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DISCUSSION PAPER

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A Model of Import Demand for Grain in the Soviet Union

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by

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ABSTRACT

During the 1970s the Soviet Union moved from being a net exporter of grain to being a net importer. Conventional market models are inappropriate for the analysis of this import demand since trade in a centrally planned economy is administratively determined, rather than being a market activity. This paper seeks to develop a model of import demand for grain in the Soviet Union based on Soviet perceptions of the purposes and processes of foreign trade. Behavioural aspects of import demand are emphasised in developing the model, and while it may be of some use in forecasting import demand its prime purpose is explanatory.

* This and previous drafts have benefitted from comments by colleagues at Newcastle and Nottingham.

CONTENTS

1. INTRODUCTION

Historically, grain is a commodity which has occupied a central position in the Soviet economy. Prior to the 1917 revolution, grain exports were relied upon by the Czarist government to finance rapid industrialisation. Subsequently, grain sales were to be a major source of hard currency for the Soviet economy. The exporting tradition came to a sudden end in the early 1970s and since that time the Soviet Union has been a substantial net importer of grain from world markets.

Current world trade in all grains amounts to some 200 million tonnes and the Soviets have been importing in excess of 30 million tonnes since 1980. The scale of Soviet buying can be expected to affect the general level of world prices, while sudden fluctuations in purchases will affect price variability. In the context of world market analyses a thorough understanding of Soviet import behaviour is important. However, conventional models are inappropriate for this purpose since this demand is not market determined. Rather the problem must be approached from the planners perspective with the emphasis on understanding the decision making process which underlies Soviet purchases of grain on world markets.

2. THE GRAIN SECTOR IN THE SOVIET UNION

Prior to any detailed discussion of import demand it is useful to consider first, some of the features of Soviet grain production which resulted in the change in trading stance, and second the resulting

pattern of trade. The area devoted to grain production has altered little since 1960. The main phase of expansion in area occurred under Khrushchevs Virgin Land Programme in the 1950s. His successors had little opportunity to increase cultivated area further and relied instead on encouraging more intensive methods of cultivation. Consequently, the growth in output since the early 1960s can be explained almost exclusively in terms of yield improvements. The pattern of yields is shown in Figure 1. Probably the most noticeable feature is the rapid growth of the late 1960s and early 1970s and the subsequent slowing down in the early 1980s. Grain yields are slightly lower than climatically similar areas of Canada and the United States [Johnson and Brookes, 1982] and in addition are considerably more variable [Diamond and Davis 1979]. The pattern of grain production is shown in Figure 2. The most rapid increases in output occurred in the late 1960s and early 1970s. Subsequently, a series of bad harvests (in particular 1975, 1979 and 1981) have considerably reduced grain output and, though there has been some growth in recent years, the rate of increase has been slow.

The patterns of grain use in the Soviet Union are outlined in Figure 3. Food, seed and industrial uses have remained fairly constant over the last 25 years, but feed usage has expanded rapidly due to the increasing priority given to meat production. Grain currently accounts for approximately 80% of concentrates fed to livestock and approximately 40% of total animal feed [Gray,1982]. The changing priorities of Soviet agricultural policy provide a simple explanation for the rapid growth in feed demand. For both Stalin and Khrushchev, the key concern of agricultural policy was simply that of

