TRENDS IN WORLD GRAIN TRADE, CONSUMPTION AND PRODUCTION, 1960-1980

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TABLE OF CONTENT

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Introduction

Increased agricultural exports have increased the exposure of U.S. agriculture to instability and periods of disequilibrium in world markets. As part of a study of the implications of instability in international grain markets for U.S. policy, this paper will describe regional trends in wheat and coarse grain trade, consumption and production.

Variability in international grain trade can be caused by supply factors (changes in yields, harvested area, and stocks), demand factors (changes in population, income, stock holding preferences, consumption preferences, and relative prices) and government policy. This paper concentrates on supply factors that could contribute to instability in international grain trade, such as production and stock behavior as they effect net exports and net imports.

Individual country data is obtained from the commodity divisions of the Foreign Agricultural Service, United States Department of Agriculture. The country data is aggregated into regions based on geographic, income and trade level considerations. The time period covered is calendar years 1960 through 1980.

The first section on wheat and the second section on coarse grains include descriptions of the following variables by region;

a) net imports/net exports

b) net imports from the U.S.

c) production

d) harvested area

e) yield

f) beginning stocks

g) consumption

Simple statistics produced by a regression of each variable against time generates a thumbnail sketch of relative size (mean), relative change (slope as a percent of the mean), and variability about trend (the coefficient of variation of the regression). Variability, or the coefficient of variation of the regression is calculated as the standard error of the regression as a percentage of its mean. The greater the coefficient of variation, the greater the dispersion of observations about the trend line. In general, this dispersion has two explanations other than random or measurement error; either the variable is inherently unstable and fluctuates greatly, or the equation is misspecified and changes in the variable are not captured by a linear trend. "T" statistics and Durbin Watson statistics are reported for each variable in order to further evaluate how well the regression fits the trend. A series of graphs are presented to aid in evaluating trend for each country or region. These include net exports (imports), imports from the U.S., production, stocks, harvested area and yields. The composition of the INTSTAB DATA BASE for wheat and coarse grain regions are shown in the appendix. Coarse grain consists of corn, barley, sorghum, oats, rye, millet, and mixed grains.

SUMMARY

Wheat

The highest volatility in wheat trade 1960-1980 is found in the centrally planned economies and among South Asian Major Importers. The Soviet Union net trade balance changed from exporting 4 MMT in 1960 to imports of over 20 MMT in 1980. In 1980, Soviet Union net import volume is equivalent to 19 percent of all major exporter's net exports. Soviet purchases have fluctuated sharply with peaks in 1963, 1965, 1972, 1975 and into 1980 (Figure 1-04). This variability is reflected in imports of wheat from the U.S., especially in 1972 (Figure 1-07). China also shows some abrupt changes in import behavior with sharply increasing imports 1975-1980. China's wheat imports from the U.S. also increased rapidly during this period.

South Asian Major Importers show two periods of accelerating and deaccelerating net imports 1961-1968 and 1972-1977. These two periods contribute to the high variability in South Asian net imports and the overall negative growth trend for the 21 year period (Figure 1-03). This variability is also reflected in imports of wheat from the U.S. (Figure 1-06). Over the 21 year period 1960-1980, South Asian major importers accounted for 14 percent of imports from major exporters.

Asia overall is an area of steady growth in wheat net imports. LDC oil exporters also show rapid steady growth especially in the 1970's. Imports to Africa and Central and South America (excluding Argentina)[1] tend to vary only moderately.

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[1]Throughout this report "South America" refers to South American countries other than Argentina. Argentina is treated individually as an exporting country.

Europe accounted for 48 percent of the world's wheat production in the period 1960 through 1980 including the Soviet Union 26 percent, Eastern Europe 8 percent and Western Europe 14 percent. Europe is also where some of the most dynamic and volatile trends in production occurred. By 1980 West European production had increased 80 percent over 1960 from 36 MMT to 64.7 MMT. Almost half (44 percent) of this increase resulted from a more than doubling of wheat output in France from 11 MMT in 1960 to 23.7 MMT in 1980. This increase in production came through yield increases of 3.2 percent of the mean per year and with relatively low variability (Figure 1-25).

Variability in wheat production is high in the Soviet Union due to yield variability. Yields fell sharply below trend in 1974, 1975 and 1979. The trend in Soviet yield increases from 1960 through 1973 appears to have leveled off from 1974 through 1980 (Figure 1-29). Variability, however, increased sharply in the latter period.

Asia produced 22 percent of the world's wheat during the period 1960 through 1980 including China (10 percent) and Major South Asian importers (8 percent). Annual growth of production in China (5.7 percent) was rapid and keeping pace with increases in consumption (5.6 percent). Production of wheat among South Asian Major Importers also grew faster than consumption (6.2 percent vs. 4.9 percent). Gains have come through increased yields.

Production grew more slowly than consumption in Africa (1.9 percent vs. 5.1 percent) and in Central America (3.2 percent vs. 4.6 percent). Production grew faster than consumption in South America. Gains in Central America have been made through increased yields while yields in South America have actually fallen as new land was brought into production.

Wheat production in the U.S. and Canada was significantly altered through acreage reduction programs (Figures 1-09 and 1-11). Yields increased significantly during periods of acreage rollbacks. Australia and South Africa have significantly increased harvested area.

Stock behavior is another source of volatility in world trade. Half of the world's wheat stocks were held by the U.S. (31 percent) and Canada (18 percent), 1960-1980. Another 30 percent of the world's stocks were held by Europe, including the Soviet Union 15 percent, West Europe 13 percent and East Europe 12 percent. Each major exporter has had periods of major stock build ups.

Among importers, two periods of change in stock behavior emerge. First, stock increases occurred in a few countries prior to 1972 due to income or policy changes such as seen in Asia after 1969 (Figure 1-32), South America 1963-1968 (Figure 1-38), and Soviet Union 1966-1969 (Figure 1-28). Second, stock behavior in most LDC regions appears to have changed significantly after 1972, including Africa, Central and South America, Asia, and the LDC Oil Exporting countries.

Coarse Grains

Some of the same sources of trade volatility effecting wheat effect coarse grains. Europe is a major actor, Asia is important, South America and Africa take on more important roles in coarse grain imports in the 1970s. Changes in stock behavior do not appear to contribute as much to trade variability as with wheat with the possible exception of West Europe and Africa.

As with wheat, European coarse grain trade is dynamic and volatile. The Soviet Union had the highest variability about trend and changed from exporting 1.8 MMT in 1960 to importing 18 MMT in 1980. Soviet purchases peaked

sharply in 1975 and also accelerated 1976-1979 (Figure 2-26). East European net imports accelerate in the 1970s. Western Europe's production increased steadily from 1960 through 1980 resulting in only a slight overall increase in net imports. West Europe imports as a percent of net exports by major exporters fell from 73 percent in 1960 to 14 percent in 1980.

Asia is the second largest net importer of coarse grains, accounting for 30 percent of net imports from major exporters over the period 1960-1980. Japan accounted for 20 percent of net imports from major exporters followed by other east Asian middle income countries at 4 percent. Japan has shown steady growth in net import with relatively low variability (Figure 2-05). Net imports by China and by South Asian major importers account for 1 percent or less of net imports from major exporting countries.

Central and South America each account for 3 percent of net coarse grain imports from major exporting countries 1960-1980. Central American net imports of grain began accelerating in 1971 after remaining virtually unchanged from 1960 through 1970. South America changed from exporter 1960-1970 to a significant importer 1971-1980. South America exported 93 thousand metric tons of coarse grains in 1960 and imported 2.592 million metric tons in 1980 (Figure 2-36).

