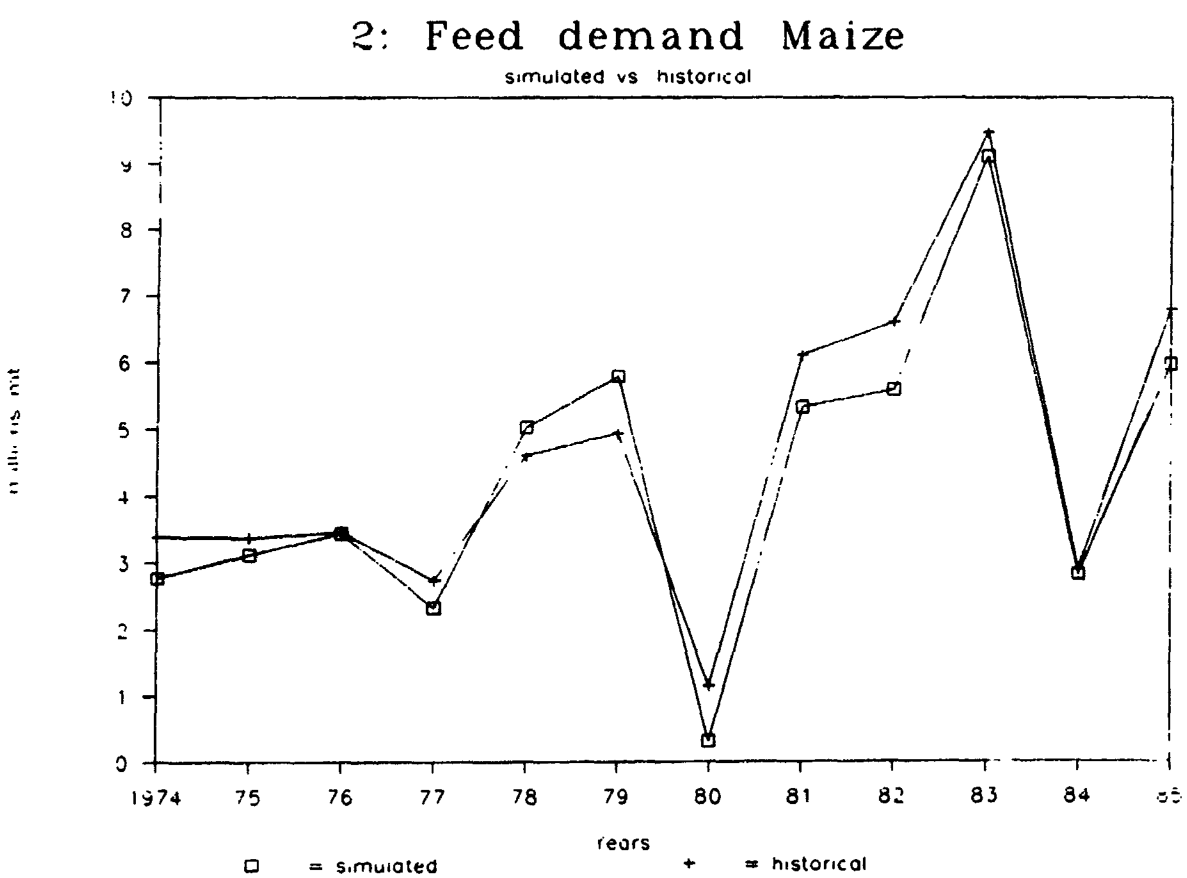
B. <u>Exogenous Variables</u>

RPGMZ	=	Maize guarantee price, deflated by WPI, 100 pesos/mt.
RPGSOR	=	Sorghum guarantee price, deflated by WPI,100 peso/mt.
RPGSOY	=	Soybeans guarantee price, deflated by WPI, 100 pesos/mt.
PASULF	=	Producer price of amonium sulfate, deflated by WPI, 100 pesos/mt
RWA	=	Reak wage rate, deflated by WPI, 100 pesos/day.
RA	=	Real interest rate, percent.
FCPI	=	Food consumer price index, 1980 = 100.
RPRCON	=	Per capita private consumption, deflated by CPI 10,000 pesos/person.
BFPUS	=	Slaughter beef price, US, in pesos, deflated by WPI, 100 pesos/mt.
TCWUS	=	Beef cow inventory in the USA, 1000 head.
MMLK	=	Net imports of milk (fluid milk equi), 1000 mt.
POPMX	=	Population of Mexico, million people.
WPI	=	Wholesale price index, 1980 = 100.
CPI	=	Consumer price index, 1980 = 100.
EXMEX	=	Mexico peso US dollar exchange rate.
DV74	=	Dummy variable; 1974=1 other years = 0
DV79	=	" " 1979=1, " "
DV82	=	" " 1982=1, " "
DV78	=	" " 1978=1, " "
DV81	=	" " 1981=1, " "
DV80	=	" " 1980-1, " "
DV85	=	" " 1985=1, " "
DV83	=	" " 1983=1, " "
DV77	=	" " 1977=1, " "
DV84	=	" " 1984=1, " "
DV720N	=	" " 19720N=1, " "
DV740N	=	" " 19740N=1, " "
DV790N	=	" " 19790N=1 " "
DV8286	=	" " 1982-86=1," "
DV8082	=	" " 1980-82=1," "
DV830N	=	" " 1930N=1, " "
DV7677	=	" " 1976-77=1," "
DV750N	=	" " 19750N=1, " "
DV8385	=	" " 1983-85=1 " "
DV7783	=	" " 1977-83=1," "
DV7982	=	" " 1979-82=1," "

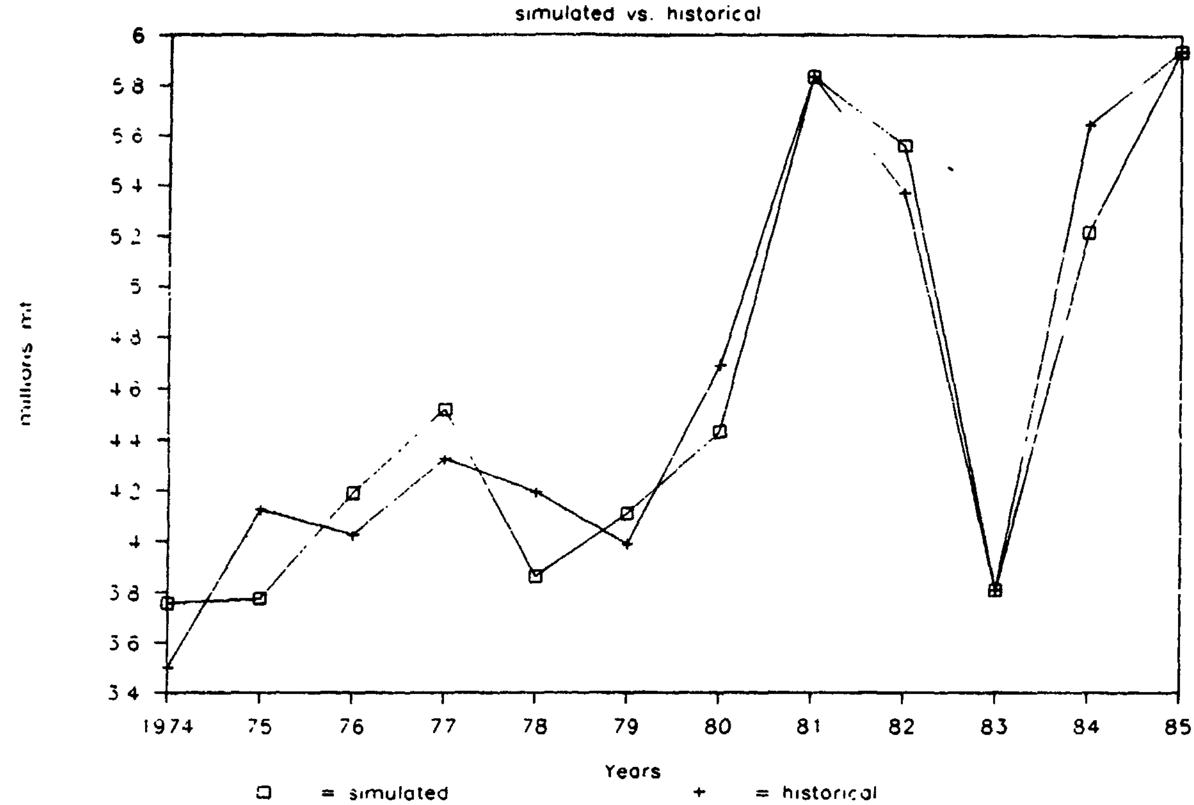
APPENDIX B

Graphical Presentation of Validation Test of MEXAGMKT

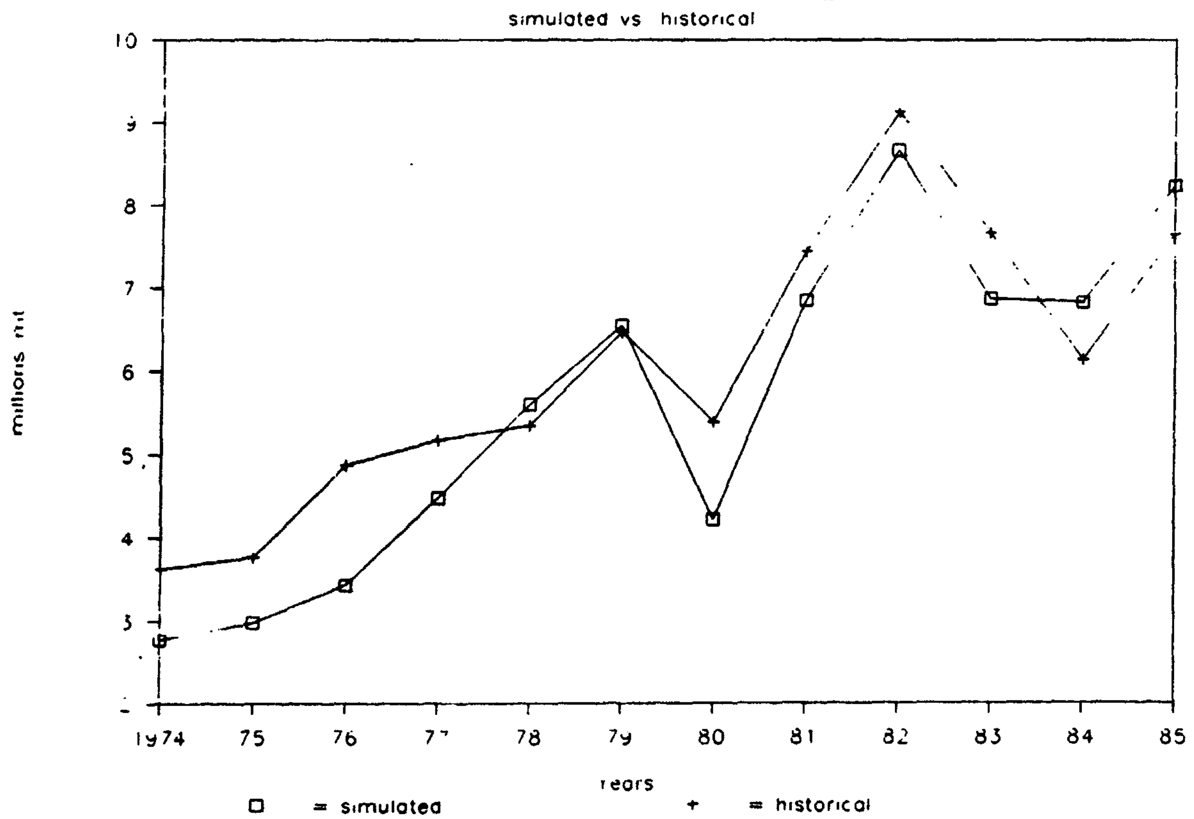

1: Production Maize
simulated vs. historical
millions mt
15
14
13
12
11
10
9
8
7
1974
75
76
77
78
79
80
81
82
83
84
85
Years
□ = simulated
+ = historical


2: Feed demand Maize
simulated vs historical
10
9
8
7
6
5
4
3
2
1
0
1974
75
76
77
78
79
80
81
82
83
84
Years
□ = simulated
+ = historical