FIGURE 1: Grain Yields in the Soviet Union

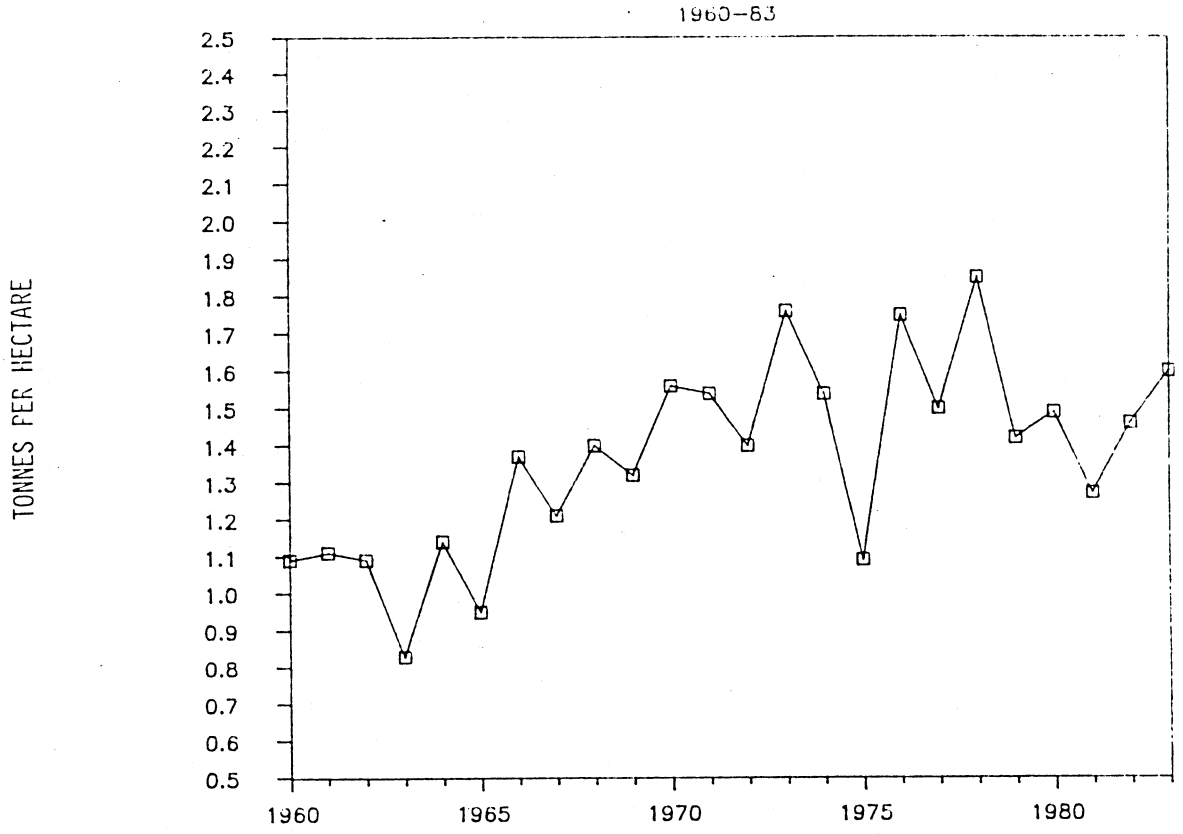


FIGURE 2: Grain Production in the Soviet Union

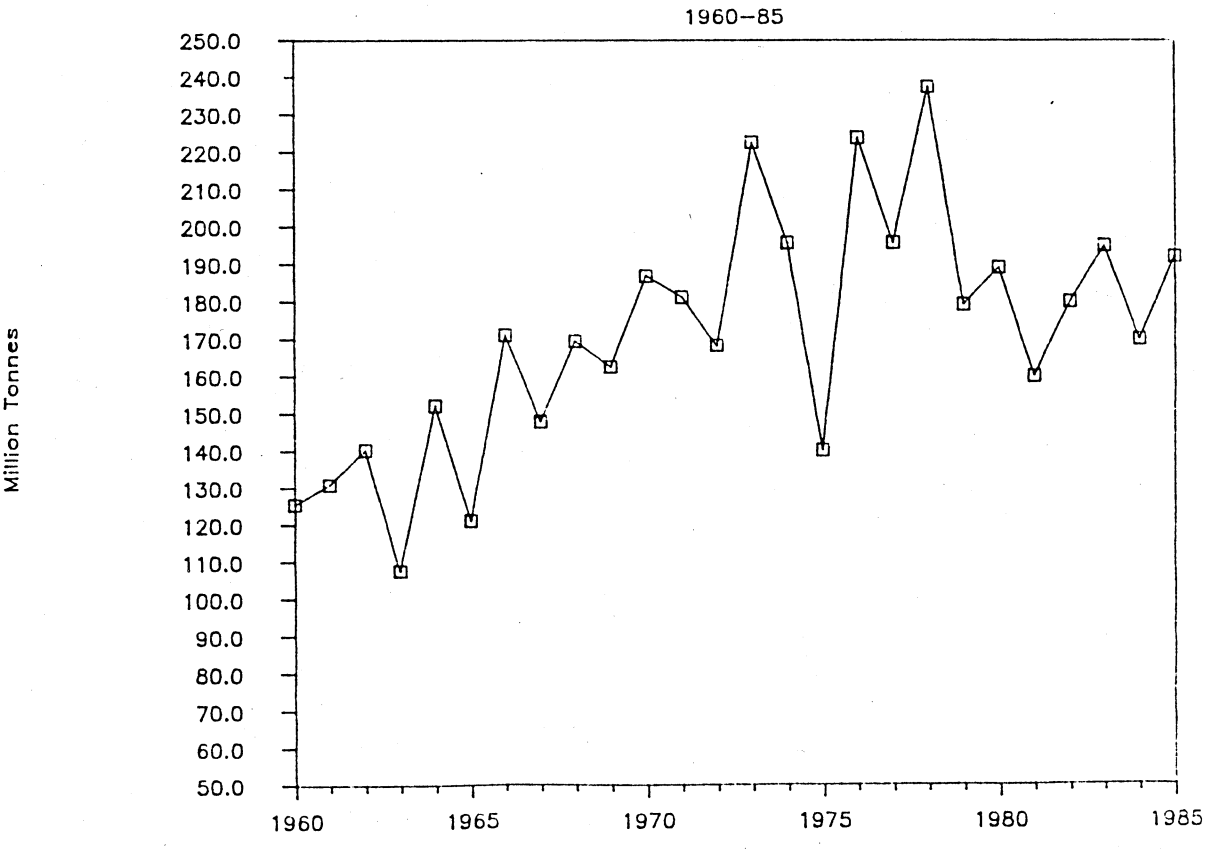
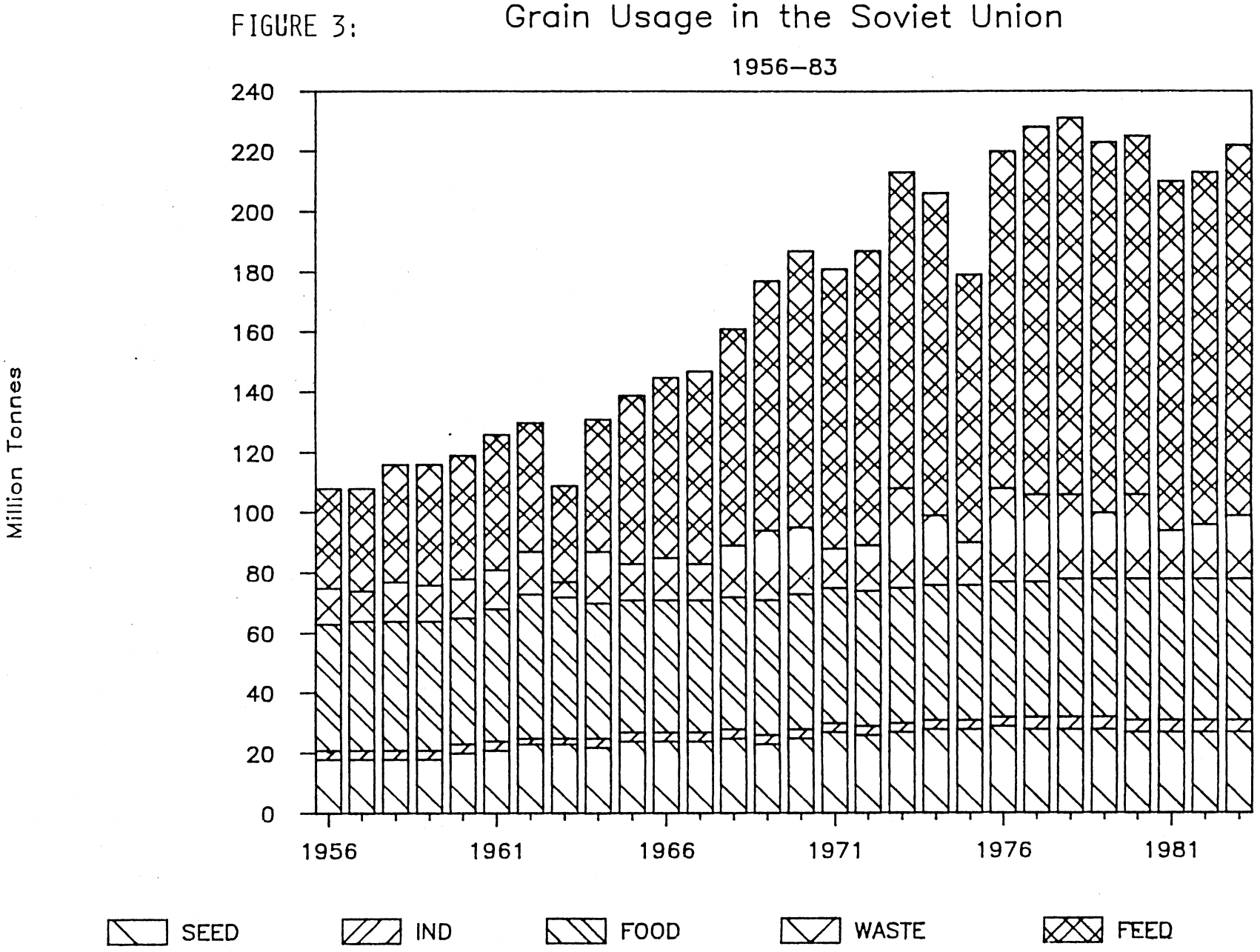