Western Europe imported 42 percent of U.S. coarse grains exports from 1960 through 1980. Western European imports, however, have decreased as a percent of U.S. exports over the 21 year period. Significant growth areas for U.S. exports include the Soviet bloc, Japan, East Asia Middle Income countries and LDC oil exporters.

Coarse grain production in Europe grew at an annual rate of 2.6 percent in the period 1960-80. Variability in both East and West Europe was between 5-6 percent of the mean while variability in Soviet production was equal to 16

percent. Variability in Soviet coarse grain production is especially pronounced after 1972 (Figure 2-27). Growth of coarse grain production in the Soviet bloc was slower than growth in consumption (2.2 percent vs. 3.7 percent).

The United States is the second largest producer of coarse grain, accounting for 29 percent of world production 1960-1980. Asia produced 19 percent of world supply including China 10 percent and South Asian major importers 6 percent. Production of coarse grain in China and among South Asian major importers has almost kept pace with consumption (3.5 percent vs. 3.6 percent in China and 1.5 percent vs. 1.6 percent in South Asia).

Among major exporters other than the U.S., growth in coarse grain production appears to have slowed in the late 1970s (Figure 2-23). Yields continued to increase but harvested area decreased overall among these countries 1970-1980 by 3 percent (Figure 2-23).

West European yield grew about the world average with low variance. East European yields grew faster than the world average. A partial explanation can be found in the 16 percent reduction in harvested area 1960-1980. Soviet average yields changed only moderately but harvested area increased 24 percent 1970-1980 (Figures 2-25, 2-27, 2-29).

Yields of coarse grain in Asia grew by 3 percent of the mean per year and appears to have accelerated 1972-1980 (Figure 2-33). Leading yield growth rates are China (4.5 percent) and East Asian Middle Income (3.3 percent).

Coarse grain stocks do not show the same volatility as wheat stocks with the exception of stocks in West Europe after 1974 (Figure 2-24) and Africa after 1971 (Figure 2-34).

TRENDS ANALYSIS OF TRADE, PRODUCTION AND CONSUMPTION OF WHEAT

Exports

Over the 21 years 1960 through 1980, the United States accounted for 46 percent of total world wheat exports. Other major exporters together accounted for 54 percent (Table 1-02). Canada accounted for about one-fourth and Australia accounted for about one-fifth. France showed the highest rate of export growth over the twenty year period (12.5 percent per year) and has exported more wheat than Australia in several recent years (Figure 1-01).

The United States increased its exports by an average of 4 percent of the mean per year over the 21 year period. Australian net wheat exports grew almost as fast at the U.S. but with higher variability (a coefficient of variation of 20 percent vs. 3 percent). Canadian and Argentina net wheat exports grew more slowly that the U.S. at 1.7 percent and 1.5 percent respectively. Argentina had a high variability (54 percent) while Canada had net export variability comparable to Australia at 20 percent.

Quantities of wheat exported by Argentina were equal to 5 percent of total net exports, Turkey and South Africa less than 1 percent. Turkey has exported wheat since 1976 and South Africa since 1972. Figures 1-14, 1-16 and 1-18 show the trends and fluctuations of wheat export for these countries.

Imports

Asian imports are a large and growing component of wheat trade. Asia accounted for an average of 43 percent of net wheat imports from major exporters from 1960-through 1980 (Table 1-02). Asian imports grew at 3.3 percent of the mean per year with relatively low variability. Major components of Asian wheat net imports are S. Asian major importers (14 percent), Japan (8 percent), China (10 percent) and East Asia middle income countries (4 percent).

Table 1-01

Quantity and Share of Wheat Net Exports
Major Wheat Exporters 1960-1980

	1960		1970		1980	
	Million Metric Tons	Percent of Total*	Million Metric Tons	Percent of Total*	Million Metric Tons	Percent of Total*
U.S.	17.74	(50)	19.82	(45)	41.45	(48)
Canada	9.61	(27)	11.85	(27)	16.00	(19)
Australia	6.46	(18)	9.15	(21)	11.50	(13)
France	1.14	(3)	2.88	(7)	13.43	(15)
Argentina	1.09	(3)	.97	(2)	3.70	(4)
Turkey	.37	(1)	.90	(2)	.50	(1)
S. Africa	.07	(--)	.16	(--)	.19	(--)
Major Exporters Less U.S.	17.86	(50)	23.78	(55)	44.94	(52)
Total Net Exports of Major Exporters	35.60	(100)	43.60	(100)	86.39	(100)
Total Exports	44.01	(1.24)	56.16	(1.29)	99.70	(1.15)

*Market share is calculated as a percent of total net exports of major exporters.

Table 1-02

Wheat: Net Exports and Imports Selected Regions, 1960-1980

Region	1000 Metric Tons (mean)	World Share* (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	24,657	46	4.00	3.20	6.00	1.08
Canada	12,492	23	1.70	19.80	2.00	1.64
Australia	7,851	15	3.50	20.50	5.00	1.60
Argentina	2,937	5	1.50	54.30	.70	1.34
Turkey**	-150	--	4.30	146.00	3.00	1.33
South Africa	-35	--	5.50	212.00	2.00	1.34
France	5,723	11	12.50	23.00	10.00	1.36
Major Exporters Less U.S.	28,819	54	3.80	14.40	7.00	.69
Importers						
Western Europe	2,002	4	-3.80	21.80	8.00	1.32
Eastern Europe	3,953	7	-2.70	33.40	2.00	1.38
U.S.S.R.**	1,695	3	6.40	56.30	3.00	1.65
Soviet Bloc	5,648	11	9.90	113.00	2.00	1.47
Total Europe	7,651	14	-2.60	76.80	1.00	1.91
Middle East Oil	1,633	3	11.72	44.59	7.00	.79
Middle East Other	1,064	2	4.99	13.51	10.00	1.95
East Asia Middle Income	1,930	4	5.90	18.50	9.00	.84
Japan	4,522	8	3.70	8.10	12.00	1.25
China	5,417	10	4.40	42.70	3.00	.87
S. Asia Major Importers	7,464	14	-.60	30.30	.50	.60
Total Asia	23,251	43	3.30	9.90	9.00	.98
Major Africa Importers	5,098	10	6.90	14.90	13.00	.90
Total Africa	7,178	13	7.70	15.90	13.00	.74
Mexico**	230	--	6.10	10.00	5.00	.91
Other C. America Major Importers	1,441	2	3.40	11.10	8.00	.91
Total C. America	1,804	3	6.30	16.00	11.00	.92
Total S. America	5,220	10	4.40	12.90	9.00	1.28
LDC Oil Exporting	4,873	9	11.00	27.40	11.00	.54

*Market share is calculated as a percent of net exports by major exporters.

**Annual growth and coefficient of variation are given as a percent of the mean of absolute change in the variable as opposed to just the mean. Because these countries change from net exporter to importers or vice-versa the standard mean understates the volume of their transactions and overstates the ratio of the slope or variation to their mean.

Mid-East Oil Country net imports of wheat have grown the fastest. Each of the Asian subregions have grown at 4-6 percent with the exception of South Asian major importers. As shown in Figure 1-03, South Asian major wheat importers show two periods of accelerating and deaccelerating net imports (1962-1968 and 1972-1978) but no overall growth trend. Japan and East Asian middle income countries had steady growth throughout the period of 3.7 percent and 5.9 percent. Japan accounted for 8 percent of net wheat imports over the period. LDC oil exporters show rapid growth (11 percent) especially after 1969. LDC oil exporters account for 9 percent of net wheat imports.

Net imports of wheat to China have fluctuated with a strong upward trend beginning in 1975. Over the 20 year period net imports have increased at 4.4 percent per year, accounting for 8 percent of world net imports in 1970 and 16 percent in 1980.