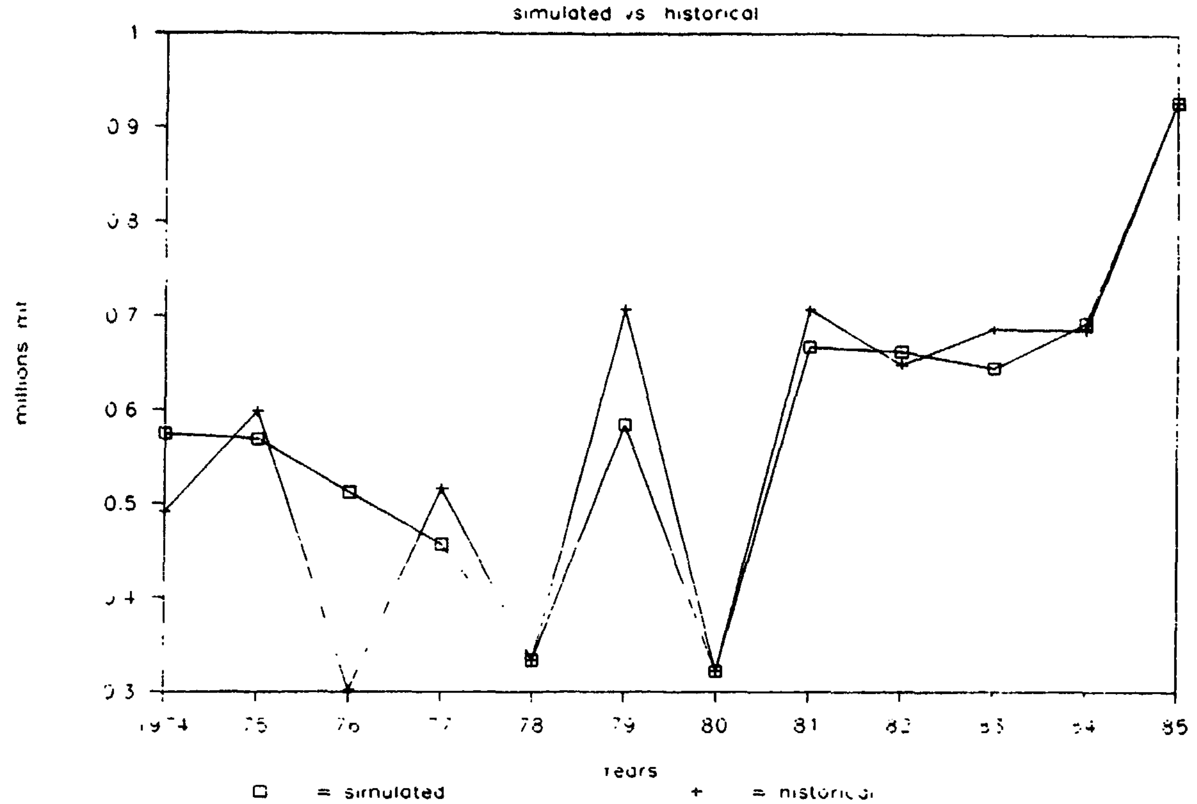
3: Production Sorghum



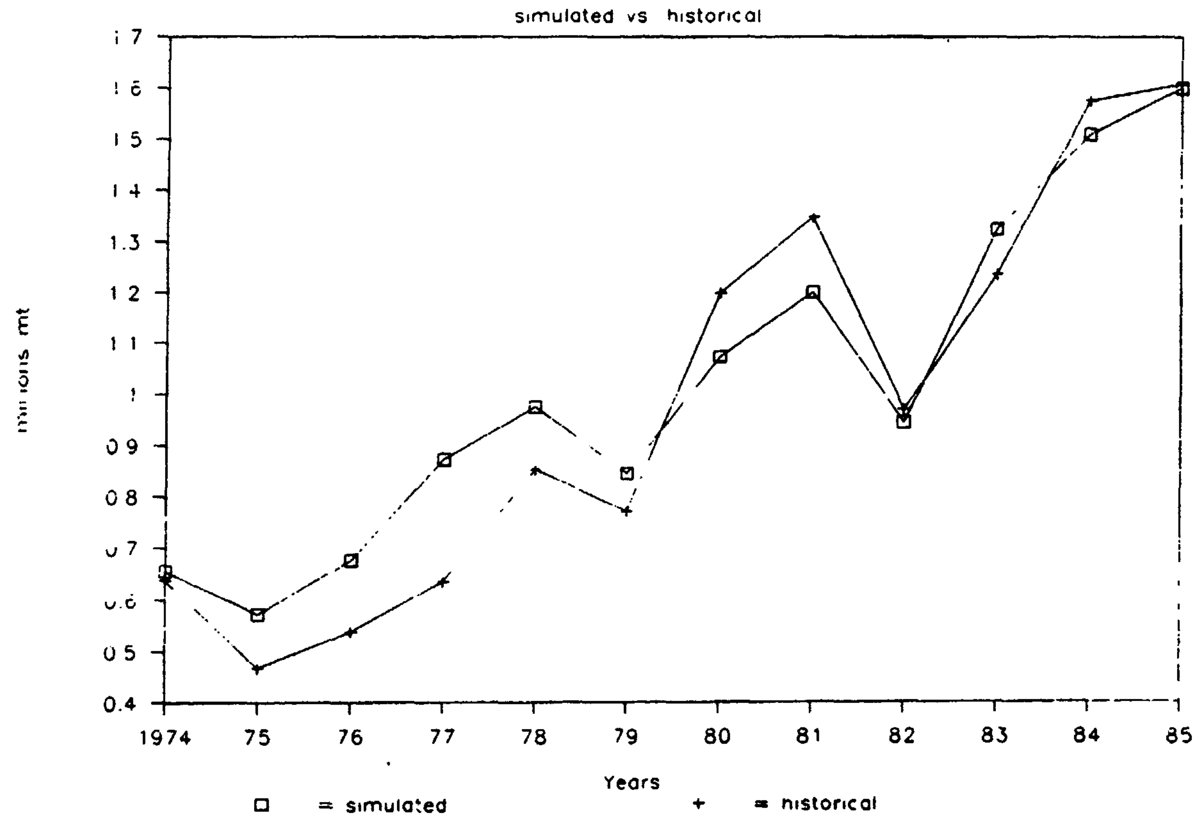
4: Feed demand Sorghum



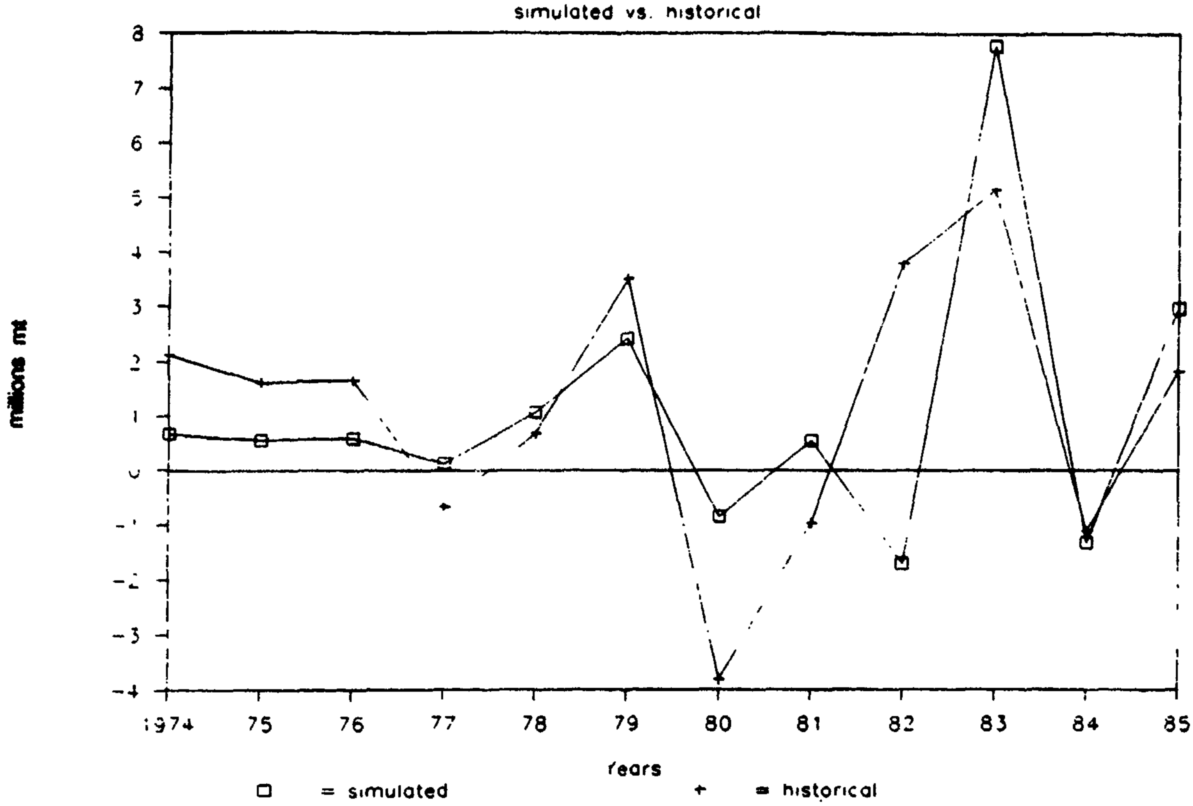
5: Production Soybeans



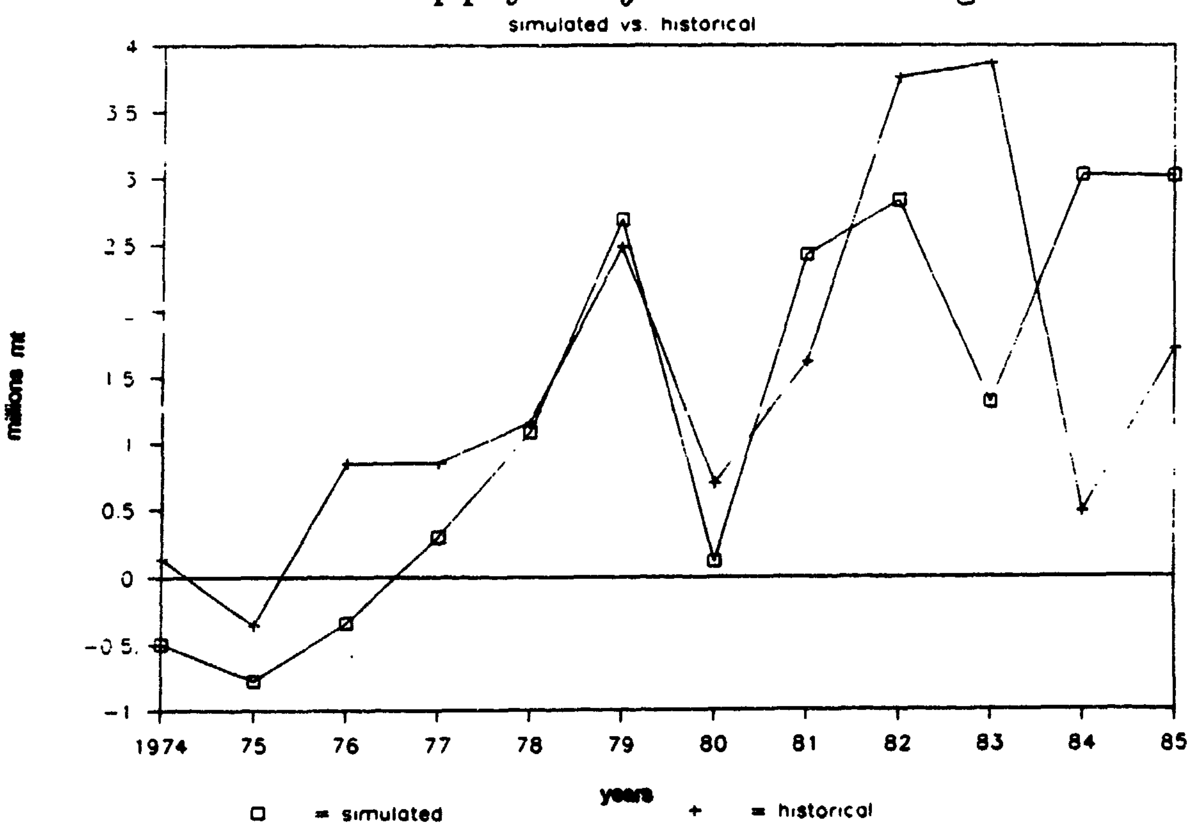
6: Feed demand Soybeans



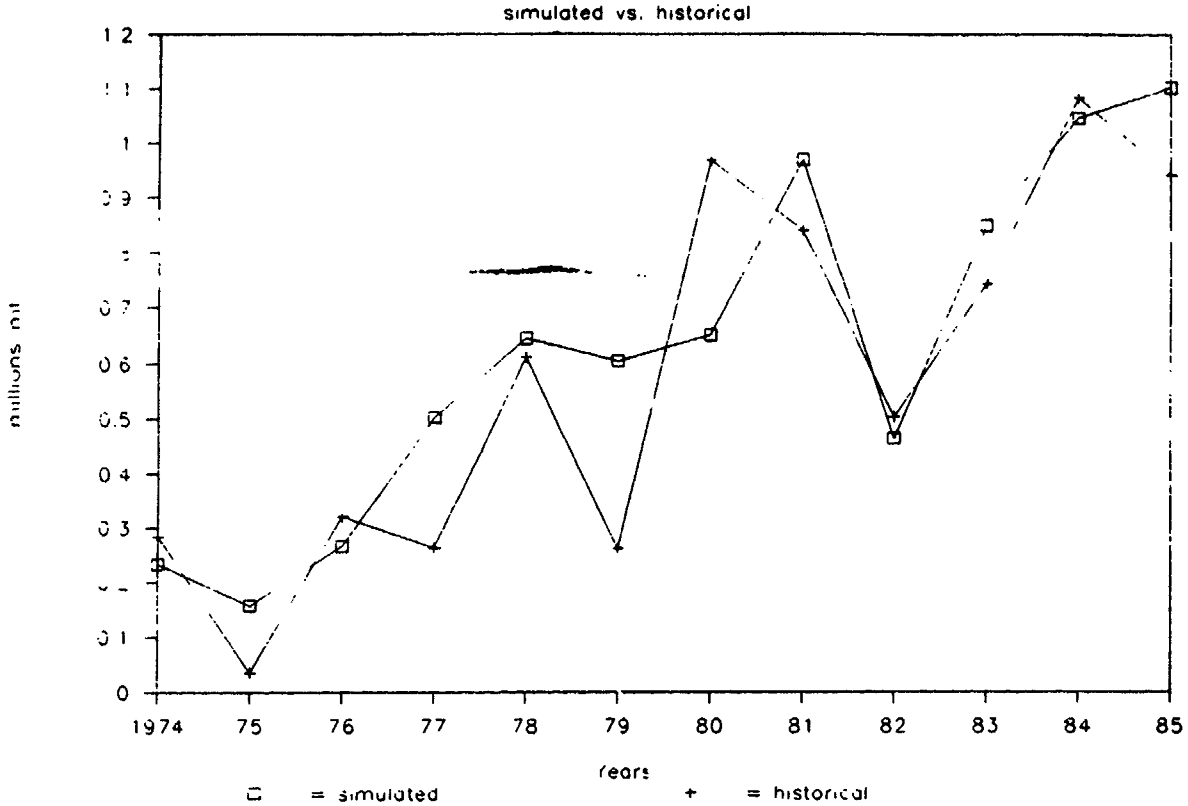
7: Gov. supply adjus.ment Maize



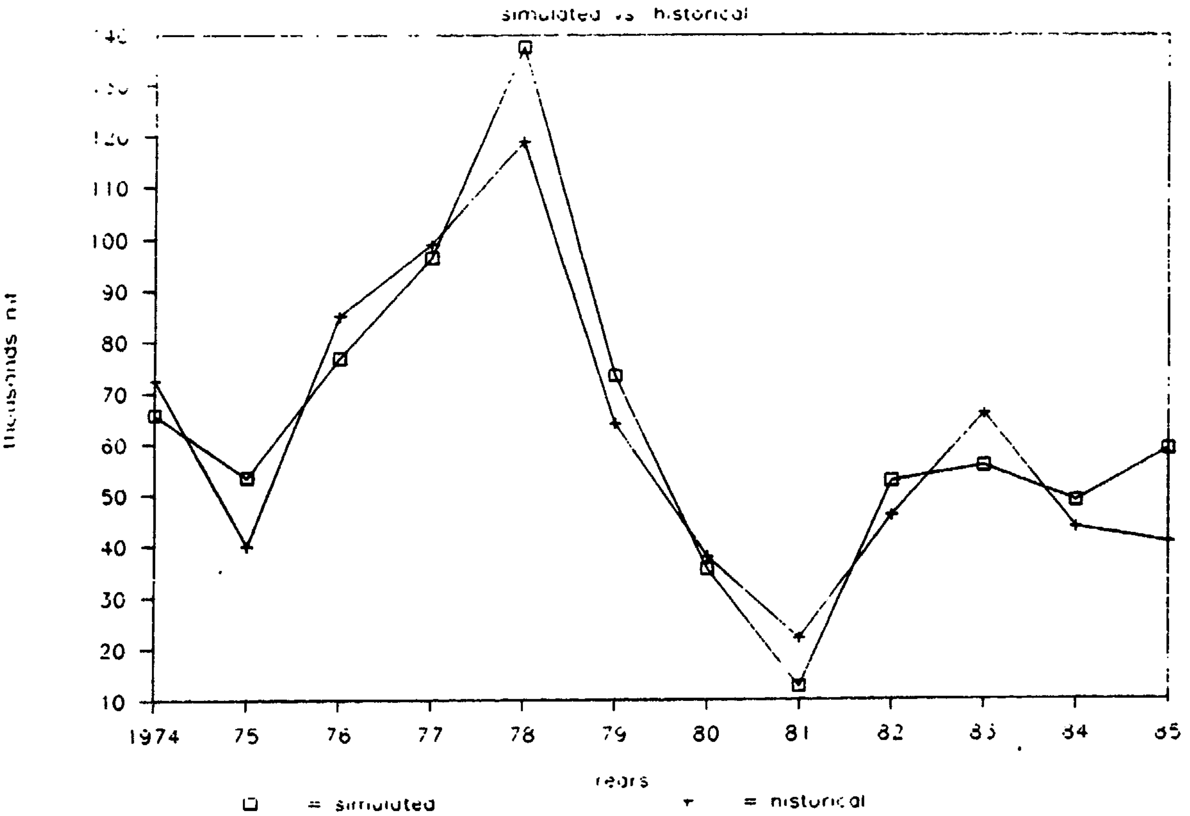
8: Gov. supply adjustment Sorghum