FIGURE 3:


Grain Usage in the Soviet Union
1956–83
Million Tonnes
240
220
200
180
160
140
120
100
80
60
40
20
0
1956
1961
1966
1971
1976
1981
SEED
IND
FOOD
WASTE
FEED

expanding output sufficiently to meet the basic calorie requirements of the Soviet population. By the early 1960s, this goal had been achieved. The policy problem facing Brezhnev (1964-82) related not to quantity but to quality - specifically the problem of meeting the rising demand for meat and livestock products. Consequently, the development of the livestock sector was given top priority. In 1965, the slaughter policy was unofficially abandonned in order to ensure that livestock inventories were not depleted in years of poor harvests [Schoonover, 1979]. This change was officially made in 1971, reaffirming the Governments committment to raising livestock production even at the expense of importing grain. The increased pressure of demand for feed grains as a result of this policy change was exacerbated during the 1970s by deteriorating feed conversion ratios [Gray, 1982].

In addition to this policy induced shift in demand for grain there is some evidence to suggest that there has been a shift in supply potential. The Soviet climate is not well suited to grain production, although the 1960s and early 1970s the weather was relatively favourable. Rainfall and temperature were both higher on average during this period and some estimates suggest that as much as 50% of the observed increase on grain yields can be attributed to favourable climatic conditions [U.S. CIA, 1976]. In the late 1970s, the Soviet climate appeared to revert to its more normal pattern of being colder and drier, and thus less suited to grain production. Associated with, and probably as a result of, this climatic shift was a slowing down in the rate of yield increase.

The combination of a major shift in demand and a shift in the supply potential has created a structural deficit in the Soviet grain sector. That is, targetted consumption requirements have been consistently higher than expected output. Consequently, the Soviets have had to rely on supplies of grain from world markets in order to satisfy domestic demand at current retail prices.

The extent and duration of the Soviet presence on world grain markets depends upon the time taken to reconcile demand and supply, thus ensuring 100% self sufficiency. Policy statements indicate a firm committment to raising meat consumption and an unwillingness to compromise those targets in response to poor grain harvests. Accordingly, the supply side, which is the main constraint on output growth has been emphasised in policy developments. Nevertheless, productivity growth has slowed in the 1960s and 1970s (Diamond, Bettis and Ramson, 1983) and agriculture is increasingly dependent on increased inputs to ensure increased output.

Constraints on output growth can be considered in groups - environment, inputs, infrastructure and technology[1].

(a) Environment

Climatically, the Soviet Union is not well suited to grain production. Areas with high rainfall are typically too cold and areas with high temperatures are typically too dry. Only 10% of the land area has the appropriate combinations of heat and moisture to permit the cultivation of a normal range of crops [Diamond and Davis, 1979]. Additionally, the soil types are

highly variable but generally of poor quality.

(b) Inputs

Suitable machinery is in short supply and often unreliable. Deliveries of fertilisers and agro-chemicals are low, and rural migration has adversely altered the age profile of the labour force.

(c) Infrastructure

Unmetalled roads, open trucks and limited storage facilities result in high levels of waste particularly with respect to grain.

(d) Technology

Breeding and husbandry practices have been slow to develop. The general nitrogen deficiency in the soil means that grain quality is poor and gluten content low. Grain varieties typically have a low fertiliser tolerance and limited disease resistance. Despite poor soil quality, summer fallow is limited and machinery constraints often result in fertiliser being applied to crops at too early a stage of development.

Although many of these supply side problems are not of recent origin, the increased pressure of demand has emphasised their importance and the 1982 Food Programme was a concerted attempt to provide some solutions [Malish, 1982]. The reforms initiated under the Food Programme have been reinforced in policy proposals for the twelfth plan period (1986-90) [USSR Guidelines, 1985]. In neither

case is there a major change in the structure of policy relating to agriculture; the reforms are primarily procedural. While these changes may be expected to have some impact on output levels, it seems unlikely that they will produce the accelerated growth in output needed to end Soviet dependence on world grain markets.

Patterns of imports and exports are outlined in Figure 4. This clearly illustrates the major shift in trading stance which occurred in 1971. In the early 1970s, the US was the major supplier of grain to the Soviet market, although the 1980-1 grain embargo forced the Soviet Union to diversify its sources of supply. Canada, Argentina and Australia now all supply large quantities to the Soviet market on a regular basis. The composition of imports is detailed in Figure 5. Initially, coarse grains were the more important category of imports, since the main requirement was for stock feed. However, a large quantity of hard wheat was also imported for bread making, allowing poorer quality domestic wheat to be used for feed. More recently, there is some evidence to suggest that wheat is becoming more important in the composition of grain imports. The immediate explanation is not a change in demand patterns but a Soviet preference for wheat imports which are available from a larger range of suppliers. To compensate, domestic production of coarse grains is being increased at the expense of domestic wheat production.

3. MODELLING IMPORT DEMAND

Conventional Western models of trade rest on a framework of decentralised decision making by private agents under competitive

FIGURE 4:

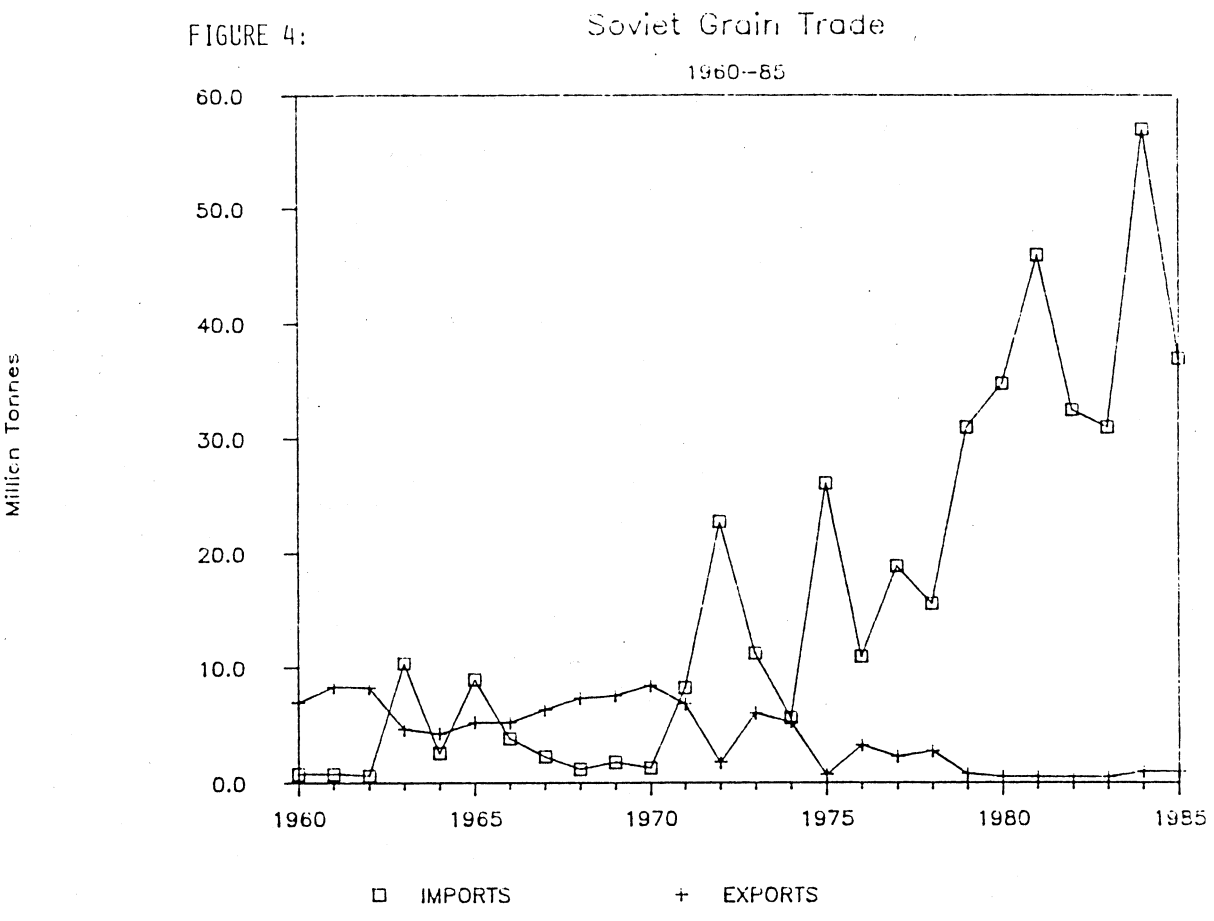
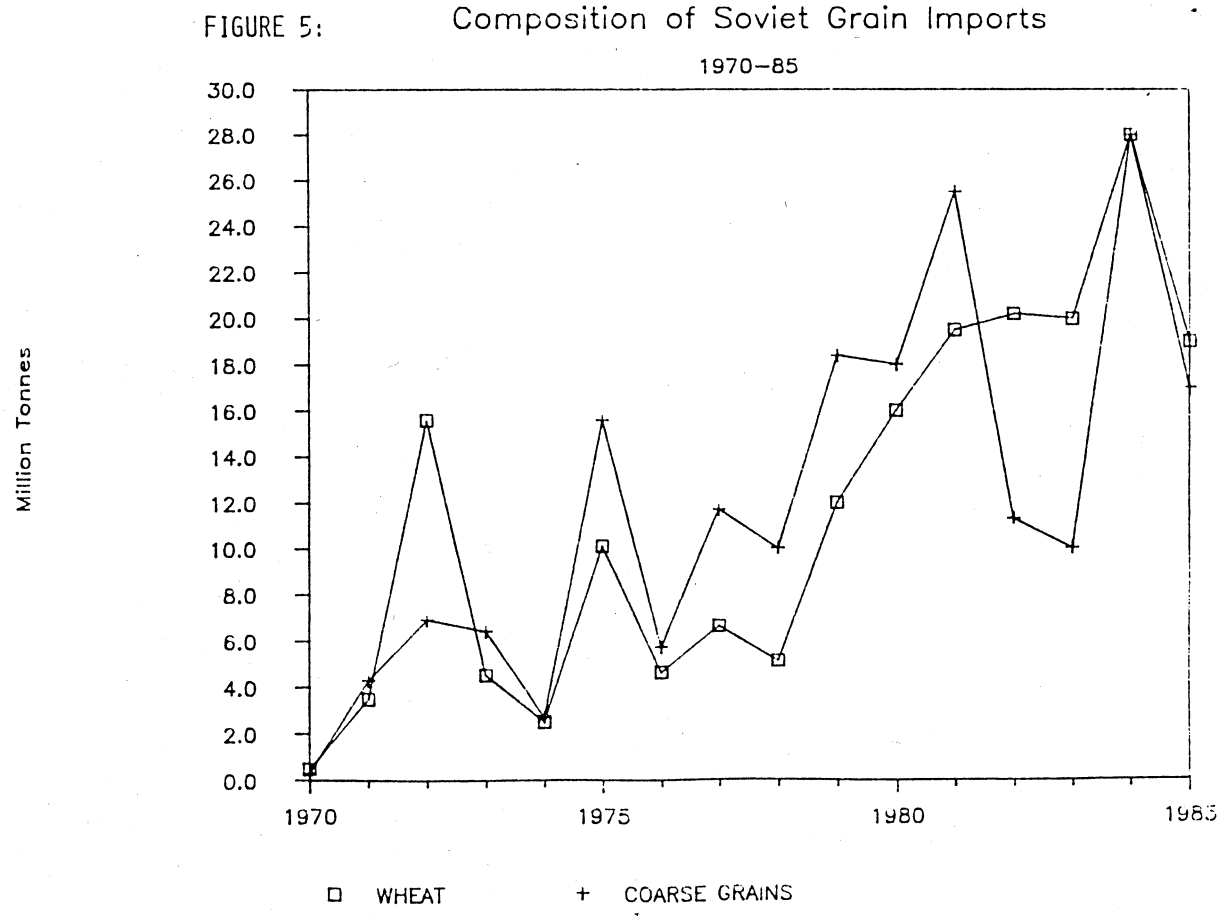


FIGURE 5:



conditions. Government intervention enters into this type of model as an influence on the conditions of supply and demand rather than as an alternative to the market mechanism. In contrast, the planned economy places the responsibility for trade in the hands of a state monopoly. The trading activities of this monopoly are directly controlled by the Government in the form of twenty, five and one year plans. In contrast to conventional perceptions, trade is not viewed as necessarily beneficial. Imports are accepted as a means of obtaining those commodities required to foster domestic economic development, while exports are a drain on domestic output necessary to pay for such imports.

In the context of the Soviet Union, target requirements for trade are determined by Gosplan (the central planning authority) in consultation with the Ministry of Foreign Trade and the relevant domestic ministry. Once targets have been determined for a commodity, the appropriate Foreign Trade Authority (FTO) will undertake the purchases and sales detailed.