The trend of European net imports is composed of three distinct trends in its three subregions (Figure 1-04). Western Europe changed from net imports of about 11 million metric tons in 1960 to net exports of 11 million metric tons in 1980. France was a strong contributor to the growth in European wheat exports, averaging a 12.5 percent growth in exports per year. The Soviet Union shows the widest range in net import behavior, changing from exporting 4.4 MMT of wheat in 1960 to importing 20 MMT in 1980. Figure 1-04 shows that peak periods of Soviet wheat imports occurred in 1963, 1965, 1972, 1975, and 1980.

Overall the Soviet Union has the highest coefficient of variation at 56 percent, much larger than that of Western Europe (22 percent), and Eastern Europe (33 percent). On the average, Soviet net imports of wheat appear to be growing at a rapid rate although a linear regression against time poorly captures changes in Soviet import behavior.

Africa has more than doubled its share of net wheat imports from 7 percent in 1960 to 16 percent in 1980 (Table 1-03 and Figure 1-02). Net imports have varied moderately about trend with a coefficient variation equal to 15.9 percent of the mean. There may be a trend break with accelerating import growth beginning in 1968.

Central America doubled its share of net wheat imports from 2 percent in 1960 to 4 percent in 1980. Variability about trend is moderate (16 percent). Net imports have been increasing at an average of over 6 percent per year. Variability may be increasing or a new trend beginning in 1976 with the lowest net import level in 1976 and the high in 1980. Mexico accounted for 1 percent of world net wheat imports and other major Central American importers for 2 percent. South America accounted for about 10 percent of world wheat imports in the period 1960 through 1980.

Wheat Imports from the U.S.

Asia is also the region of greatest quantity of wheat imports from the U.S., accounting for 48 percent of U.S. wheat exports over the 21 year period (table 1-04). Major components of the market are South Asian major importers (20 percent) and Japan (10 percent) (Figure 1-06). Japanese imports of wheat have grown steadily at an average rate of 5 percent of the mean per year with 14.5 percent variability.

High rates of growth in imports from the U.S. are shown for Middle East oil exporters (10.6 percent), and East Asian Middle Income countries (7.5 percent). A sharp increase in Asian net imports from the U.S. in 1980 can be explained by China. Chinese wheat imports from the U.S. grew from 0 to about 2.5 MMT in 1973 and then shot up to over 8 MMT in 1980 (Figure 1-07). China accounted for 4 percent of U.S. wheat exports, 1960-1980.

Table 1-03

Quantity and Share of Wheat Net Imports
Selected Regions, 1960, 1970 and 1980

Importers	1960 Million Metric Tons	1960 Percent of Total*	1970 Million Metric Tons	1970 Percent of Total*	1980 Million Metric Tons	1980 Percent of Total*
Western Europe	11.140	31	7.645	18	-11.110	-13
Eastern Europe	4.566	13	6.664	15	4.025	5
U.S.S.R.	-4.435	-12	-6.719	-15	16.200	19
Soviet Bloc	.131	004	-.005	--	20.230	23
Total Europe	11.271	32	7.590	17	9.120	11
Middle East Oil	.834	2.3	1.043	2.4	4.710	5.5
Middle East Other	.659	1.9	1.163	2.7	1.566	1.8
East Asia Middle Income	.681	1.9	2.599	6	3.080	3.6
Japan	2.781	08	4.799	11	5.550	6
China	1.947	05	3.658	08	14.000	16
S. Asia Major Importers	6.611	19	5.957	14	4.522	5
Total Asia	14.630	41	20.960	48	35.150	41
Major Africa Importers	1.778	05	4.947	11	9.658	11
Total Africa	2.403	07	6.541	15	14.130	16
Mexico	.007	--	-.035	--	1.130	1
Other C. American Major Importers	.602	02	1.399	03	2.026	2
Total C. America	.681	02	1.514	09	3.379	4
Total S. America	3.066	09	3.831	09	8.269	10
LDC Oil Exporters	1.767	05	3.410	08	12.290	14
Total Net Exports	35,600	100	43.600	100	86.390	100

*Market share is calculated as a percent of total net exports of major exporters.

Table 1-04

Wheat Imports from the U.S. Selected Regions, 1960-1980

Region	1000 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Western Europe	2,630.00	11	2.10	30.00	1.9	1.95
Eastern Europe	1,099.00	5	.80	68.20	.3	1.13
U.S.S.R.	1,663.00	7	13.00	119.00	3.0	2.10
Soviet Bloc	2,762.00	12	8.20	84.90	2.7	1.96
Total Europe	5,392.00	23	5.20	50.30	2.9	1.98
Middle East Oil	709.00	3	10.60	69.60	4.2	1.13
Middle East Other	564.00	2	3.80	18.00	5.8	2.06
East Asia Middle Income	1,625.00	7	7.50	20.40	10.2	1.25
Japan	2,451.00	10	5.10	14.50	9.8	1.94
China	911.00	4	21.00	1.91	3.0	1.07
S. Asia Major Importers	4,858.00	20	-2.90	36.80	2.2	1.08
Total Asia	11,412.00	48	3.40	18.90	5.0	1.37
Major Africa Importers	1,969.00	8	3.30	46.70	2.0	.44
Total Africa	2,860.00	12	5.20	38.90	3.7	.58
Mexico	290.00	1	15.90	91.30	4.8	.98
Other C. America Importers	434.00	2	5.10	9.80	14.5	1.31
Total C. America	838.00	3	9.10	29.20	8.6	.98
Total S. America	3,102.00	13	5.30	24.60	5.9	2.01
LDC Oil Exporting	2,750.00	11	10.10	25.40	11.1	1.03
World Total	23,960.00	100	4.30	18.90	6.3	1.14

Figure 1-07 shows sharp fluctuations in net imports of wheat from the U.S. by the Soviet Union 1971-1974, and China 1977-1980. The Soviet Union imported 7 percent of U.S. wheat exports 1960-1980 despite making virtually no purchases prior to 1972.

Overall, Europe accounted for 23 percent of U.S. wheat exports, including Western Europe 11 percent, Eastern Europe 5 percent and the Soviet Union 7 percent. Western European imports from the U.S. are shown to be increasing slightly by 2 percent of the mean per year. Eastern Europe wheat imports from the U.S. declined from 1960 to 1968 then increasing slightly from 1968 to 1980. Overall, Eastern European imports show little change from 1960 to 1980 although Eastern European wheat imports like those of the Soviet Union are not well represented by a simple linear time trend (Table 1-04).

South America accounted for 13 percent of wheat imports from the U.S. The growth trend for imports from the U.S. to Central and South America are fairly linear (Figure 1-05), with coefficients of variation equal to less than 10 percent.

African wheat imports from the U.S. also shows fairly steady growth, equal to 5 percent of the mean per year. Wheat imports from the U.S. appear to have slowed from 1966 to 1970 and then have grown steadily from 1970 to 1980.

LDC oil exporters increased imports of wheat from the U.S. by 10 percent per year on the average. LDC oil exporters accounted for 11 percent of U.S. exports of wheat with moderate variability.