9: Gov. supply adjustment Soybeans

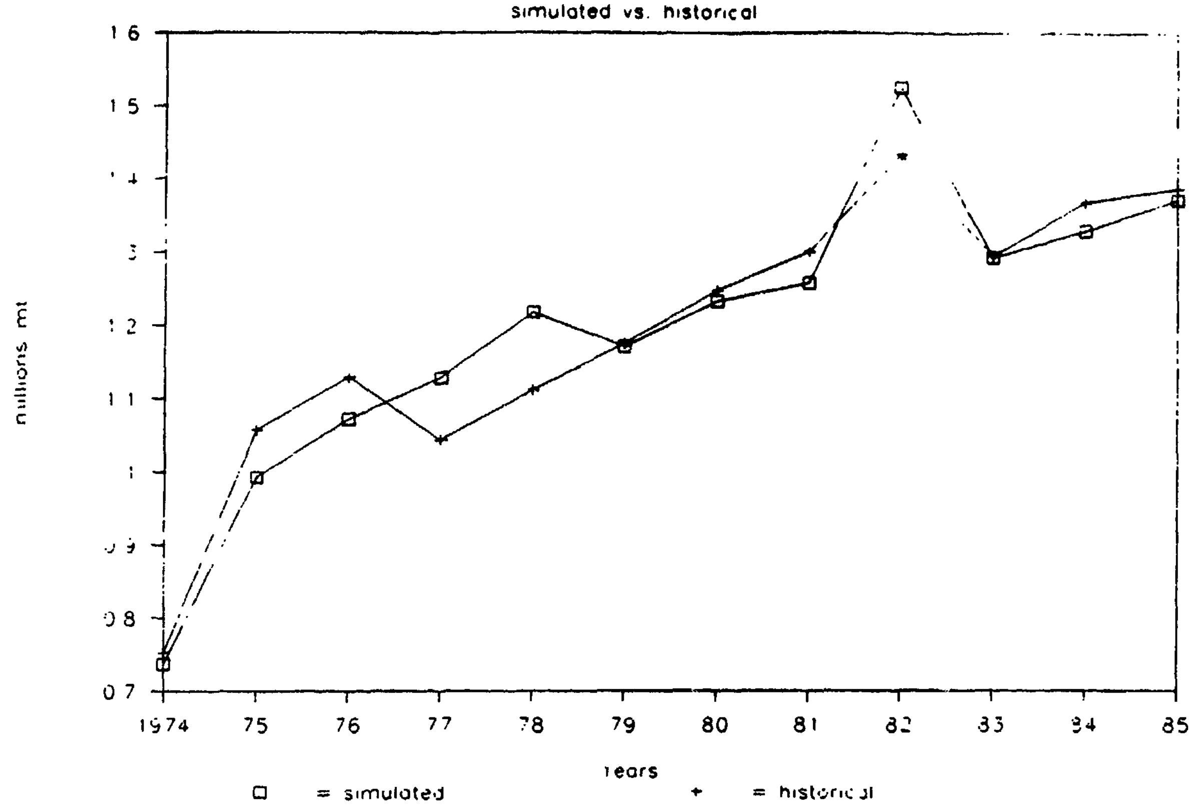


10: Exports Beef



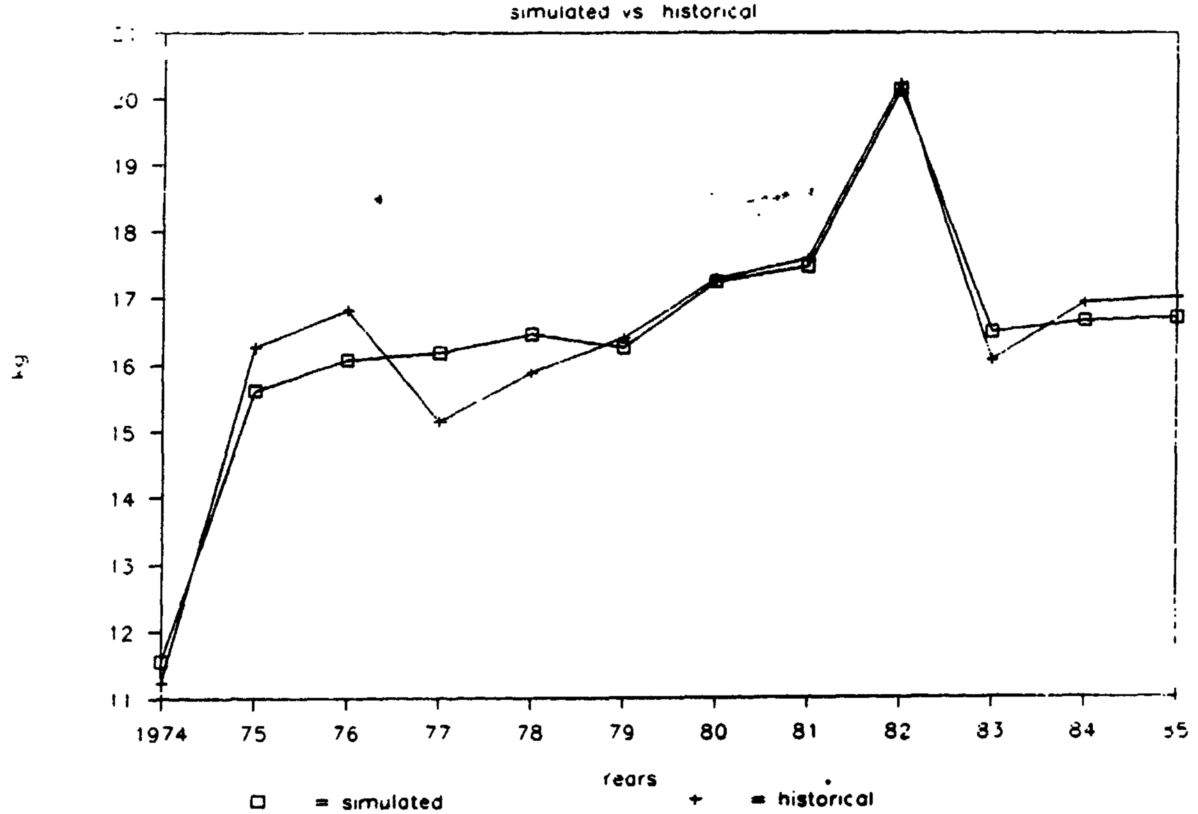
11: Production Beef

simulated vs. historical

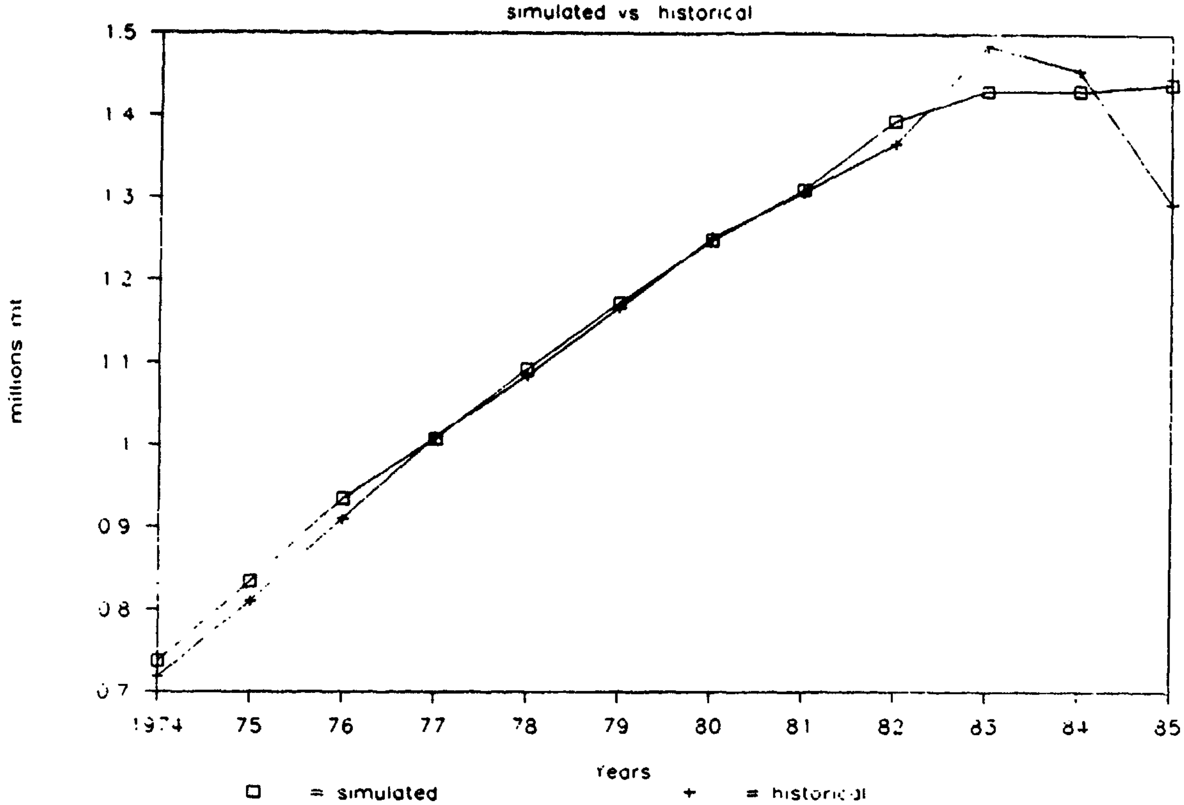


12: Per capita consumption Beef

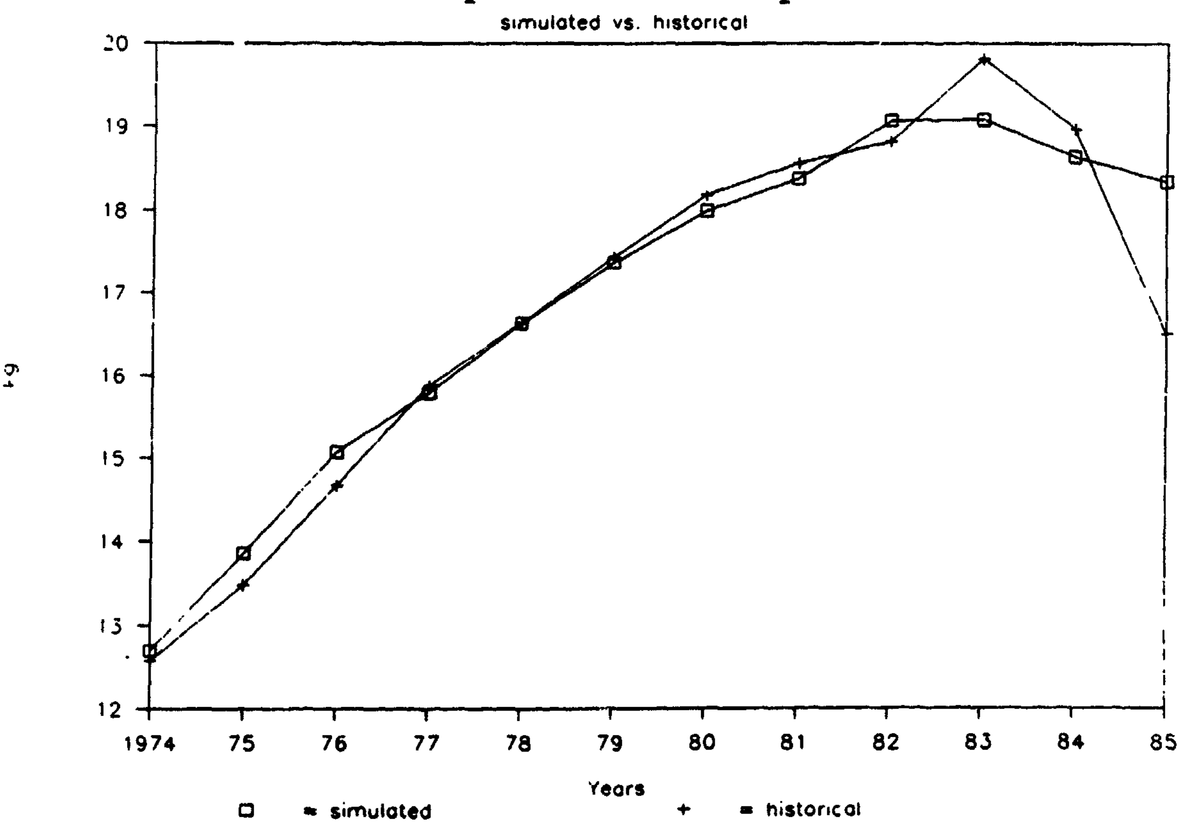
simulated vs historical



13: Production Pork

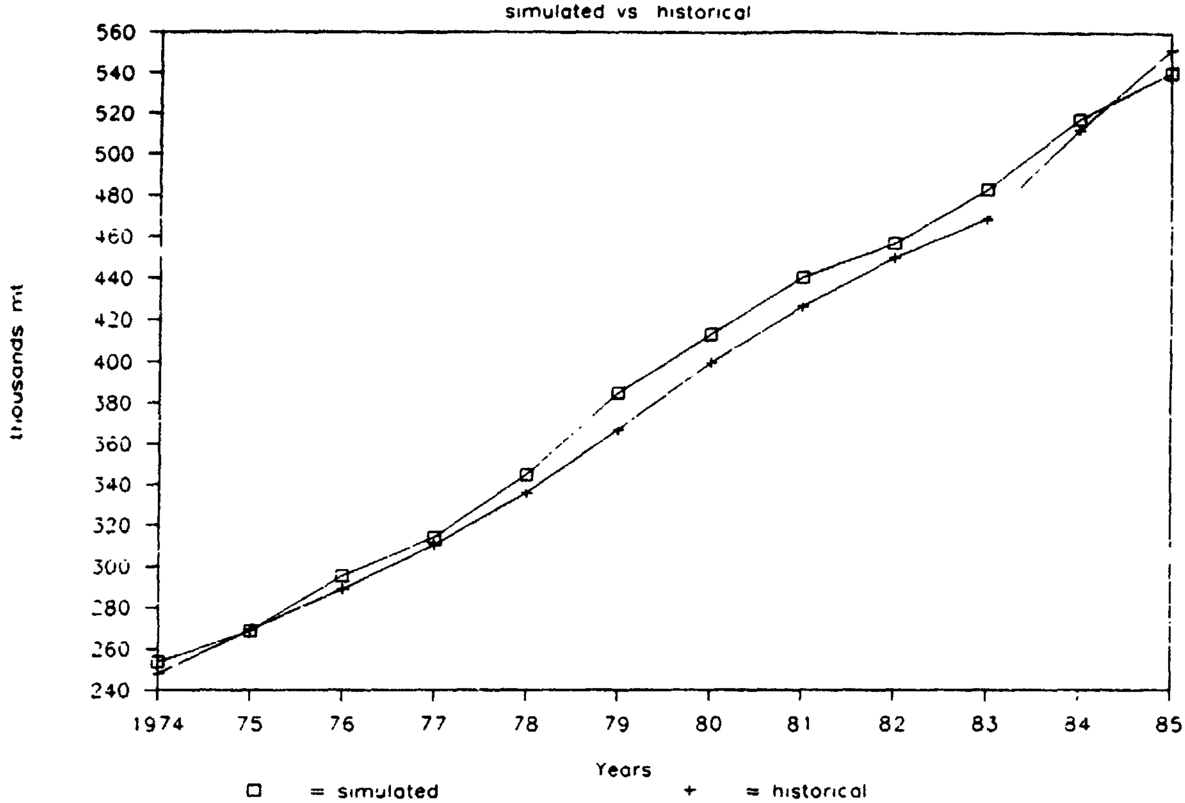


14: Per capita consumption Pork