Resource allocation in the Soviet economy is based on input-output methods. Underlying this is the materials balance principle - primarily an accounting device - used to ensure consistency between the output of commodities and their various uses. Any imbalance between the production and consumption side of the materials balance will result in failure to achieve stated goals, although such imbalances may be corrected by changes on either the supply or demand side. Materials balances are used at both firm and economy level and it is through the use of national materials balances

that imports are determined [Hewett, 1983].

The major use of grain in the Soviet economy is as livestock feed. In deciding to make the livestock production a priority goal, Soviet policy-makers implicitly stated that shortfalls on the national balance for meat would be accommodated primarily by attempts to increase supply rather than reduce demand. By implication, the grain sector must supply sufficient feed to meet target requirements for the livestock sector. This suggests that shortages on the grain balance could not be accommodated by demand reductions; grain supplies would have to be increased, with imports the only short term solution. Information concerning feed requirements and domestic production potential will be used in discussions between Gosplan, the Foreign Trade Ministry and Gosagroprom (the State Agro-industrial Committee) in order to determine the appropriate level of imports [Robertson, 1982].

Within the planning process then, the logic of the materials balance approach appears to dictate import requirements. However, as the planning authorities enter into discussions concerning import levels, it would appear that import requirements are not determined simply by an accounting process. As Wilczynski [1969] points out, its would be unwise to assume that foreign trade in any commodity is solely a residual to handle short-term bottlenecks. Rather, materials balances may determine the general level of imports required, but in making final purchasing decisions, the planning authorities will take into consideration the relative efficiencies of imports and exports in terms of hard currency availabilities and value to the economy.

Previous attempts to model the import demand for grain in the Soviet Union have tended to rely on an ad hoc approach. Desai [1981] has identified two broad approaches to this problem. The first - the domestic supply-demand balance approach - entails estimating imports as the difference between expected production and consumption. The second - the direct approach - requires that imports are estimated directly as a function of a range of explanatory variables including domestic grain output, lagged world price, trend and dummy terms. The first approach is rather inflexible in that it implies that any shortfall between anticipated production and target consumption is automatically made up by imports. Both approaches are subject to the criticism that they fail to recognise explicitly the role of the planning process in determining import requirements.

The model developed here will take as its starting point the potential for there to exist a deficit on the national balance for grains. The size of this deficit will depend upon the difference between required production as stated in the plan (the output component of the national grain balance) and actual production (the input component of the national grain balance). This deficit can be separated into two components - an expected deficit and an unexpected deficit. The expected deficit can be defined as the difference between target production and trend production. This will determine the size of imports that the Soviets expect in any given season prior to harvesting. When the size of the crop is known, policy-makers will be able to identify the true deficit - that is, the difference between target production and actual production. The difference between the

expected deficit and the actual deficit gives the unexpected deficit. This will determine the final deficit realised on the national balance and thus exert some influence on quantities imported.

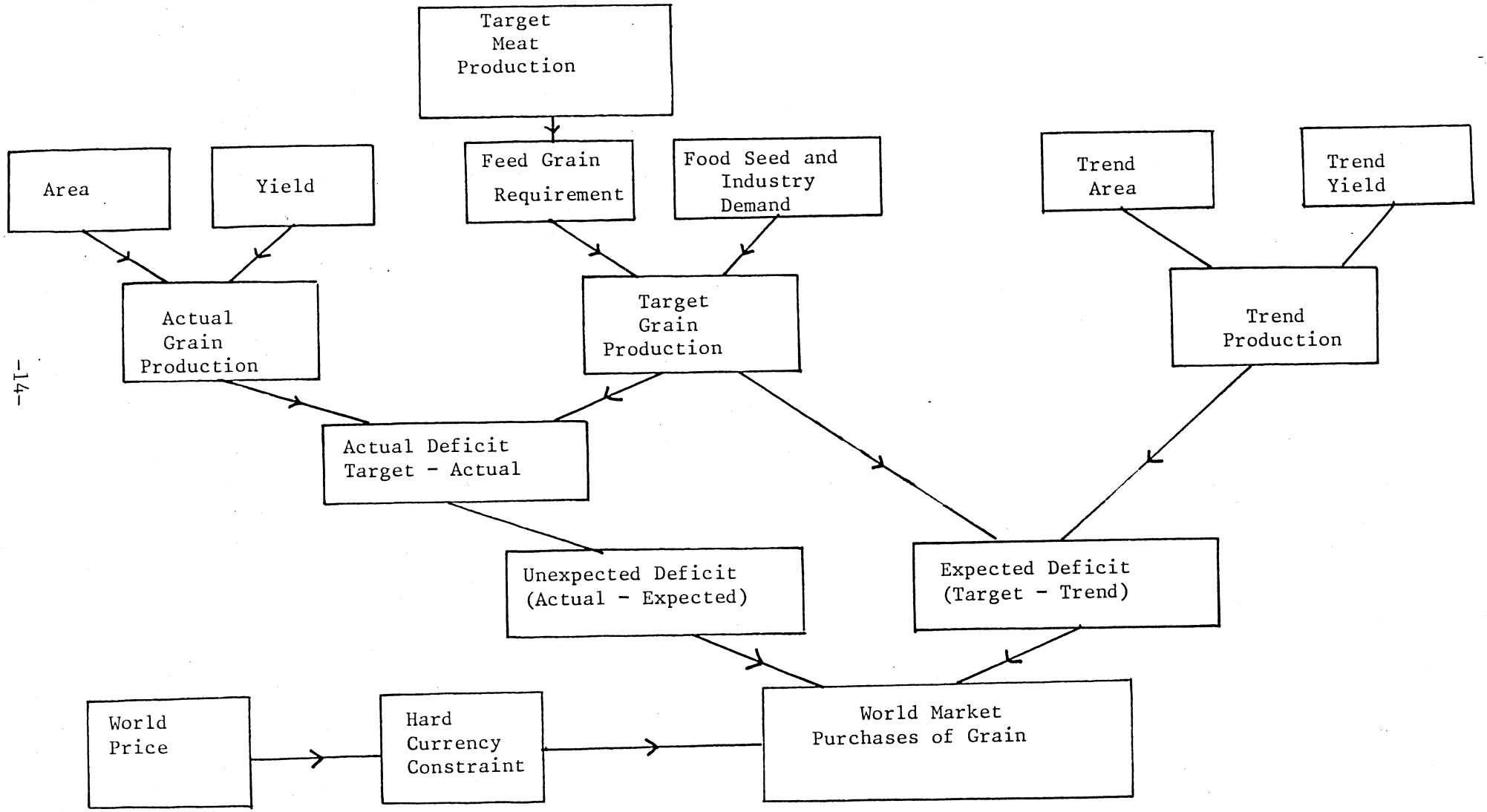
Given attitudes to trade, Soviet purchases are likely to be relatively insensitive to exogenous price fluctuations, although it is quite possible for Soviet purchases to influence the level of prices in world markets. Consequently, the role to be played by price in the model is not obvious. The factor which is probably more important than price is the hard currency constraint. Hard currency is in limited supply, and although grain has been given high priority, the quantity of hard currency available will be an important consideration for policy-makers. Since hard currency availabilities are not directly observable, a proxy variable must be used if this element is to be included in the model. The simplest proxy variable is a deflated world price, on the assumption that the hard currency constraint will be more binding the higher the world price. The final structure of the model is given in Figure 6.