Production

Production trends for wheat are shown in Table 1-05. Europe was the largest wheat producer on the average during the period 1960-1980, accounting

Table 1-05

Wheat: Production, Selected Regions, 1960-1980

Region	1000 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	43,868	13	3.40	10.00	9.6	1.2
Canada	16,710	5	1.40	22.00	1.7	1.6
Australia	10,420	3	2.80	25.00	3.1	2.2
Argentina	7,009	2	1.20	26.00	1.3	1.7
Turkey	9,474	3	3.80	12.00	8.6	1.0
South Africa	1,354	--	1.50	20.00	7.0	1.4
France	15,457	5	3.20	11.00	7.5	2.1
Major Exporters Less U.S.	60,425	18	2.50	8.00	6.2	1.6
Importers						
Western Europe	47,601	14	2.20	8.00	7.9	2.3
Eastern Europe	26,352	8	3.70	10.00	10.0	1.8
U.S.S.R.	84,721	26	2.20	16.00	3.8	2.4
Soviet Bloc	111,072	34	2.60	14.00	5.3	2.3
Total Europe	158,673	48	2.50	10.06	6.8	2.4
Middle East Oil	51,130	2	3.07	12.08	7.0	2.2
Middle East Other	349	--	2.03	34.50		
East Asia Middle Income	156	--	5.90	25.80	6.3	.5
Japan	753	--	-9.10	38.00	6.7	1.0
China	33,971	10	5.70	14.00	11.6	1.3
S. Asia Major Importers	26,713	8	6.20	11.00	15.4	.9
Total Asia	71,748	22	5.30	9.00	16.9	1.3
Major Africa Importers	4,593	1	2.10	13.00	4.7	2.0
Total Africa	6,301	2	1.90	13.00	4.0	2.1
Mexico	2,053	1	3.20	16.00	5.6	1.5
Other C. American Major Importers	36	--	3.10	16.00	5.3	1.5
Total C. America	2,088	1	3.20	15.00	5.7	1.4
Total S. America	3,073	1	4.70	17.00	7.7	2.4
LDC Oil Exporting	8,598	3	2.70	11.00	6.5	2.3
World Total	330,719	100	3.20	5.00	16.8	3.1

for 48 percent of world wheat production over the twenty-one year period. Growth in European production was slower than the world average (2.5 percent vs. 3.2 percent). Low growth rates were seen in both Western Europe and the Soviet Union (2.2 percent). Western Europe and the Soviet Union had 14 and 26 percent of world wheat production respectively. The Soviet Union, however, had higher variability (16 percent vs. 8 percent). Eastern Europe produced 8 percent of the world's wheat and output grew at a faster than average rate of 3.7 percent.

As indicated in figures 1-25, 1-27, and 1-29 production growth in Western European and Eastern European appear to be adequately approximated by a linear trend but this is not the case for Soviet production. Soviet wheat production appears to have flattened out from 1966 to the end of the reporting period. West European and East European production gains and Soviet production stagnation are closely related to yields as shown in Figures 1-25, 1-27, and 1-29.

The U.S. accounted for 13 percent of world wheat production. U.S. production grew at a faster rate than the world average (3.4 percent vs. 3.2 percent) with moderately low variability (10 percent). As shown in Figure 1-09 U.S. wheat production has been effected by acreage reduction programs during part of the period.

Asia produced 22 percent of the world's wheat from 1960 to 1980. Wheat production is most concentrated in China (10 percent) and Major South Asian importers (8 percent). Growth in wheat production in these areas averaged about 6 percent of the mean per year with a moderately low degree of variability equal to 14 percent in China and 11 percent in South Asian Major importers.

Africa produced 2 percent of the world's wheat in the years 1960-1980. Production grew only 2 percent per year on average and varied 13 percent.

Most of Central America's wheat is produced in Mexico. Production grew by 3.2 percent of the mean per year with 16 percent variation. Figure 1-37 shows that gains in production were made through expansion of harvested area except in the period 1972-1976. Expansion of harvested area from 1977 through 1980 did not result in increased production as yields fell from their 1976 peak.

LDC Oil Exporters have increased production moderately over the period 1960 through 1980. Over the 21 year period they produced 3 percent of the world's wheat. Production increased at a slower than average rate of 2.7 percent per year with moderate variation (11 percent). Figure 1-41 shows that production peaked in 1976 and fell to lower levels 1977-1980.

Yields

World yields of wheat averaged 1.51 metric tons per hectare over the 21 year period 1960-1980. Yields grew at an average rate of 2.6 percent of the mean with 5 percent annual variation (Table 1-06).

Among major wheat exporters, France shows the highest yield per hectare (3.75). Yields in France are among the fastest growing 3.2 percent of the mean per year and varied only 7 percent of the mean. The U.S. has the second highest yield per hectare, 1.96 metric tons, but yield are growing at a slower rate of 1.5 percent of the mean. Third and fourth highest yields are found in Canada 1.64 and Argentina 1.45 metric tons per hectare. The greatest average increases in yields were in South Africa 3.4 percent of the mean, France 3.2 percent and Turkey 3.2 percent. Variability ranged from 6 percent (U.S.) to 19 percent (Australia) for major wheat exporters.

Figures 1-09 and 1-21 highlight a difference in U.S. and French wheat yields. France shows consistent gains with fluctuations about a linear trend.

Table 1-06

Wheat: Yields Selected Regions, 1960-1980

Region	MT Per Hectare (mean)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters					
U.S.	1.96	1.50	6.00	6.5	1.0
Canada	1.64	1.80	15.00	3.4	2.0
Australia	1.24	.20	19.00	.2	2.6
Argentina	1.45	1.20	14.00	2.4	1.3
Turkey	1.15	3.20	11.00	7.8	1.1
South Africa	.8	3.40	15.00	6.3	1.9
France	3.75	3.20	9.00	9.7	1.7
Major Exporters Less U.S.	1.61	1.90	7.00	2.7	2.2
Importers					
Western Europe	2.81	3.20	6.00	15.9	2.0
Eastern Europe	2.58	3.90	8.00	13.9	2.0
U.S.S.R.	1.3	2.80	15.00	5.0	2.3
Soviet Bloc	1.51	3.10	12.00	6.9	2.2
Total Europe	1.75	3.04	6.73	9.3	2.3
Middle East Oil	.82	1.43	6.73	5.9	2.0
Middle East Other	.99	3.24	22.70	3.95	1.8
East Asia Middle Income	2.26	1.70	16.00	2.9	1.3
Japan	2.65	1.50	16.00	2.6	1.7
China	1.26	4.80	10.00	12.9	1.6
S. Asia Major Importers	1.13	3.60	7.00	13.9	1.1
Total Asia	1.16	3.80	5.00	20.2	2.0
Major Africa Importers	1.07	2.20	11.00	6.2	2.3
Total Africa	.93	1.80	10.00	5.1	2.4
Mexico	2.68	3.50	10.00	9.7	1.7
Other C. America Major Importers	.92	.70	16.00	.13	1.2
Total C. America	2.58	3.30	10.00	9.0	1.6
Total S. America	1.03	-.50	14.00	1.1	1.5
LDC Oil Exporting	.97	1.50	7.00	6.5	2.2
World Total	1.51	2.60	5.00	14.5	2.7

Harvested area is relatively unchanged. The U.S. shows significant changes in harvested area due to government supply management programs. When harvested area was withdrawn 1966-1970 and 1975-1978, yields increased, when harvested area was returned 1970-1974 yields decreased. Overall, variability in both countries is moderate at 6 percent in the U.S. and 9 percent in France, but expansion and contraction of harvested area is a much more influential factor in U.S. yields than it is in France.

Yields in Canada, like the U.S. appear to be affected by supply management programs. Canadian yields averaged 1.64 metric tons per hectare, about the world average. Yields grew faster than the U.S. (1.8 percent vs. 1.5 percent) and varied two and one-half times as much (15 percent vs. 6 percent).

Yields in Europe averaged 1.75 metric tons per hectare, ranging from a low of 1.3 in the Soviet Union, to 2.6 in Eastern Europe, and 2.8 in Western Europe. Yields in Eastern Europe grew faster than in Western Europe (3.9 percent vs. 3.2 percent). The Soviet Union increased yields at 2.8 percent per year with about twice as much variability (15 percent) as either Eastern Europe (8 percent) or Western Europe (6 percent).