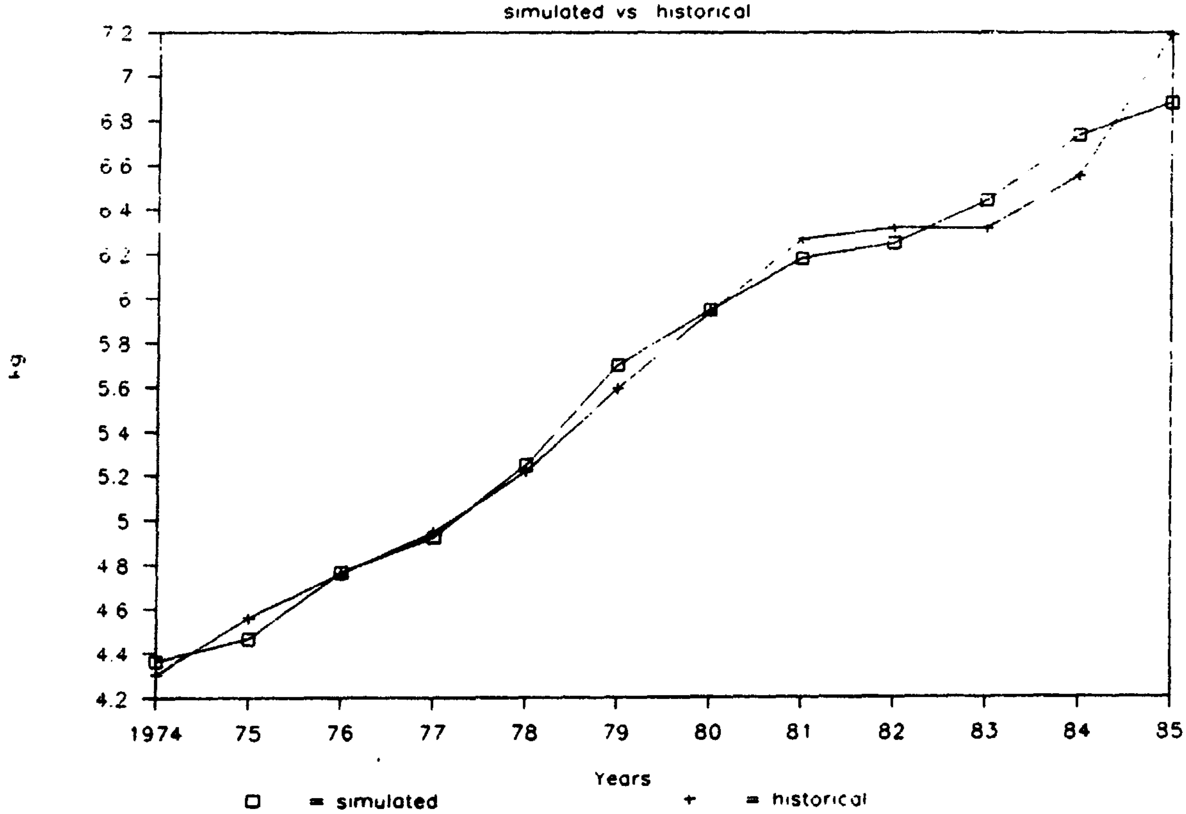
15: Production Poultry

simulated vs historical



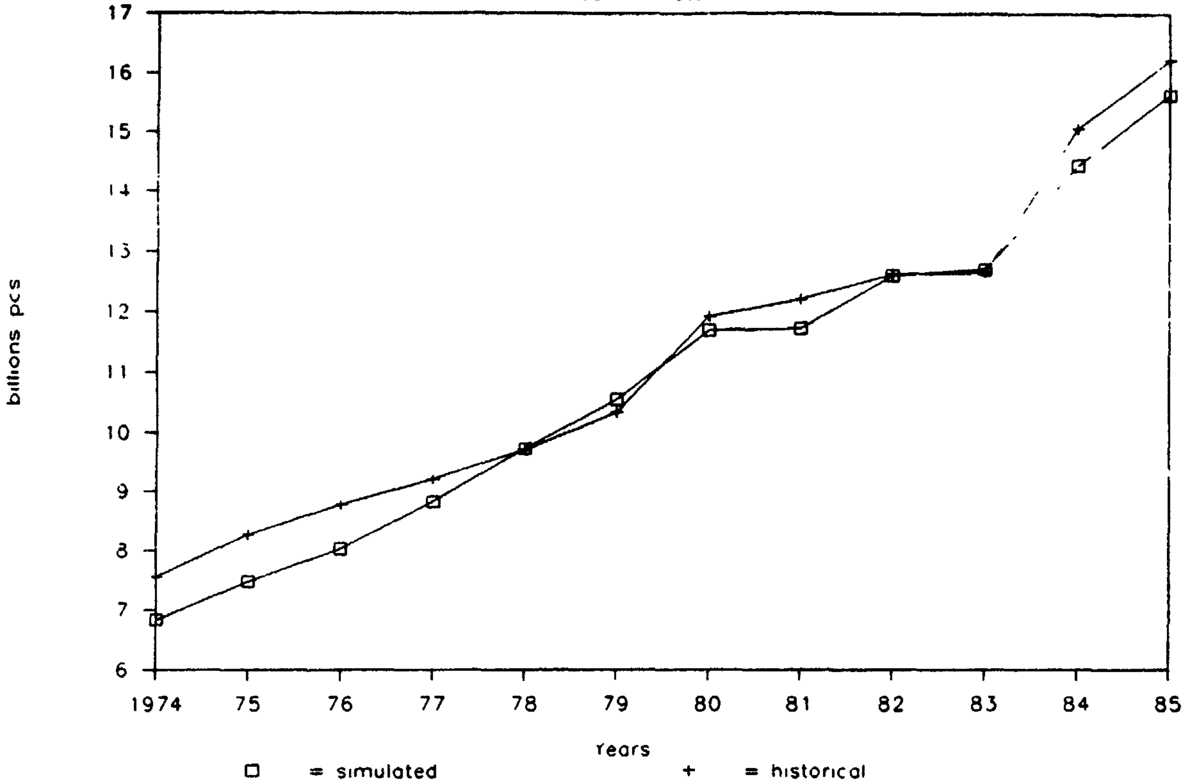
16: Per capita consumption Poultry

simulated vs historical



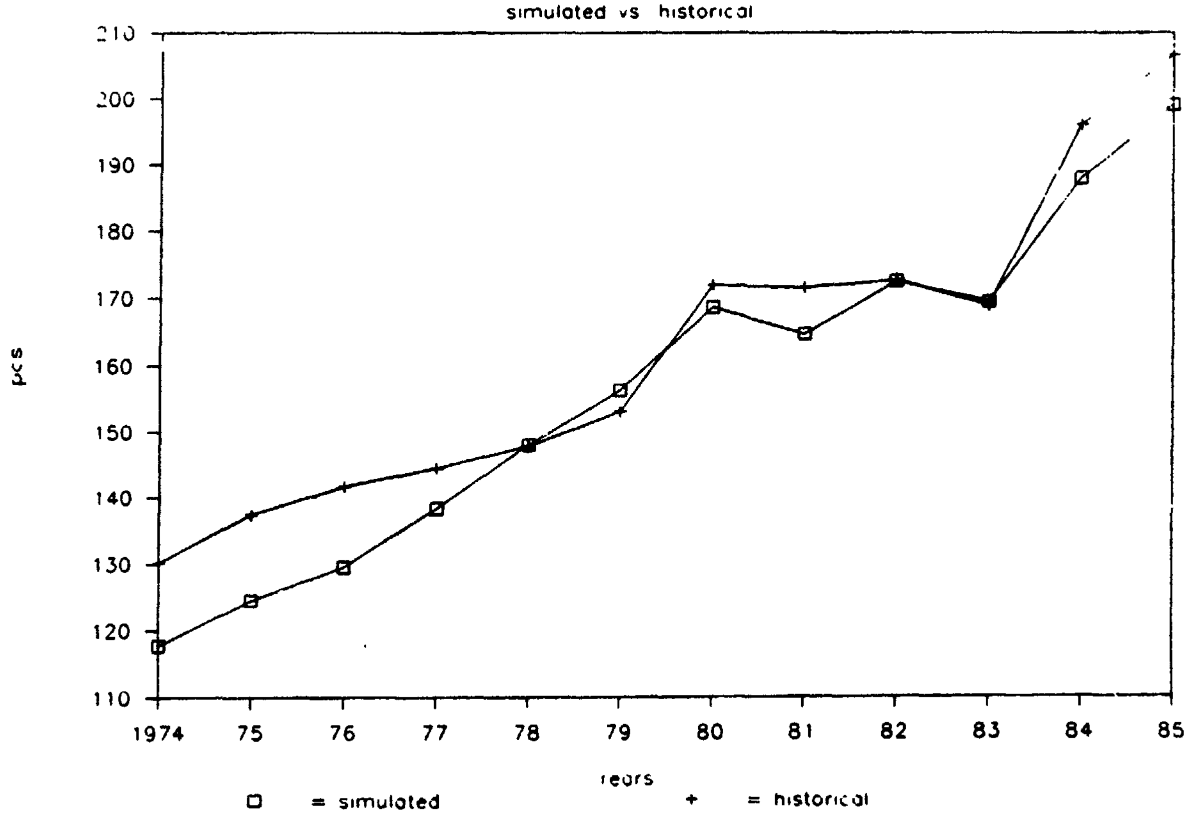
17: Production Eggs

simulated vs. historical



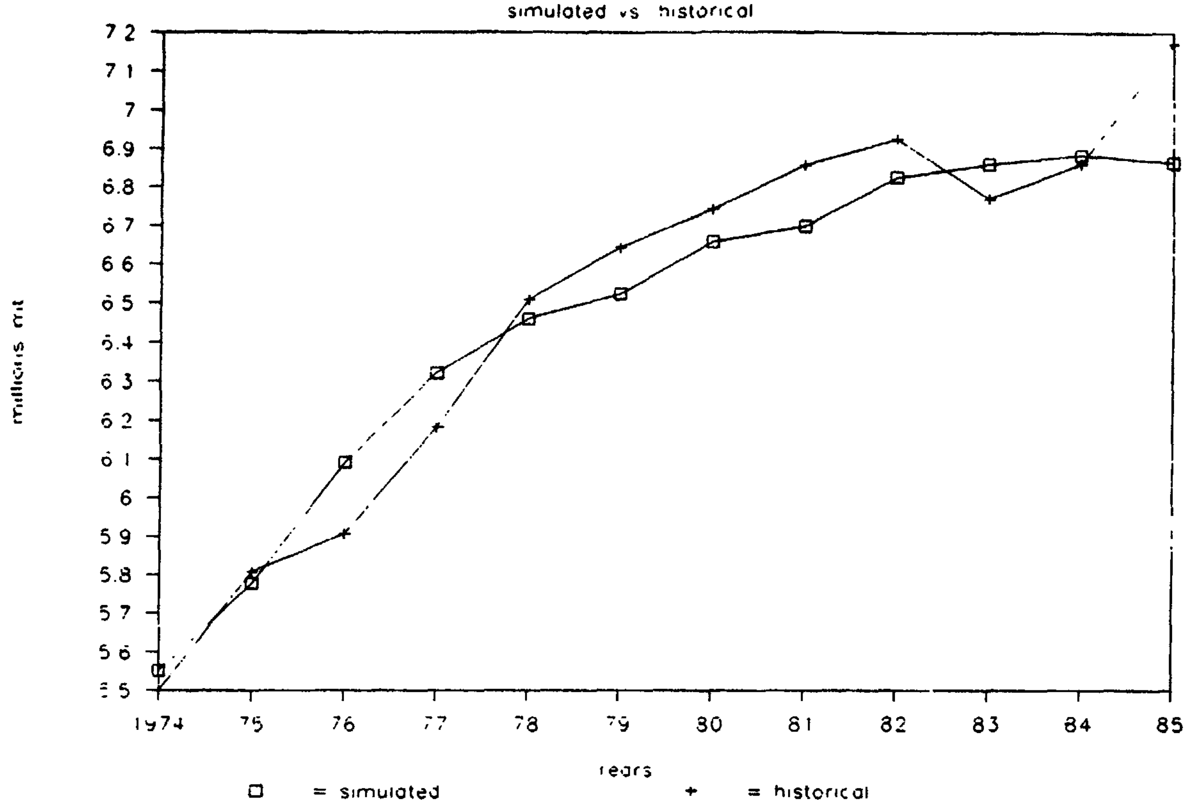
18: Per capita consumption Eggs

simulated vs historical



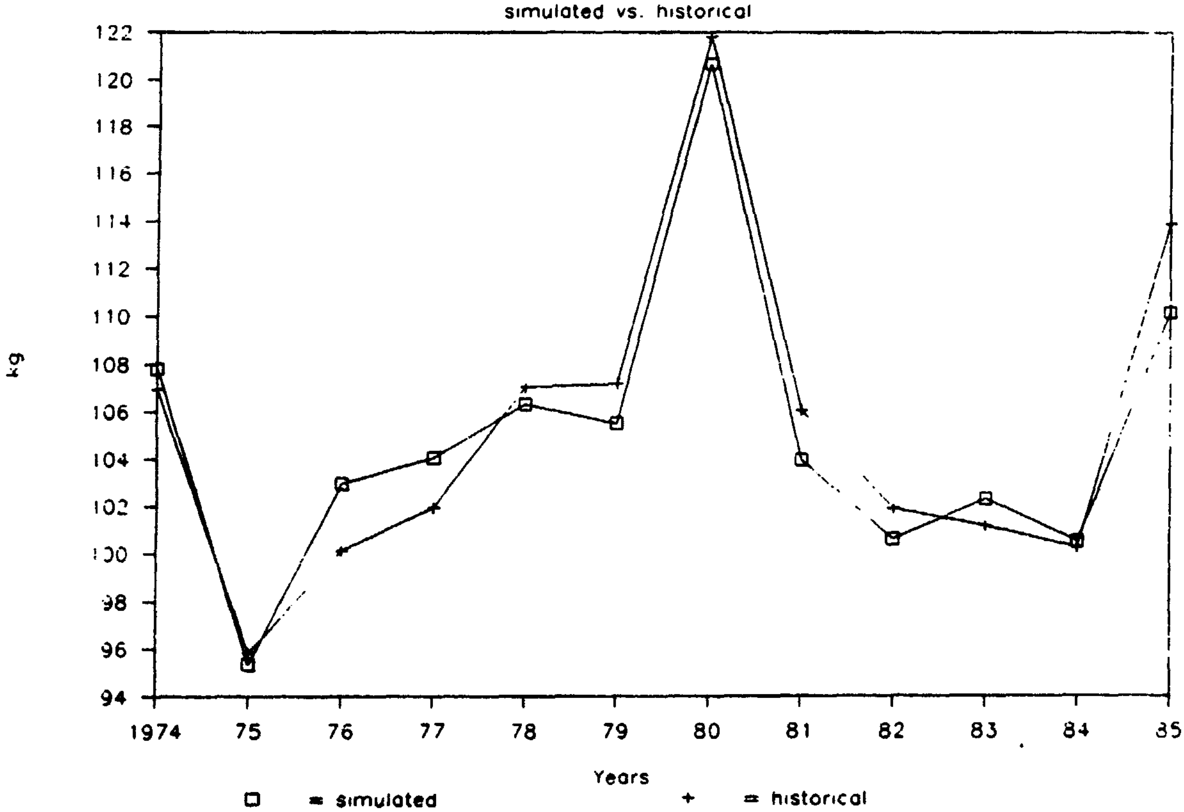