4. ESTIMATION

From the structure outlined in Figure 6, imports (I) are to be estimated as a function of expected deficit, unexpected deficit and world price:

$$I_t = F(DE_t, DU_t, WP_t)$$

FIGURE 6: The Import Model



where: DE_t = expected deficit in year t,

DU_t = unexpected deficit in year t; and

WP_t = world price in year t.

The import figures used in estimation are net of exports and are based on data published by USDA[2]. The data are for all grains; no distinction is made between wheat and coarse grains, first because the disaggregated data are less readily available, and second because the two commodities are regarded as relatively close substitutes and quantites imported are determined by the same criteria. The expected grain deficit depends upon the difference between target production and expected trend production, while the unexpected grain deficit depends upon the difference between anticipated shortage pre harvest and the realised shortage post harvest. Considering the expected deficit first we need to identify the supply and demand sides of the national grain balance. The demand side can conveniently be taken to be the output of grain specified in plan targets. The supply side depends on some estimate of trend production as perceived by policy-makers. Trend production can be decomposed into trend area and trend yield. Since 1960, there have been no major changes in planned area and no major changes are indicated for future plan periods. Accordingly, the area component of trend production was taken to be constant at 124 million hectares - the average of plantings over the period. The yield series is rather more erratic and while climate based models can produce good fits, such models are of limited use in a forecasting framework. Consequently, on the grounds of simplicity it was assumed that policy-makers would envisage yields to be trending upwards over the period as a simple linear function of time. The

estimated form is given by

$$\hat{Y} = 1.064 + 0.024T$$
$$(0.08) \quad (0.01)$$

where: $\hat{Y}$ = estimated yield in tonnes/hectare

$T = 1, 2 \ldots, 24$

with standard errors in parentheses. With fixed area and the fitted value for yield, a trend production series can be derived for use in calculating expected demand for imports. The expected deficit on the grain balance can be identified pre harvest. The unexpected deficit can only be identified post harvest and depends upon the extent to which actual production differs from trend production. If actual production is above trend production then unexpected deficit is negative - that is, better than expected harvests have reduced the size of the deficit on the grain balance. Conversely, if actual production is less than trend production then unexpected demand is positive - that is, poor harvests have increased the size of the deficit on the grain balance. The two series are presented together in Table 1.

World price enters the model as a proxy for a hard currency constraint. The price series used is the IWC indicator price[3] which was deflated using an index of barter terms of trade for the Soviet Union in order to capture some of the effects of the hard currency constraint[4]. A linear version of the model was estimated using OLS. A *priori* there should be no intercept term in the model since the

TABLE 1: Expected and Unexpected Deficits

	Plan Production	Actual Production	Trend Area	Trend Yield	Trend Production	Expected Deficit	Unexpected Deficit
1960	128.40	125.50	124.00	1.09	135.16	-6.76	9.66
1961	130.60	130.80	124.00	1.11	137.64	-7.04	6.84
1962	132.80	140.20	124.00	1.13	140.12	-7.32	-0.08
1963	135.00	107.50	124.00	1.16	143.84	-8.84	36.34
1964	141.40	152.10	124.00	1.18	146.32	-4.92	-5.78
1965	147.80	121.10	124.00	1.21	150.04	-2.24	28.94
1966	154.20	171.10	124.00	1.23	152.52	1.68	-18.58
1967	160.60	147.90	124.00	1.26	156.24	4.36	8.34
1968	167.00	169.50	124.00	1.28	158.72	8.28	-10.78
1969	172.60	162.40	124.00	1.30	161.20	11.40	-1.20
1970	178.20	168.90	124.00	1.33	164.92	13.28	-3.98
1971	183.80	181.20	124.00	1.35	167.40	16.40	-13.80
1972	189.40	168.20	124.00	1.38	171.12	18.28	2.92
1973	195.00	222.50	124.00	1.40	173.60	21.40	-48.90
1974	200.00	195.70	124.00	1.42	176.08	23.92	-19.62
1975	205.00	140.10	124.00	1.45	179.80	25.20	39.70
1976	211.00	223.80	124.00	1.47	182.28	28.72	-41.52
1977	217.00	195.10	124.00	1.49	184.76	32.24	-10.34
1978	223.00	237.40	124.00	1.52	188.48	34.52	-48.92
1979	229.00	179.20	124.00	1.54	190.96	38.04	11.76
1980	235.00	189.10	124.00	1.57	194.68	40.32	5.58
1981*	236.00	160.00	124.00	1.59	197.16	38.84	37.16
1982*	238.00	180.00	124.00	1.61	199.64	38.36	19.64
1983*	240.00	195.00	124.00	1.63	202.12	37.88	7.12

*Estimates

Years refer to crop years

Expected Deficit is calculated as planned production - trend production

Unexpected Deficit is calculated as trend production - actual production

Source: USDA (Various) and USSR Guidelines (Various)

presence of a constant implies some level of imports irrespective of expected and actual harvest levels. This expectation is confirmed by the statistical significance of a constant term when included in the model. Accordingly, the homogenous form was preferred. Furthermore, in the context of state policy 1971 marks an important turning point. The Party Congress of that year formally identified livestock production as a priority area: by implication the output side of the grain and meat balances would thereafter take priority over the input side. This suggests that the concept of a structural deficit on the grain balance is only of relevance after 1971. Accordingly, the model was estimated with a slope dummy on the structural deficit term. The final estimated form is:

$$I_t = b_1 DE_t + b_2 DDE_t + b_3 DU_t + b_4 WP_t$$

where $DDE_t = DE_t^* D_t$ where D_t takes the value of 0 prior to 1971 and 1 thereafter.