Asian wheat yields were lower than the world average, 1.2 vs. 1.5 metric tons per hectare, with the exception of East Asia (2.26) and China (2.65). Growth in Chinese wheat yields were the highest anywhere in the world at 4.8 percent of the mean from 1960 through 1980. Yields in South Asian Major Importers also grew at a rapid rate of 3.6 percent per year.

African wheat yields averaged only .93 metric tons per hectare and grew at a low 1.8 percent per year.

Central America had a high yield average of 2.58 metric tons per hectare. Growth in yields appears to be flattening out after 1976, possibly due to the

strong expansion in harvested acres (Figure 1-37). South American wheat yields are a low 1.03 and have declined somewhat from the mid-1960s (Figure 1-39).

Harvested Area

During the years 1960-1980 an average of 217,659,000 hectares of wheat were harvested throughout the world. Harvested area has increased an average of .6 percent of the mean per year and varied only 3 percent. Table 1-05 shows the distribution of wheat harvested area. Europe harvests 42 percent of the world's wheat, including the Soviet Union 29 percent, Western Europe 8 percent, and Eastern Europe 5 percent. Asia harvested 28 percent of the world's wheat area, including China 12 percent, Major South Asian Importing countries 10 percent. Africa harvested 3 percent of the world's wheat area, Central America 1 percent and South America 1 percent. LDC Oil Exporters altogether accounted for 4 percent (Table 1-07).

The highest growth areas for harvested area are South America (5.5 percent), Central America Major Importers (3.3 percent) and Australia (2.6 percent). Japan and Western Europe have decreased harvested area of wheat by an average of 1 percent per year. Among major wheat exporters, harvested area has been fairly stable with the exception of temporary acreage control programs by the U.S. and Canada, and the increases in harvested area by Australia. South Africa expanded harvested area from 1966 to 1972 and since has reduced acreage slightly from its 1972 level (Figure 1-17).

Stocks

As would be expected, stocks of wheat show greater variability than any other variable both for the world in total and for most countries and regions.

Table 1-07

Wheat: Harvested Area Selected Regions, 1960-1980

Region	1000 Hectares (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	22,259	10	1.90	12.00	4.4	.8
Canada	10,236	5	-.50	16.00	.8	.9
Australia	8,368	4	2.60	14.00	5.2	.8
Argentina	4,820	2	.10	18.00	.1	1.6
Turkey	8,161	4	.60	1.00	14.0	1.0
South Africa	1,652	1	1.90	13.00	4.1	.6
France	4,124	2	-.10	6.00	.3	2.0
Major Exporters Less U.S.	37,362	17	.70	8.00	2.5	1.0
Importers						
Western Europe	17,159	8	-1.00	3.00	8.3	2.4
Eastern Europe	10,222	5	.03	4.00	10.0	1.1
U.S.S.R.	63,822	29	-.50	5.00	3.0	1.0
Soviet Bloc	74,044	34	.50	4.00	2.9	11.9
Total Europe	91,203	42	-.56	3.81	4.1	1.0
Middle East Oil	5,763	2	1.72	7.25	6.6	1.9
Middle East Other	401	--	-.95	17.34	1.8	1.6
East Asia Middle Income	72	--	-.70	22.00	8.8	.35
Japan	297	--	-1.03	29.00	9.7	.2
China	26,419	12	.80	3.00	7.2	.8
S. Asia Major Importers	22,744	10	.28	5.00	14.8	.8
Total Asia	60,317	28	1.60	3.00	16.2	1.0
Major Africa Importers	4,303	2	-.10	6.00	.3	1.1
Total Africa	6,759	3	-.20	7.00	.6	1.2
Mexico	768	--	-.40	8.00	1.6	1.5
Other C. America Major Importers	40	--	3.30	20.00	4.5	.72
Total C. America	808	--	.30	8.00	.9	1.4
Total S. America	3,037	1	5.50	14.00	9.1	1.4
LDC Oil Exporting	8,806	4	1.20	6.00	5.1	1.9
World Total	217,659	100	.60	3.00	6.7	1.0

World stocks averaged 78.144 million metric tons per year over the 21 year period. Five country/regions account for nearly all of the wheat stocks (Table 1-08).

Almost 50 percent of the world's wheat stocks were held in North America (U.S. 31 percent and Canada 18 percent). Europe held 30 percent, including the Soviet Union (15 percent), Western Europe (13 percent), and Eastern Europe (2 percent). Asia accounted for 11 percent of world wheat stocks, found mostly in South Asian Major Importers (7 percent).

Western Europe and Japan show the most stable stocking behavior and the lowest coefficient of variation.

Wheat stocks in the U.S. and Canada decreased 2-3 percent per year through 1980 from their 1960 levels (Figure 1-08 and 1-10). Periods of the most rapid stock reduction in the U.S. were 1961-1968 and 1972-1974. Canadian wheat stocks surged to record levels from 1966 through 1970 then fell back to more normal levels. Australia, Argentina and Turkey all have had periods of surging stocks but at different times.

In Europe, the Soviet Union shows the most volatile stock behavior with a coefficient of variation equal to almost five times the world average and three times that of the U.S. Figure 1-28 shows the highest peaks in Soviet wheat stocks to occur in 1968-1970, 1974, and 1979.

Asia shows wheat stocks growing a 6.4 percent of the mean per year. Figure 1-32 shows fairly steady growth until stocks surged in 1975 to a 1977 peak. Asian stocks have since declined. Figure 1-34 shows Africa with fairly low stock until rapid growth began in 1972 to a 1978 peak, after which stock levels have declined.

Central and South America maintain only modest wheat stocks though some expansion occurred following the grain scare of 1973 when the Soviets entered

Table 1-08

Wheat: Beginning Stocks Selected Regions, 1960-1980

Region	1000 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	24,255	31	-2.1	32	1.8	.32
Canada	14,395	18	-3.1	32	1.1	.34
Australia	2,409	3	3.9	64	1.3	.84
Argentina	925	1	1.3	82	.4	.82
Turkey	2,228	3	10.5	50	5.8	.05
South Africa	393	1	9.3	38	6.7	.38
France	1,734	2	.4	37	.29	.37
Major Exporters Less U.S.	21,984	28	.7	29	.7	.29
Importers						
Western Europe	10,419	13	.8	15	1.5	.15
Eastern Europe	1,361	2	2.5	31	2.2	.31
U.S.S.R.	11,381	15	1.9	95	.6	.95
Soviet Bloc	12,742	16	1.5	86	.5	.86
Total Europe	11,291	30	1.17	48.8	.67	.49
Middle East Oil	765	1	8.57	39.36	6	.39
Middle East Other	266	--	2.50	33.26	2.1	.33
East Asia Middle Income	202	--	13.1	42	8.6	.42
Japan	1,120	1	3.2	13	6.7	.13
China	na	na	na	na	na	na
S. Asia Major Importers	5,688	7	6.3	36	4.9	.36
Total Asia	8,340	11	6.4	29	6.2	.29
Major Africa Importers	723	1	11.7	48	6.7	.48
Total Africa	185	--	1.5	46	7.5	.46
Mexico	185	--	1.5	62	.7	.62
Other C. American Major Importers	45	--	8.8	22	11.1	.22
Total C. America	240	--	3.4	48	2	.48
Total S. America	791	1	4.2	32	3.7	.32
LDC Oil Exporting	1,241	2	8.9	39	6.4	.39
World Total	78,144	100	7.9	19	1.2	.19

the market to make unprecedented purchases. Change in stock behavior after 1973 also appears to have occurred in LDC oil exporting countries.

Consumption

On the average 328 million metric tons of wheat were consumed per year over the 21 year period 1960-1980. Consumption has grown at 3.2 percent of the mean per year with low variability of 3 percent (Table 1-09).