19: Production Milk

simulated vs historical

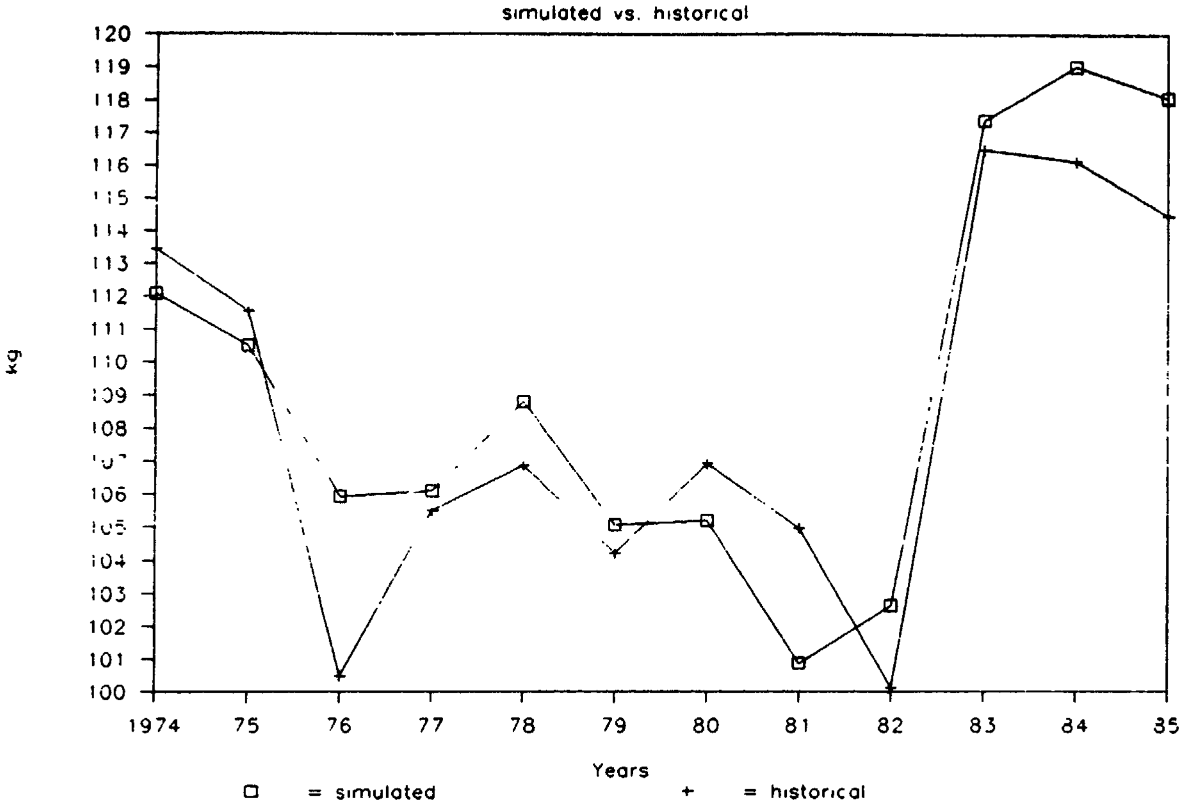


20: Per capita consumption Milk

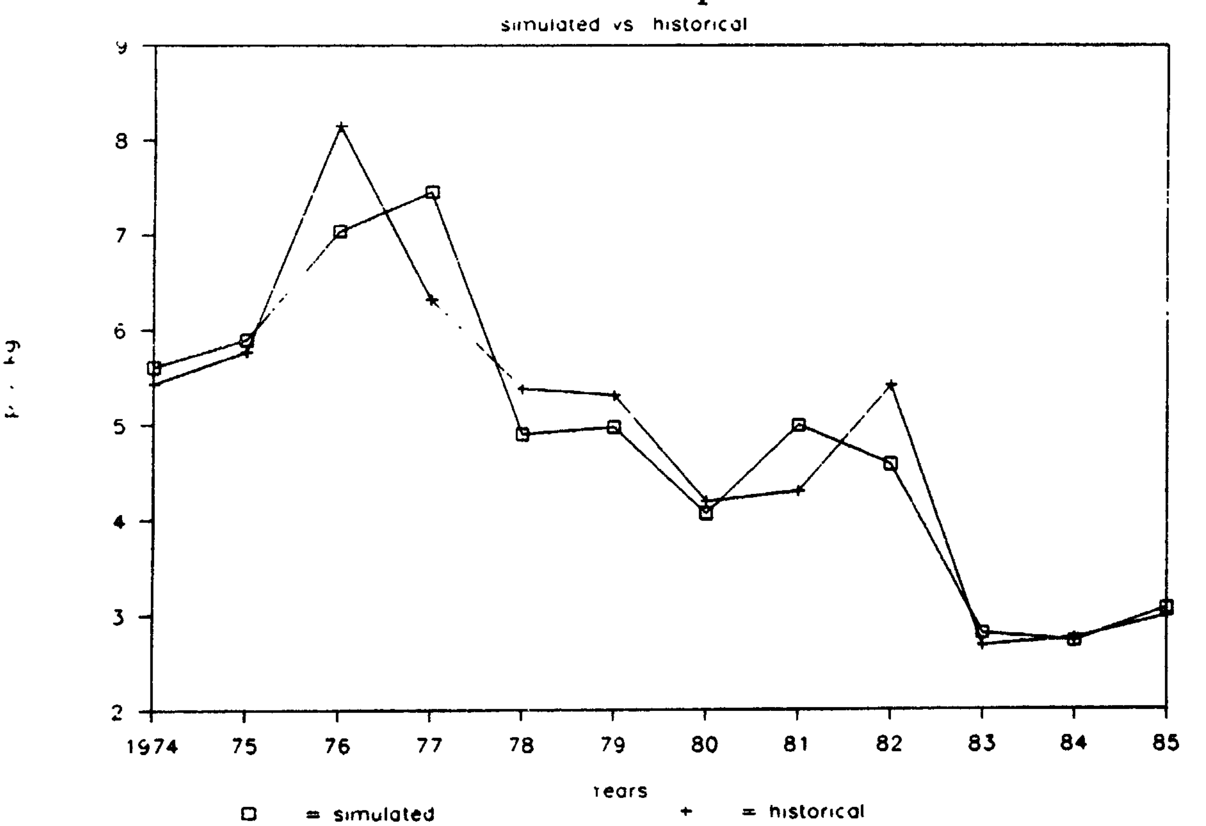
simulated vs. historical



21: Per capita consumption Maize

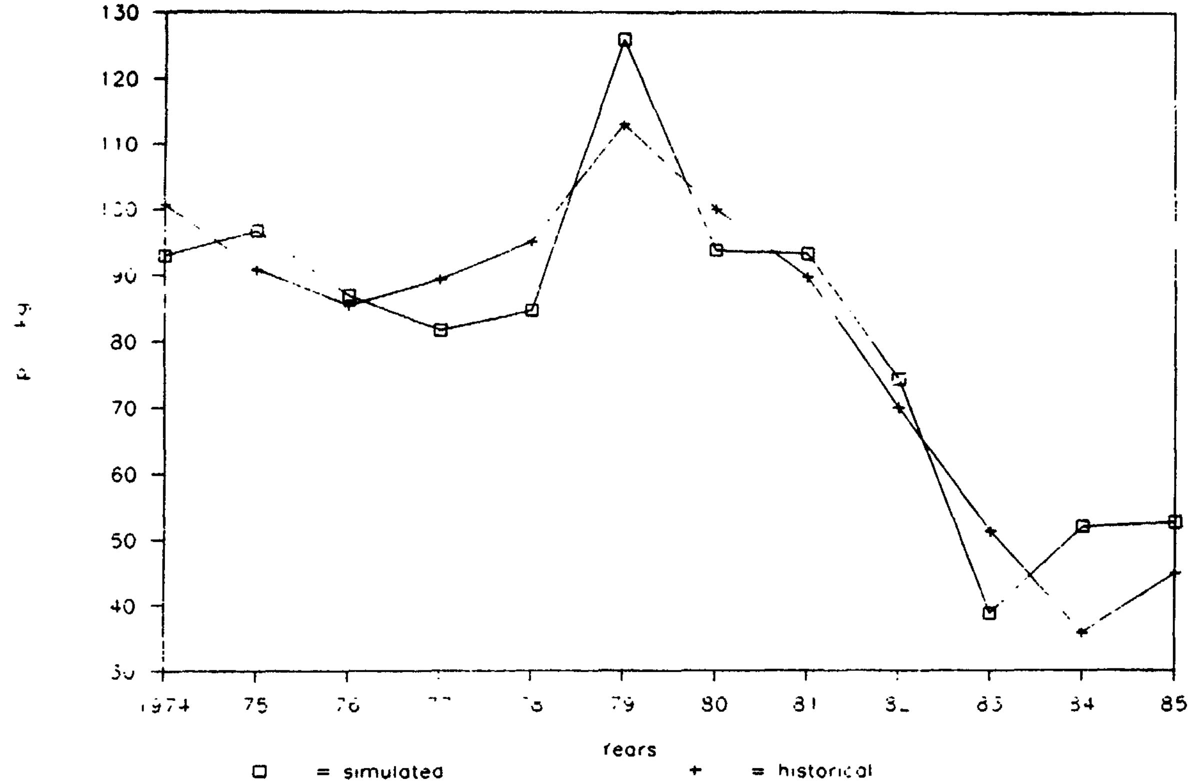


22: Real consumer price Tortillas



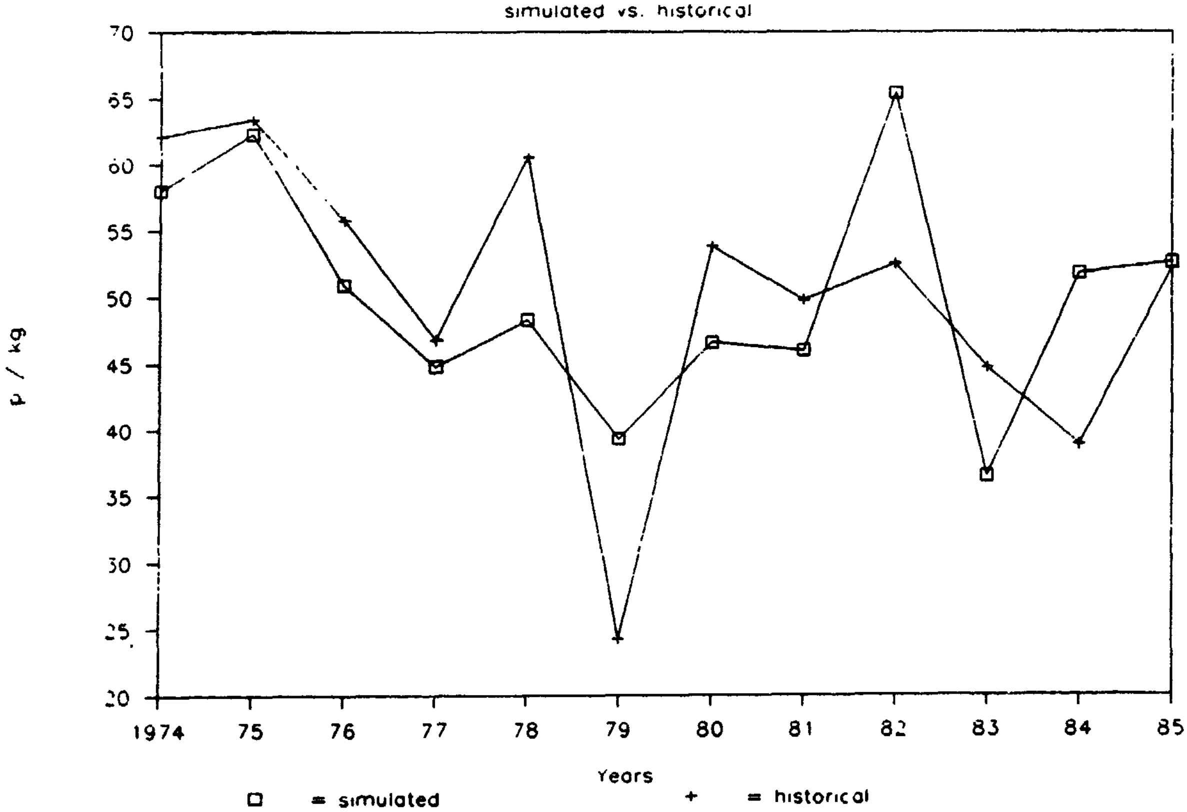
23: Real consumer price Beef

simulated vs historical



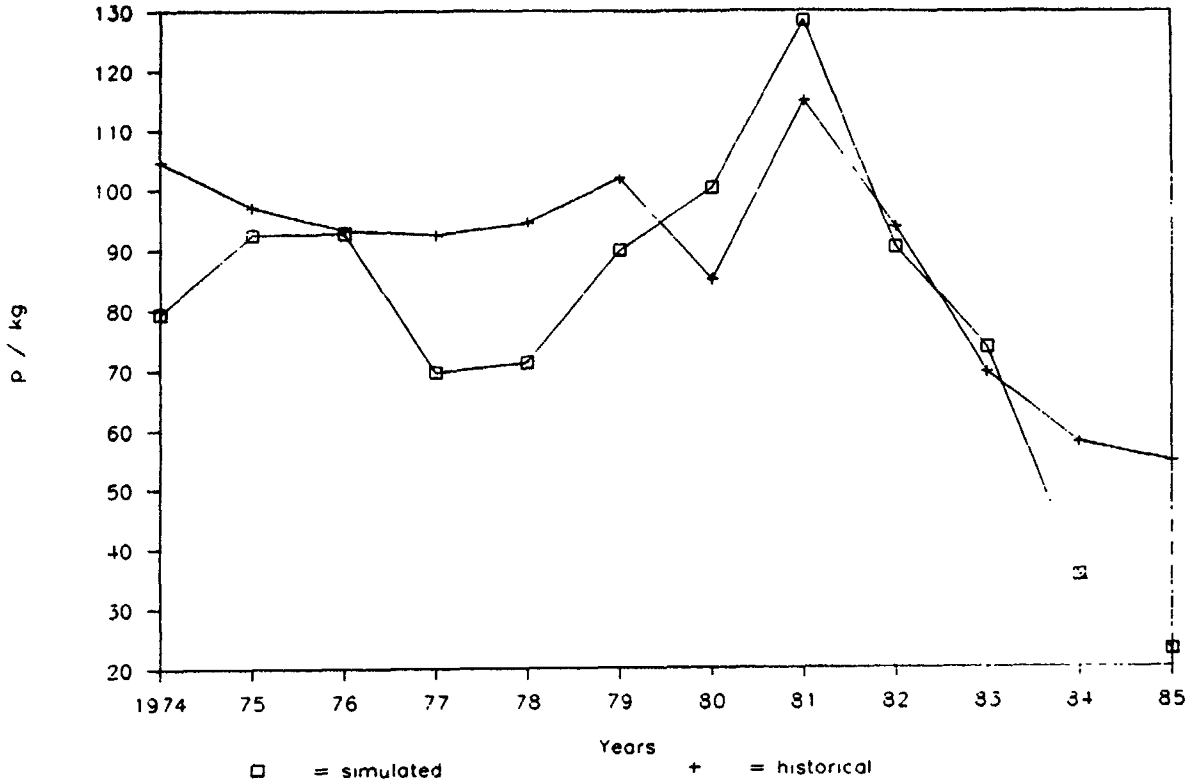