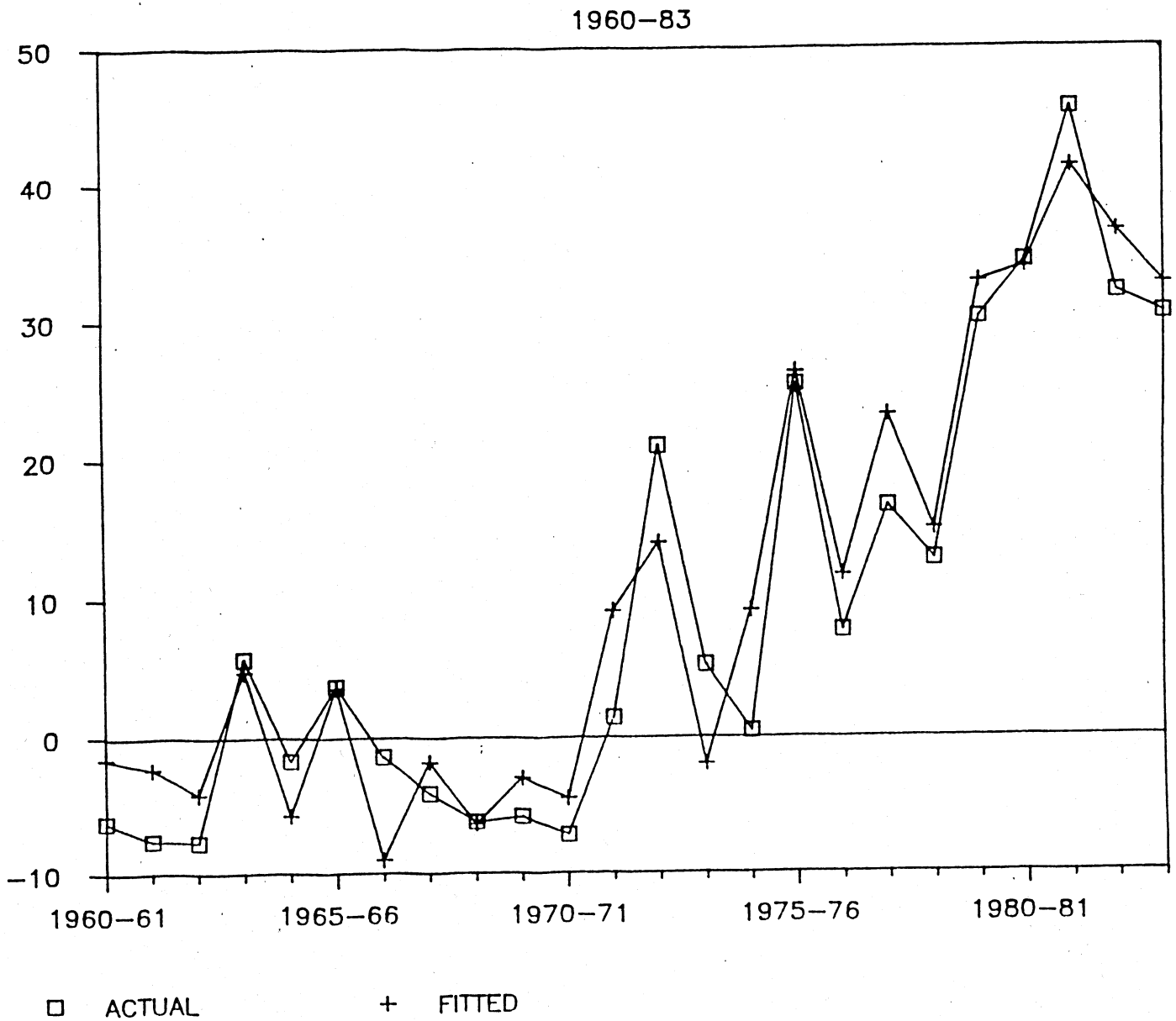
A priori , the estimated parameters would be expected to display the following characteristics. The coefficients on the demand terms should be positive to reflect the fact that the larger the shortage the larger the quantities imported. In addition, both parameters should be less than or equal to unity. (A value for either parameter in excess of unity would suggest that the Soviet Union is consistently importing in excess of its deficits.) Finally, the coefficient on price should be negative indicating that higher world prices effectively tighten the hard currency constraint and restrict the scope for imports. Table 2 below gives details of the estimated

TABLE 2: Model Estimation: with imports as the dependent variable

Variable	Coefficients	Model 1	Model 1 (Dropping DE)
DE	b_1	0.062 (0.19)	
DDE	b_2	0.910 (0.21)	0.972 (0.09)
DU	b_3	0.258 (0.04)	0.255 (0.04)
WP	b_4	-0.105 (0.03)	-0.105 (0.03)
	$\bar{R}^2$	0.91	0.91
	D-W	1.91	1.90

Figures in Parentheses are Standard Errors

FIGURE 7: Net Imports – Actual and Fitted Values



coefficients for the model and Figure 7 compares actual and fitted values.

The coefficient on the structural demand term is not significantly different from zero illustrating the structural demand was of no importance in determining imports prior to 1971. That is to say imports prior to 1971 were the result of harvest fluctuations creating occasional shortages. This is consistent with policy developments which formally identified livestock production as a priority area in 1971. The model was re-estimated dropping this term and the results are presented in Table 2. The size of the parameter on the dummy structural demand term is high not significantly different from unity, indicating that, in general, the Soviets make up all of any structural deficit with imported supplies. However, the parameter on the random demand term is much smaller indicating that only some 25% of any unexpected shortage is made up. This implies that when such shortages occur their impact is partially absorbed by stock changes or by compromises on meat production targets. Conversely, if harvests are good and actual production is above trend production, the implication is that import demand is not reduced by the full amount of the surplus and that imports in excess of requirements are made in order build up stocks. Estimates of stock changes partially confirm this analysis - stocks are reduced in years when the harvest is below its expected level and increased in years when the harvest is above its expected level - as shown in Table 3 and Figure 8.