About fifty percent of the world's wheat was consumed in Europe, including the Soviet Union 26 percent, Western Europe 15 percent, and Eastern Europe 9 percent. The Soviet Union shows the largest potential production-consumption deficit with consumption growing at 3.2 percent of the mean per year compared with production growth of 2.2 percent. Western Europe shows the greatest surplus production trend with consumption growing at .6 percent and production growing at 2.2 percent. Eastern Europe also shows a surplus production trend with consumption growing at 2.8 percent and production growth of 3.7 percent.

Asia consumes 29 percent of the world's wheat, including South Asia Major Importers 10 percent and China 12 percent. Consumption in both of these Asian regions has been growing fast, South Asia Major Importers at 4.9 percent and China at 5.6 percent. South Asian wheat production has actually been growing faster than its wheat consumption (6.2 percent vs. 4.9 percent) while Chinese wheat production has almost kept pace (production 5.7 percent growth vs. consumption 5.6 percent). Still, production fell short by 7.2 million metric tons or 16 percent of production in South Asia and by 13.8 million metric tons or 25 percent of production in China in 1980. Consumption has varied more for East Asia Middle Income countries and China than anywhere else in the world.

Table 1-09

Wheat: Consumption Selected Regions, 1960-1980

Region	1000 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	19,806	6	1.5	8	5.2	1.0
Canada	4,608	1	1.6	4	10.5	1.2
Australia	2,622	1	1.7	14	3.4	1.0
Argentina	4,108	1	1	10	2.9	1.6
Turkey	9,335	3	2.7	4	17.0	.5
South Africa	1,387	--	3.7	7	14.1	2.4
France	9,644	3	.2	2	.8	1.5
Major Exporters Less U.S.	31,705	10	1.5	4	1.4	.7
Importers						
Western Europe	49,361	15	.6	3	5.3	1.2
Eastern Europe	30,367	9	2.8	7	12.2	1.8
U.S.S.R.	86,368	26	3.2	8	10.8	.9
Soviet Bloc	116,735	36	3.1	6	14.1	.9
Total Europe	166,096	51	2.39	5	12.9	.9
Middle East Oil	6,693	2	5.1	9	15.7	.5
Middle East Other	1,468	--	4.28	5	25.6	2.2
East Asia Middle Income	2,065	1	5	17	8.3	.74
Japan	5,235	2	1.9	2	28.7	1.3
China	39,389	12	5.6	15	10.6	.6
S. Asia Major Importers	34,076	10	4.9	6	21.3	1.1
Total Asia	94,758	29	4.9	8	18.0	.7
Major Africa Importers	9,885	3	4.7	5	29.4	1.1
Total Africa	13,454	4	5.1	6	25.3	.8
Mexico	2,275	1	5.5	6	28.6	.4
Other C. American Major Importers	1,473	--	3.4	11	8.5	.9
Total C. America	3,882	1	4.6	4	32.2	1.0
Total S. America	8,321	3	4.6	5	24.5	.9
LDC Oil Exporting	13,386	4	5.6	8	18.6	.3
World Total	328,379	100	3.2	3	26.1	.9

Africa accounts for only 4 percent of wheat consumption. African consumption has grown rapidly at 5.1 percent per year while production has grown by only 1.9 percent per year.

Central America accounts for 1 percent of the world's wheat consumption. Consumption has grown at 4.6 percent while production has grown at 3.2 percent. South America accounted for 3 percent of the world's wheat consumption on the average. Wheat consumption has kept pace with wheat production, consumption growing at 4.6 percent and production growing at 4.7 percent of the mean over the 21 year period.

LDC Oil Exporting countries accounted for 4 percent of world wheat consumption on the average over the 21 year period. Consumption has grown by 5.6 percent of the mean while production has grown at 2.7 percent of the mean per year.

Among exporters wheat consumption has grown only slowly, 1-2 percent per year, with the exception of Turkey (3.7 percent) and South Africa (2.7 percent) and France (.2 percent). Production of wheat in Turkey has grown more rapidly than its consumption (3.8 percent vs. 2.7 percent) while production of wheat in South Africa has grown more slowly that its consumption (1.5 percent vs. 3.7 percent).