24: Real producer price Beef

simulated vs. historical



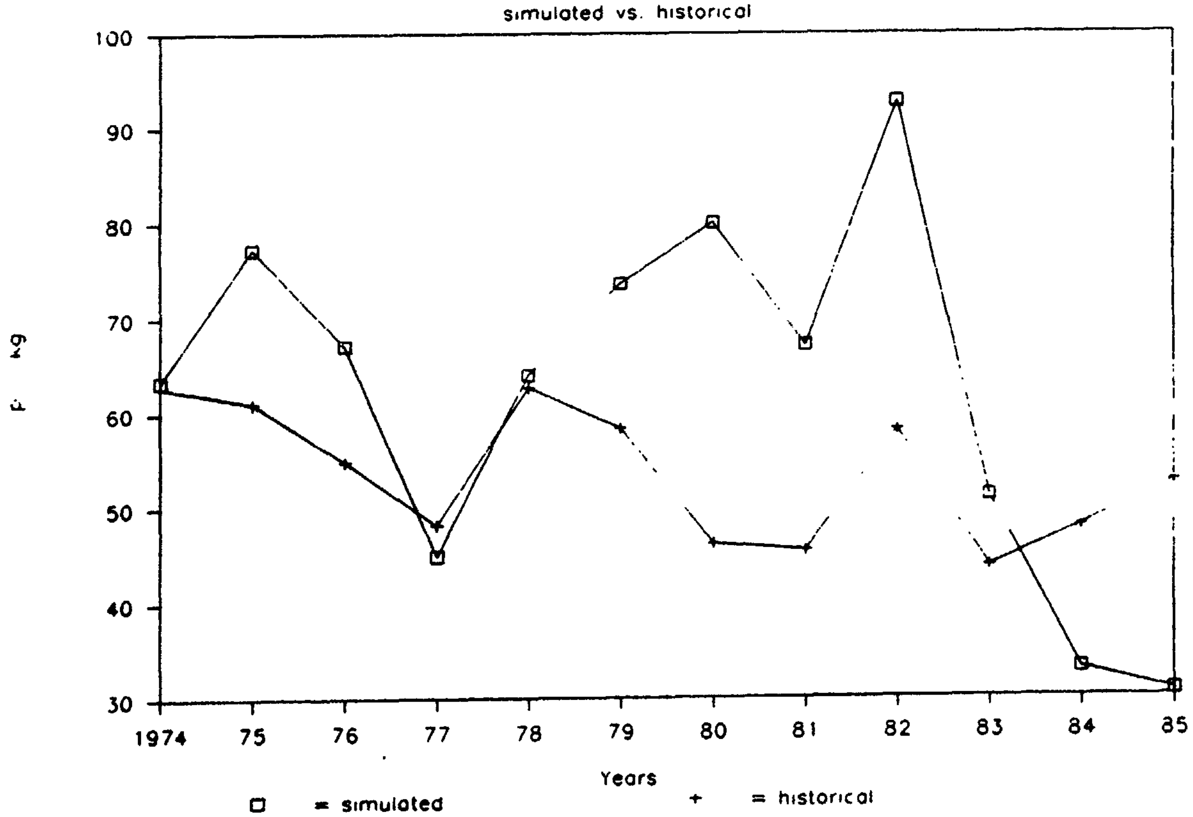
25: Real consumer price Pork

simulated vs. historical



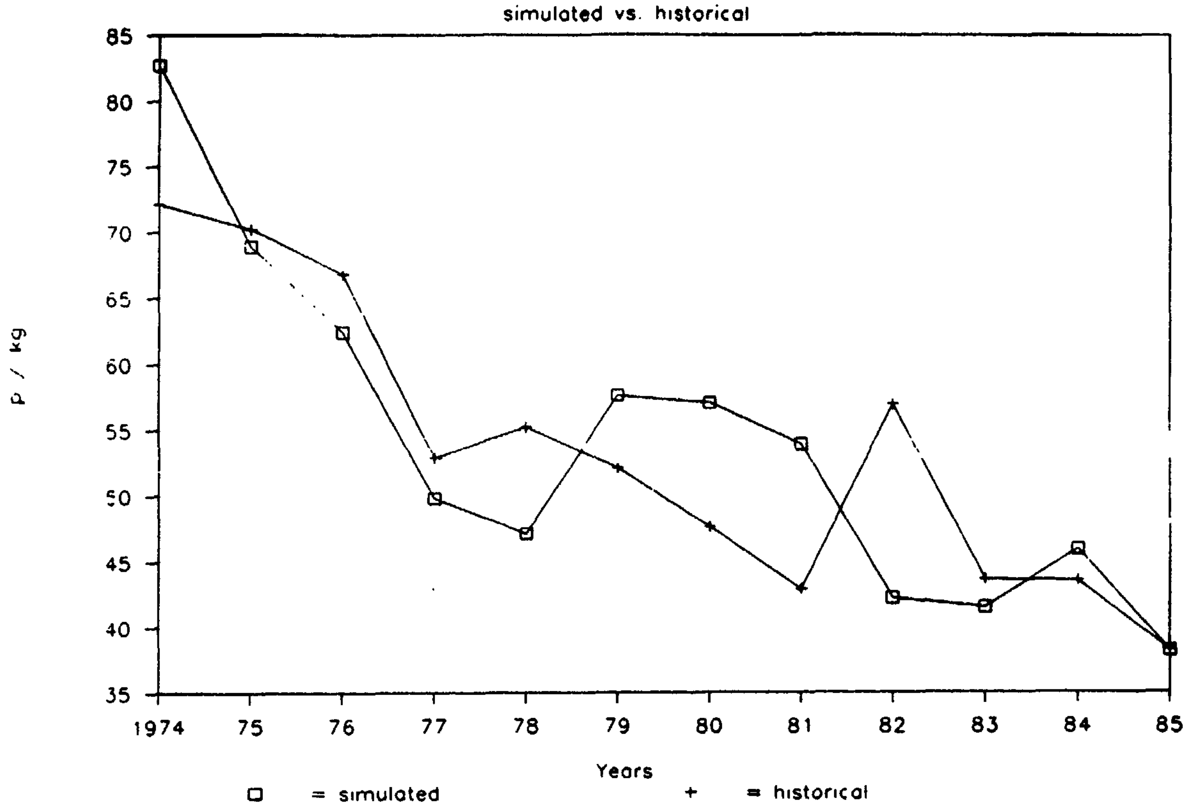
26: Real producer price Pork

simulated vs. historical



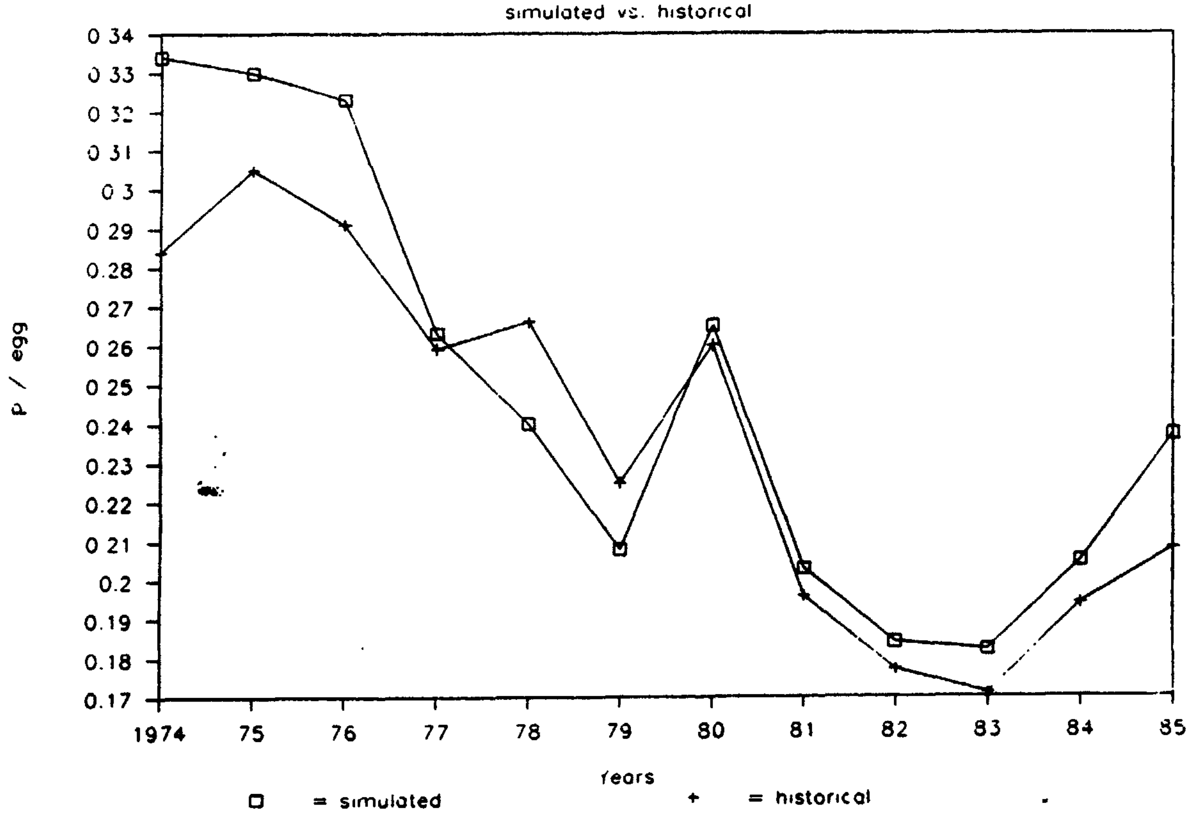
27: Real consumer price Poultry

simulated vs. historical



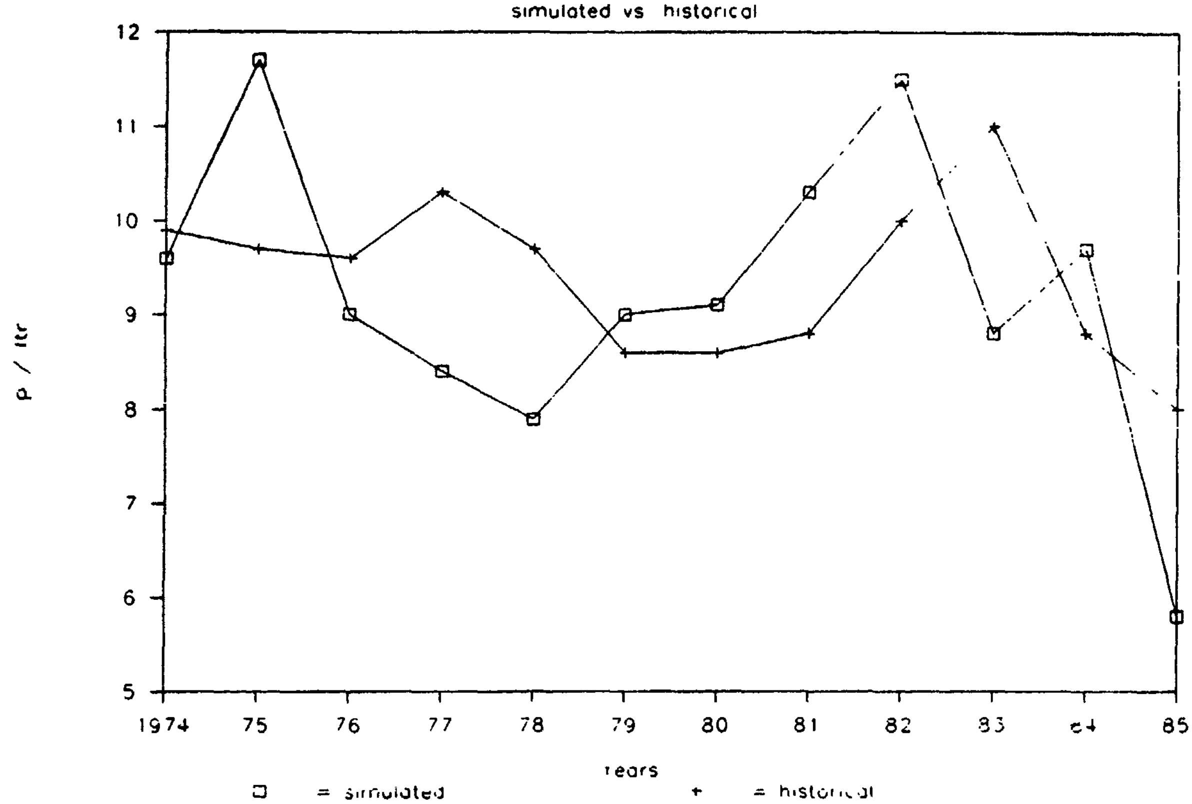