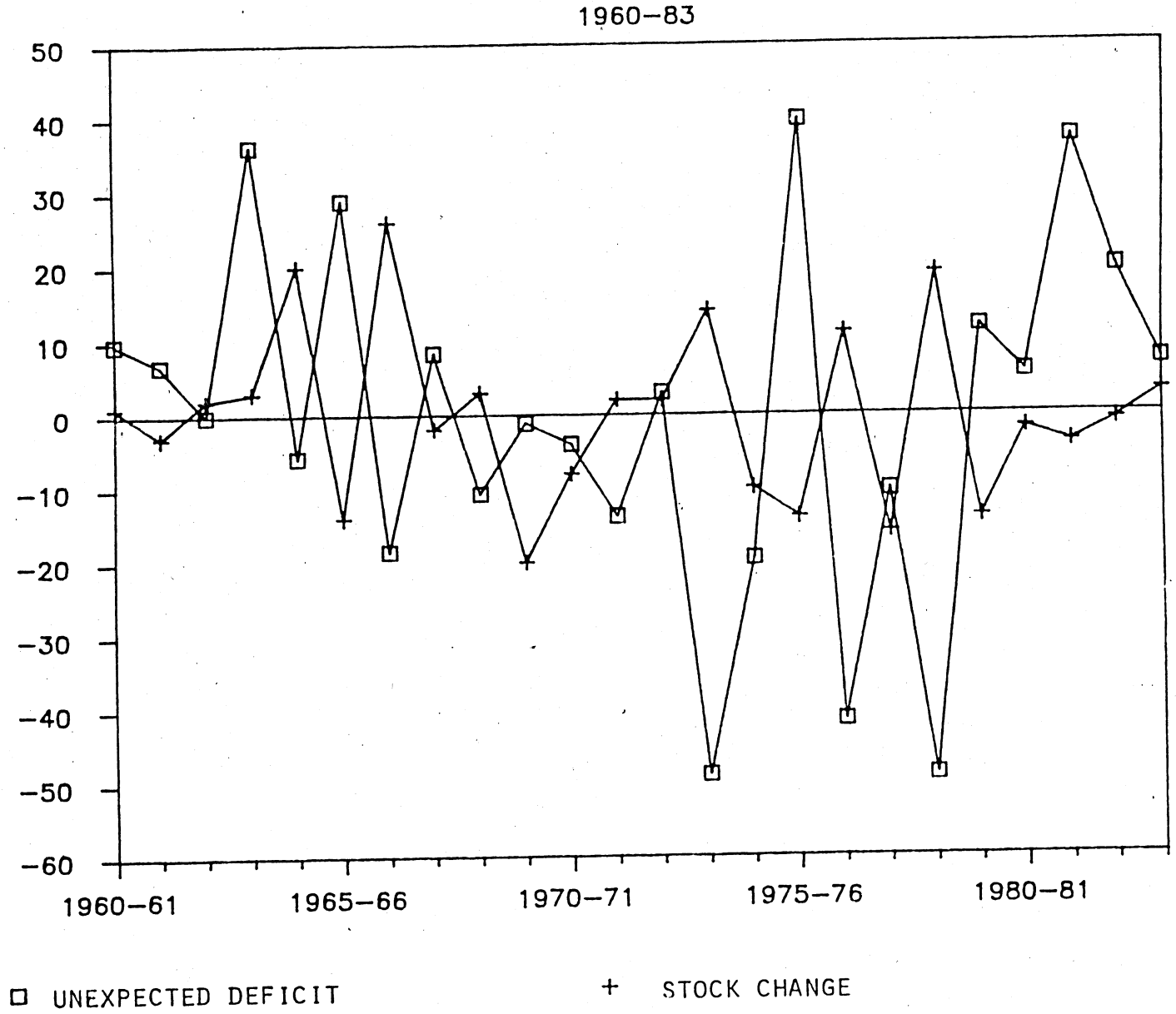
TABLE 3: Unexpected Deficits and Stock Changes

	Trend Production	Actual Production	Unexpected Deficit	Stock Changes
1960	135.16	125.50	9.66	1.09
1961	137.64	130.80	6.84	-3.00
1962	140.12	140.20	-0.08	2.00
1963	143.84	107.50	36.34	3.00
1964	146.32	152.10	-5.78	20.00
1965	150.04	121.10	28.94	-14.00
1966	152.52	171.10	-18.58	26.00
1967	156.24	147.90	8.34	-2.00
1968	158.72	169.50	-10.78	3.00
1969	161.20	162.40	-1.20	-20.00
1970	164.92	168.90	-3.98	-8.00
1971	167.40	181.20	-13.80	2.00
1972	171.12	168.20	2.92	2.00
1973	173.60	222.50	-48.90	14.00
1974	176.08	195.70	-19.62	-10.00
1975	179.80	140.10	39.70	-14.00
1976	182.28	223.80	-41.52	11.00
1977	184.76	195.11	-10.34	-16.00
1978	188.48	237.40	-48.92	19.00
1979	190.96	179.20	11.76	-14.00
1980	194.68	189.10	5.58	-2.00
1981	197.16	160.00	37.16	-4.00
1982	199.64	180.00	19.64	-1.00
1983	202.12	195.00	7.12	3.00

Correlation Coefficient between unexpected deficit and stock change: $R = -0.53$

Source: USDA (Various)

FIGURE 8: UNEXPECTED DEFICITS AND STOCK CHANGES



The world price term is less easily interpreted because of the possibility that as a pure price term it may be endogenous to the model. Its function in this model is as a proxy for the hard currency constraint which would be expected to tighten as world prices rose. In this context, a negative value is readily interpreted. The hard currency constraint is likely to have its greatest impact on imports required to meet unexpected deficits. The process of planning foreign trade implies that structural grain imports will be determined annually, included in annual plans and allocated hard currency accordingly. Unexpected increases in imports, as a result of poor harvests, will be possible only if the hard currency constraint is not binding and high world prices will tighten this constraint and thus will tend to reduce imports.

5. CONCLUSIONS

Structural shortages of grain in the Soviet Union are currently in the region of 30 million tonnes, 21 million tonnes of which is purchased through long term agreements. While the 1982 Food Programme has resulted in some increase in agricultural output and more recent policy statements suggest that some of the supply constraint will be eased, rising real incomes are likely to maintain the pressure of demand, particularly for livestock produce.

The import model developed in this paper has emphasised the role of planning in determining the volume of imports into the Soviet Union. In its current form it permits only crude forecasts to be made concerning import demand and such forecasts can only predict

structural import demand. Predictions through to 1990 on the assumption that there are no significant changes in world price suggest that the Soviet Union will continue to be a major presence on world grain markets. With the fall in oil and gold prices, the likelihood is that the hard currency constraint will become more binding, which implies that the current forecasts will be over estimates.

Despite this, the Soviets can be expected to be purchasing in the region of 25-30 million tonnes of grain, with the emphasis on wheat purchases. This will alter as harvests fluctuate, but since only a small proportion of random shortages are made up through imports, the de-stabilising effect year on year for world markets is likely to be relatively small.

NOTES

1. Kogan (1983) and Hedlund (1984) offer more detailed discussions of the nature of supply side constraints in Soviet agriculture.

2. Both production and trade figures are based on USDA figures reproduced in US Congress (1979) and USDA (various).

3. The indicator price only dates back to 1970 so the series was spliced with the US No. 2 HRW index to give a series dating back to 1960.

4. Many Commentators argue that this constraint is not particularly binding although recent falls in oil prices may tighten it.

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