Figure 1-01. WHEAT: NET EXPORTS SELECTED REGIONS 1960-1980

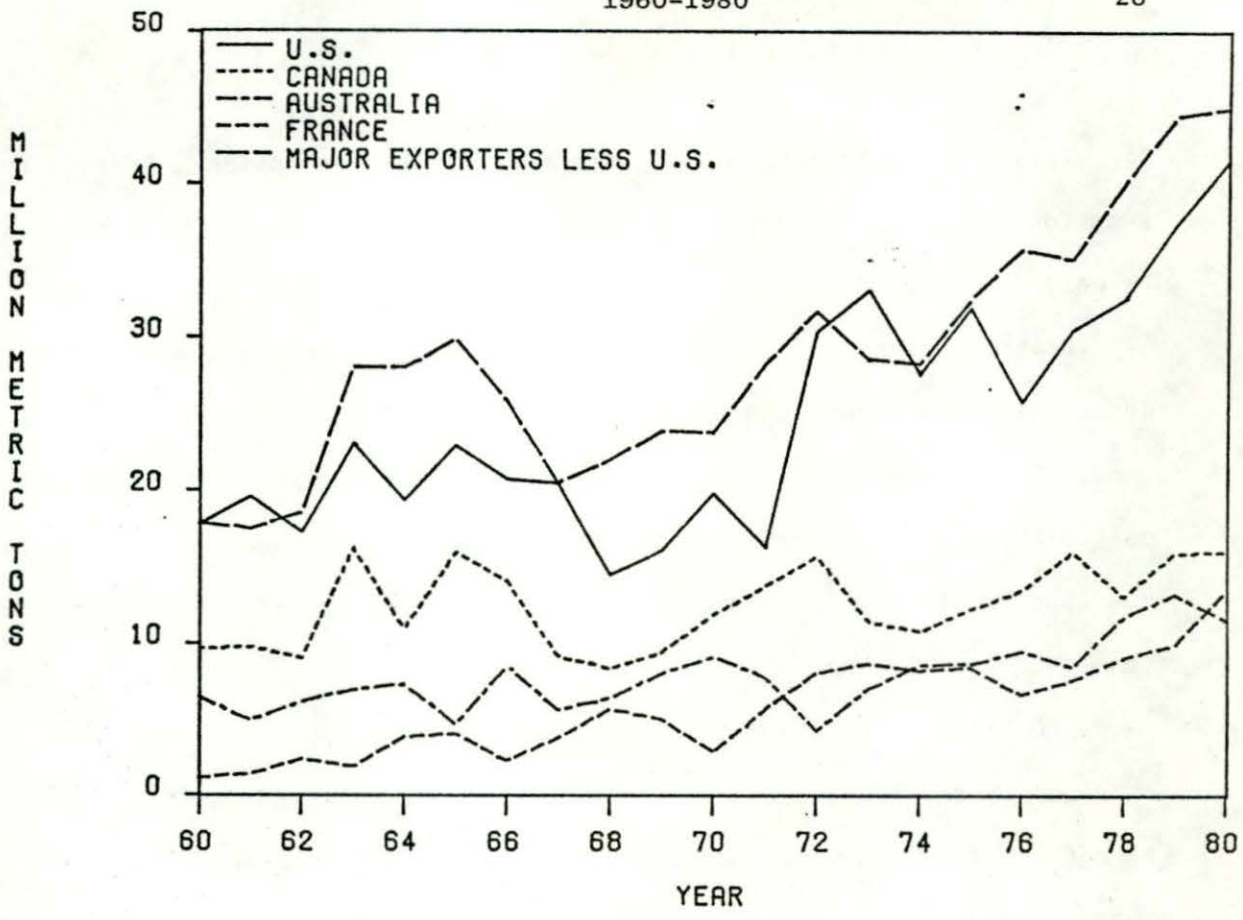


FIGURE 1-02

WHEAT: NET IMPORTS MAJOR IMPORTING REGIONS, 1960-80

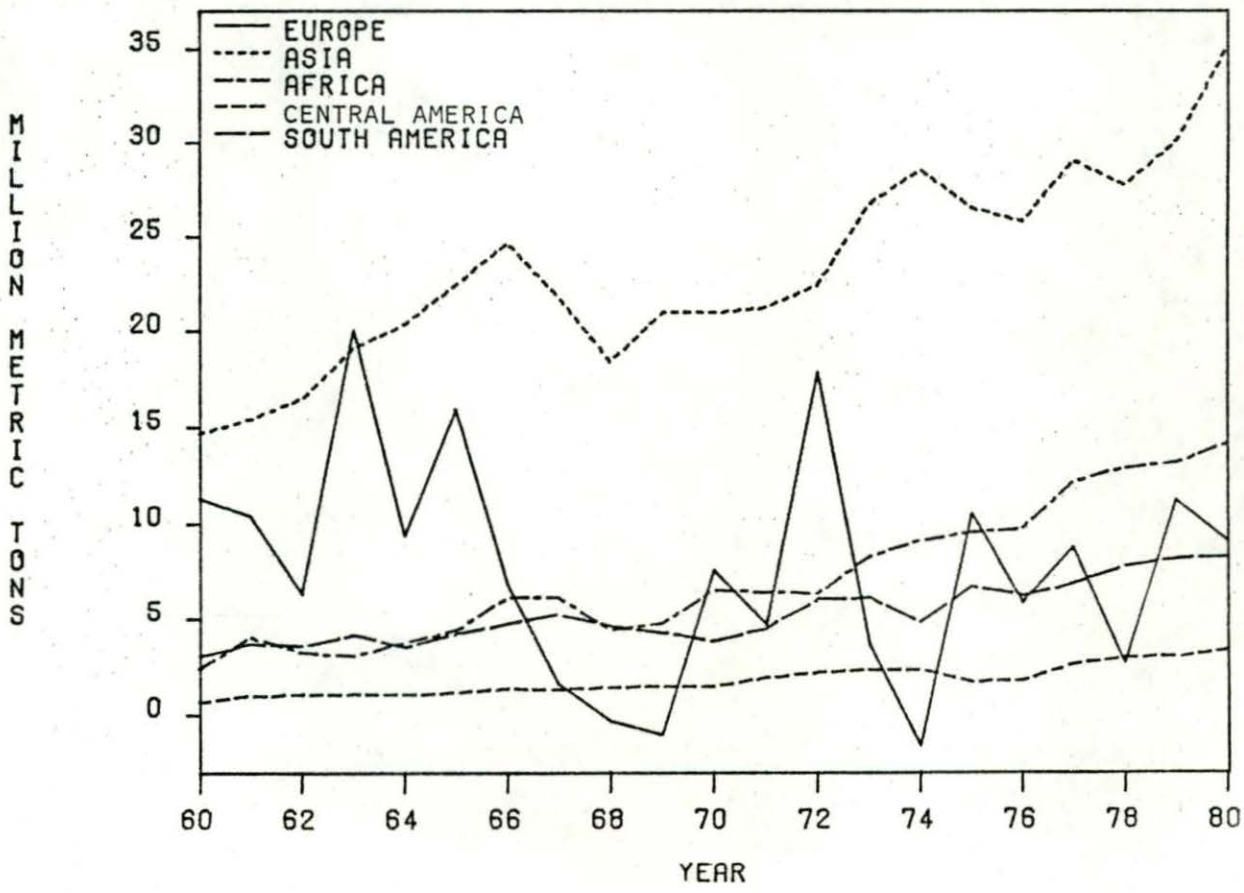


FIGURE 1-03. WHEAT: NET IMPORTS
SELECTED REGIONS, 1960-1980

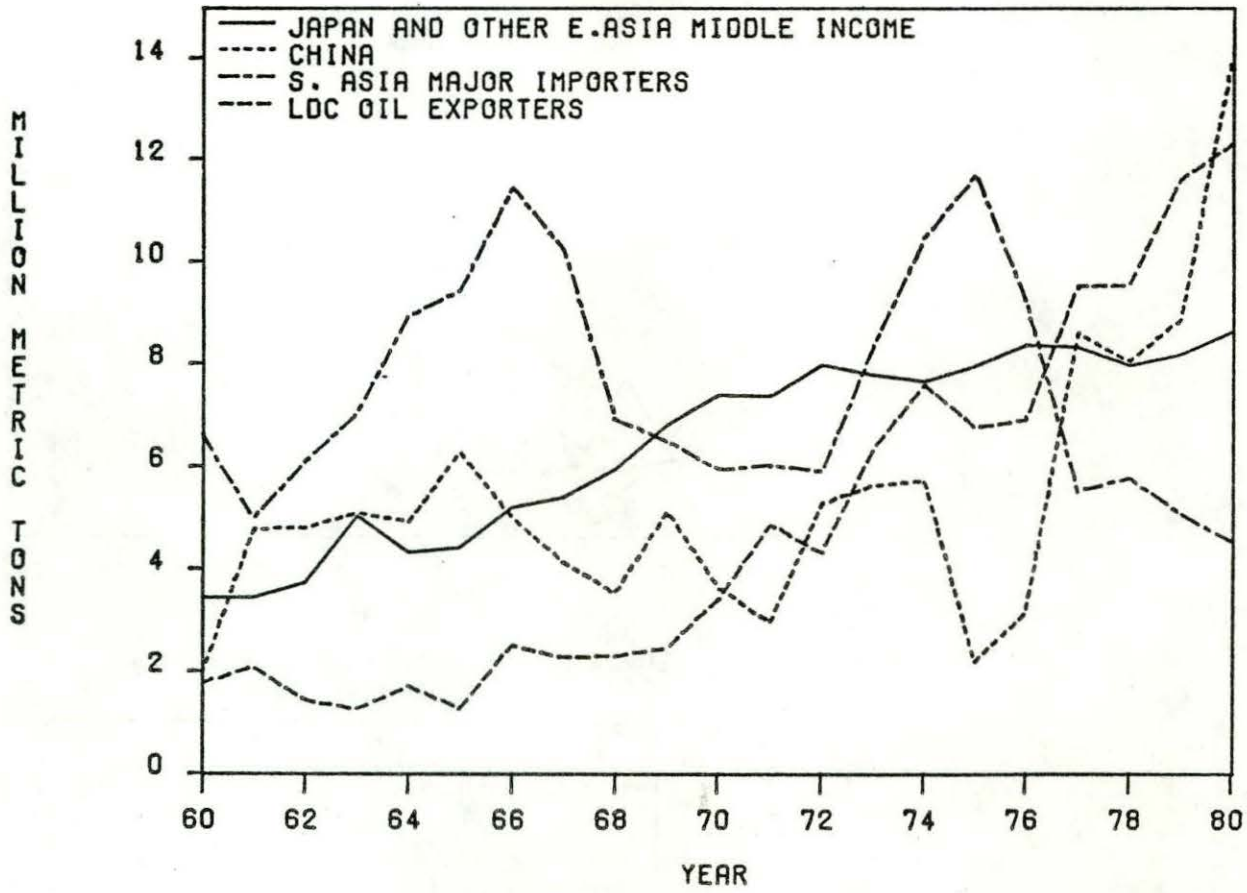


FIGURE 1-04, WHEAT: NET IMPORTS