28: Real consumer price Eggs

simulated vs. historical



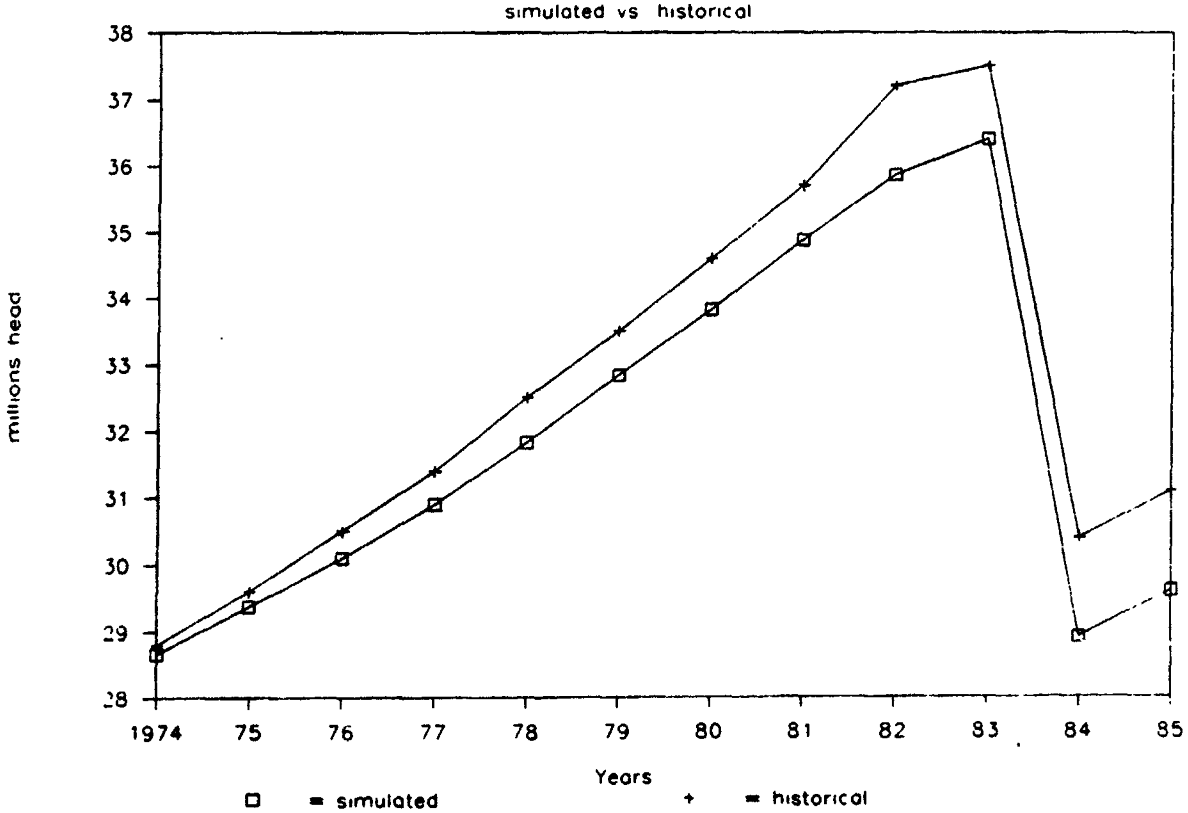
29: Real consumer price Milk

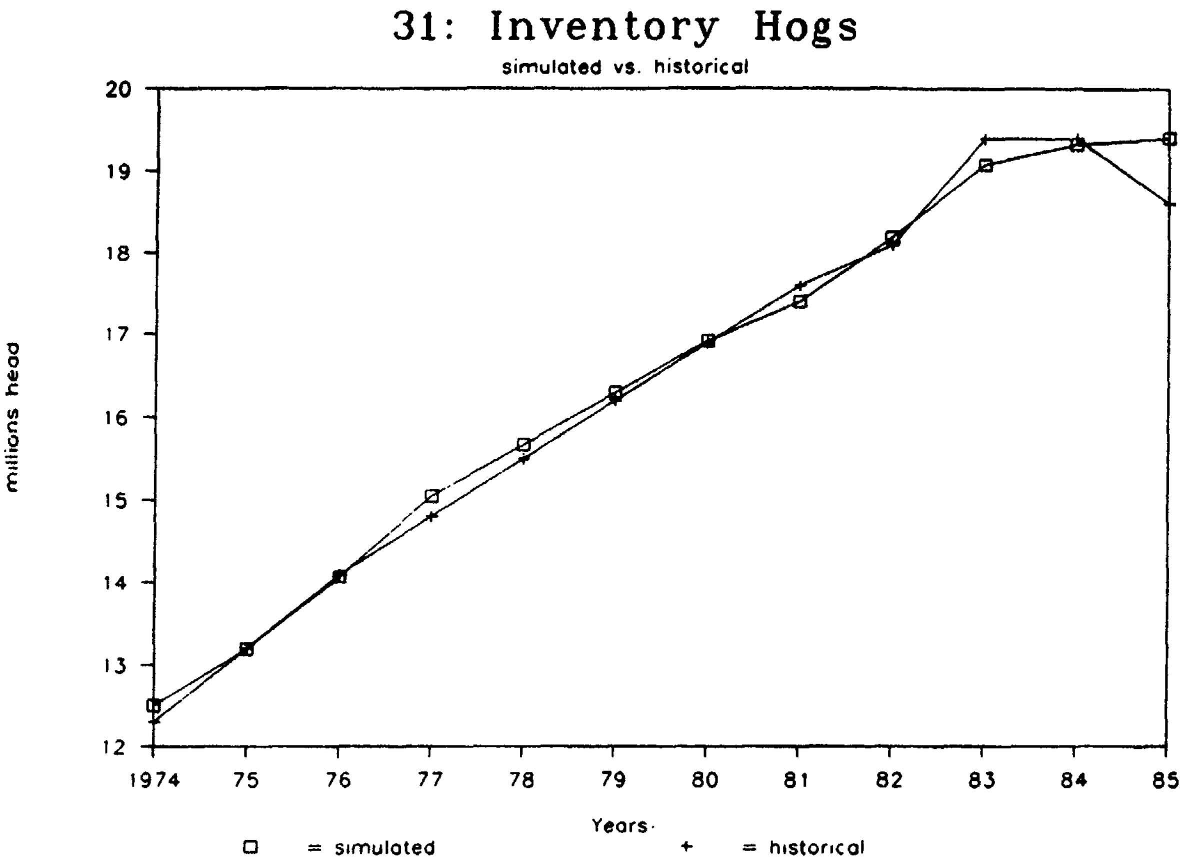
simulated vs historical

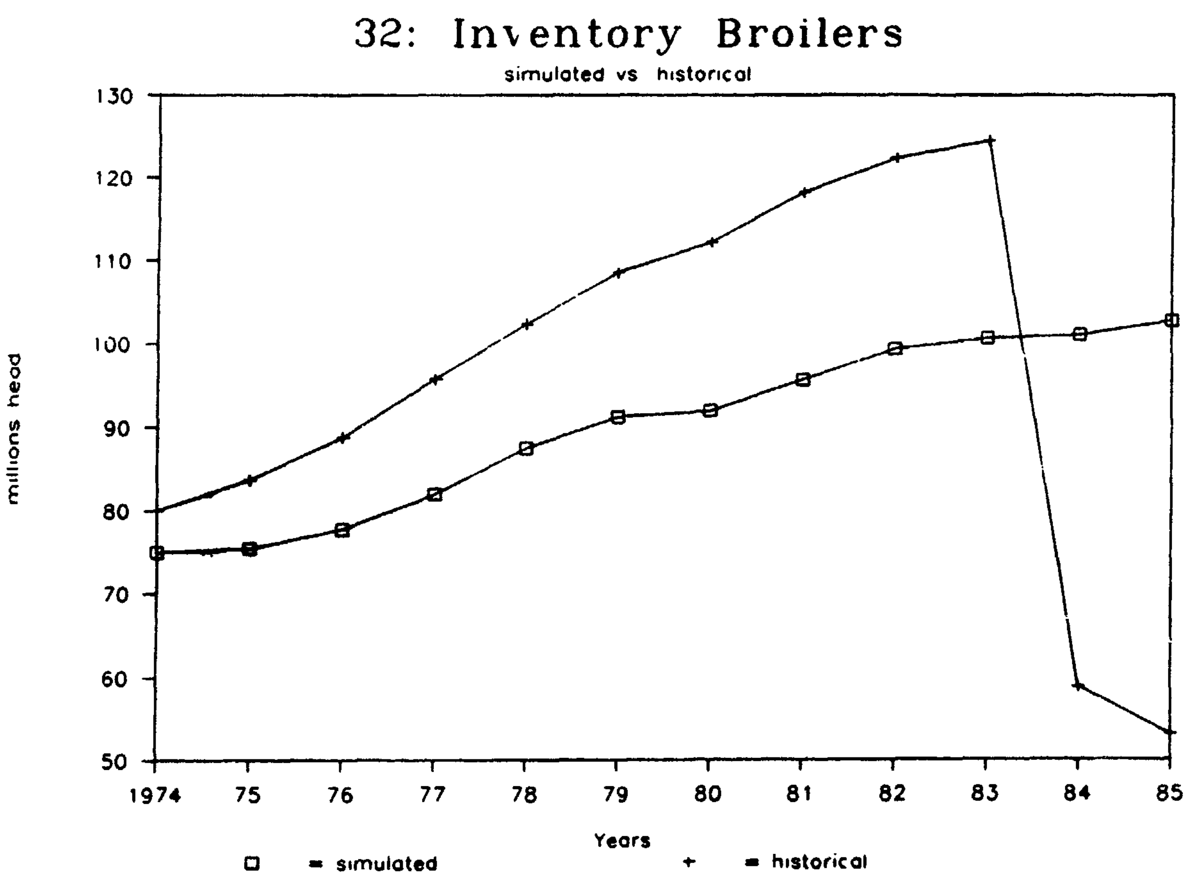


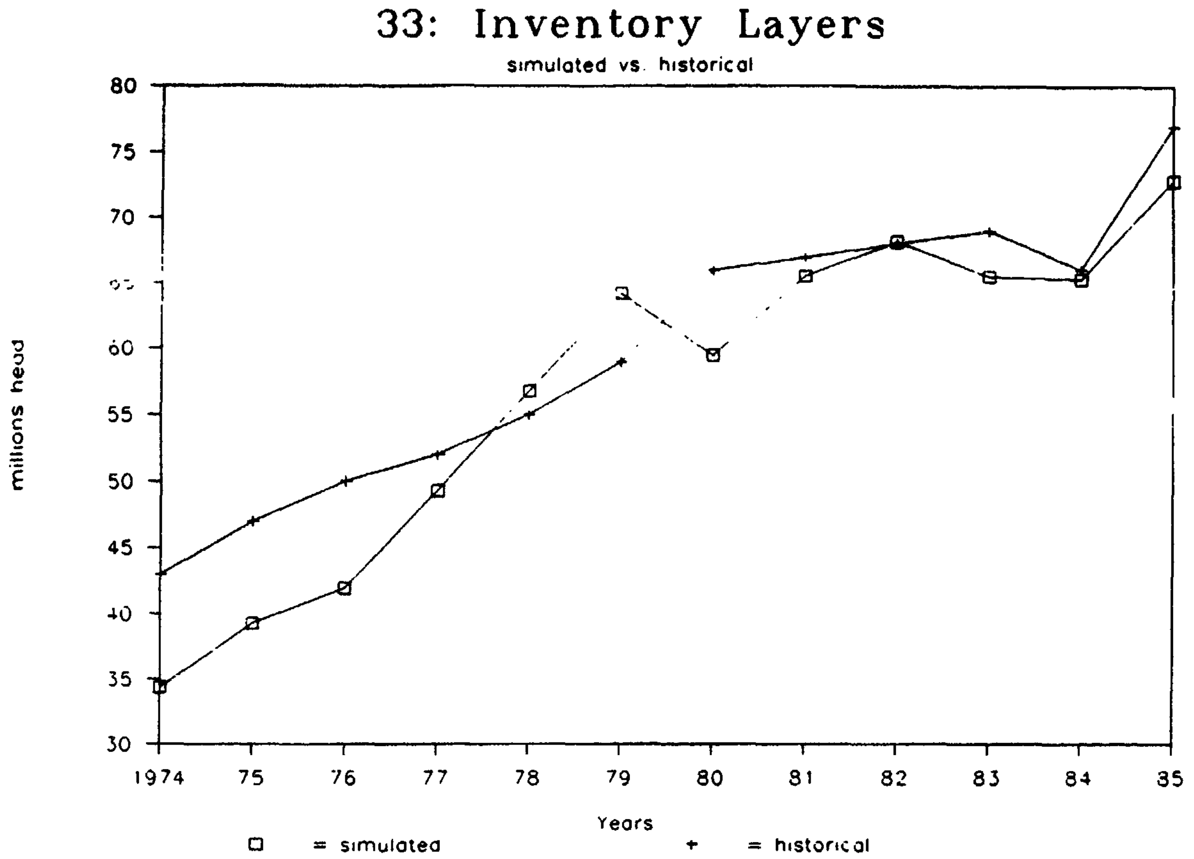
30: Inventory Cattle

simulated vs historical




31: Inventory Hogs
simulated vs. historical
millions head
20
19
18
17
16
15
14
13
12
1974
75
76
77
78
79
80
81
82
83
84
85
Years
□ = simulated
+ = historical


32: Inventory Broilers
simulated vs historical
millions head
130
120
110
100
90
80
70
60
50
1974
75
76
77
78
79
80
81
82
83
84
85
Years
□ = simulated
+ = historical


33: Inventory Layers
simulated vs. historical
80
75
70
60
55
50
45
40
35
30
millions head
1974
75
76
77
78
79
80
81
82
83
84
85
Years
= simulated
= historical

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