SELECTED IMPORTERS, 1960-80

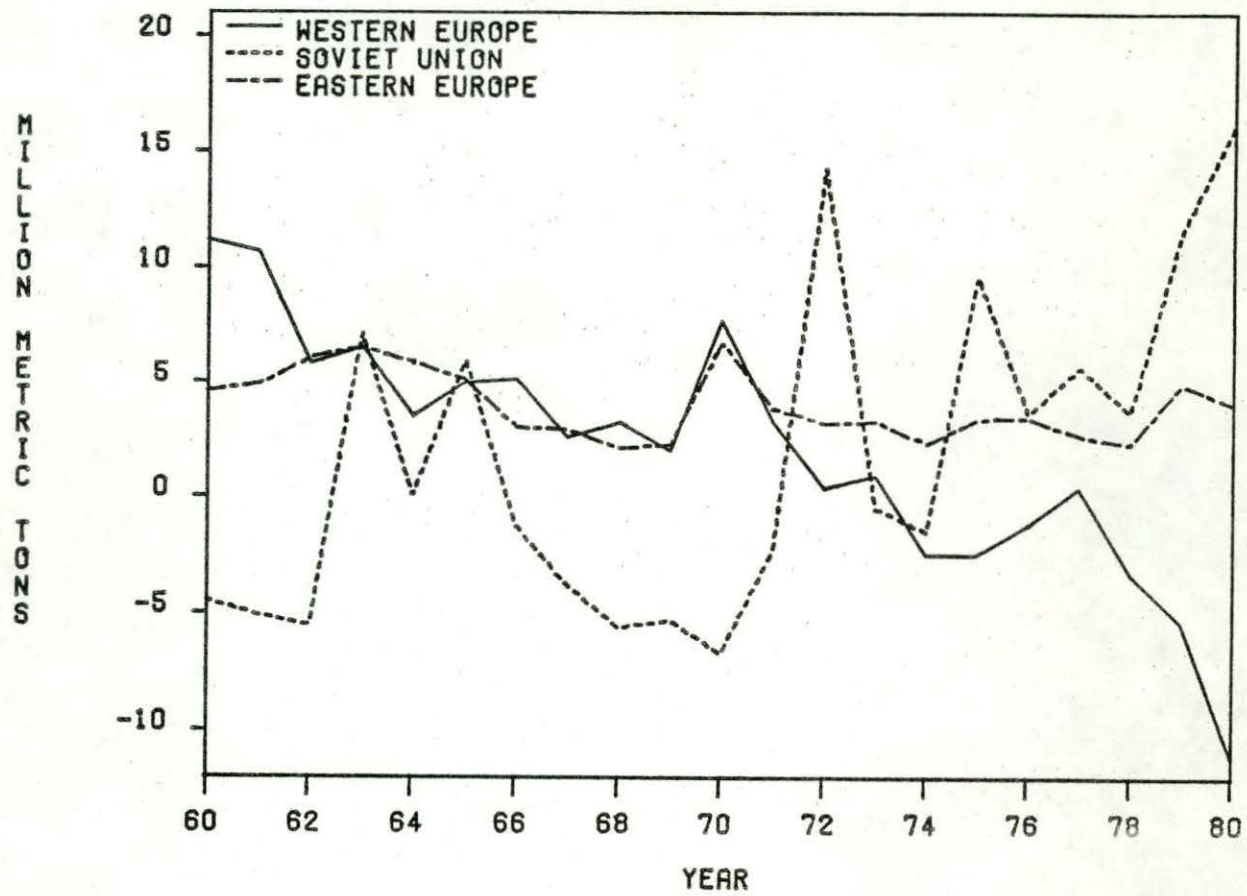


Figure 1-05. WHEAT: IMPORTS FROM THE U.S.
MAJOR REGIONS, 1960-80

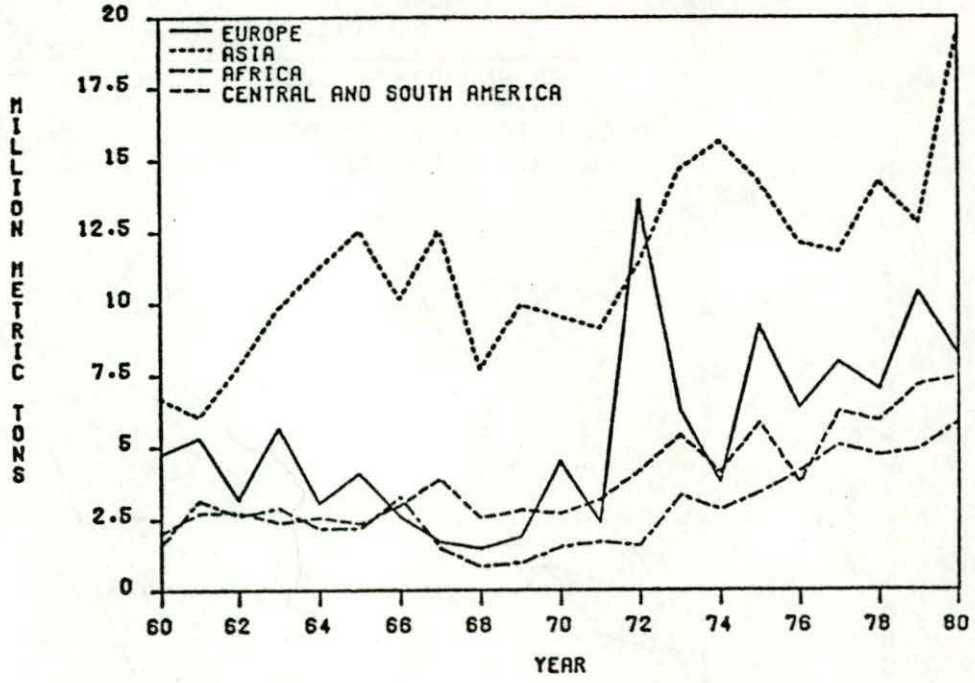


Figure 1-06. WHEAT: IMPORTS FROM THE U.S.
SELECTED REGIONS, 1960-80

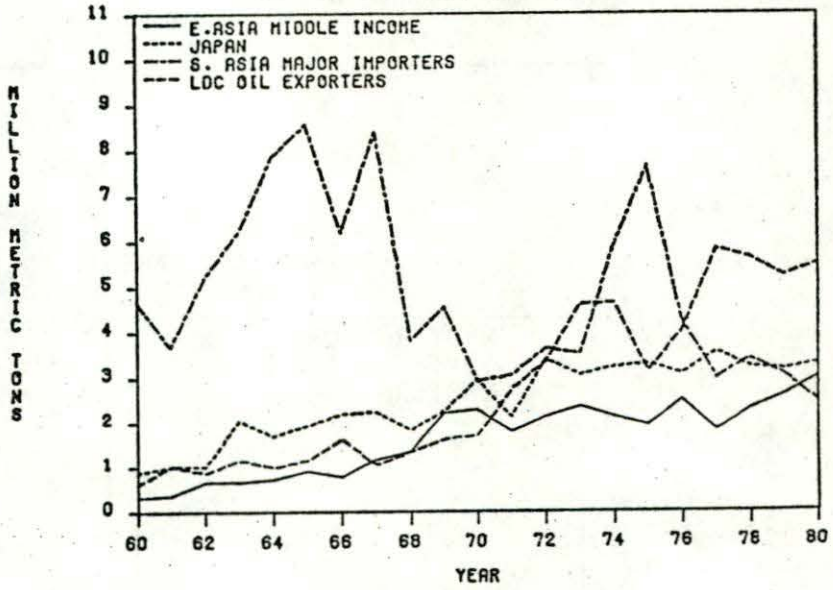


Figure 1-07. WHEAT: IMPORTS FROM THE U.S.
SELECTED IMPORTERS, 1960-80

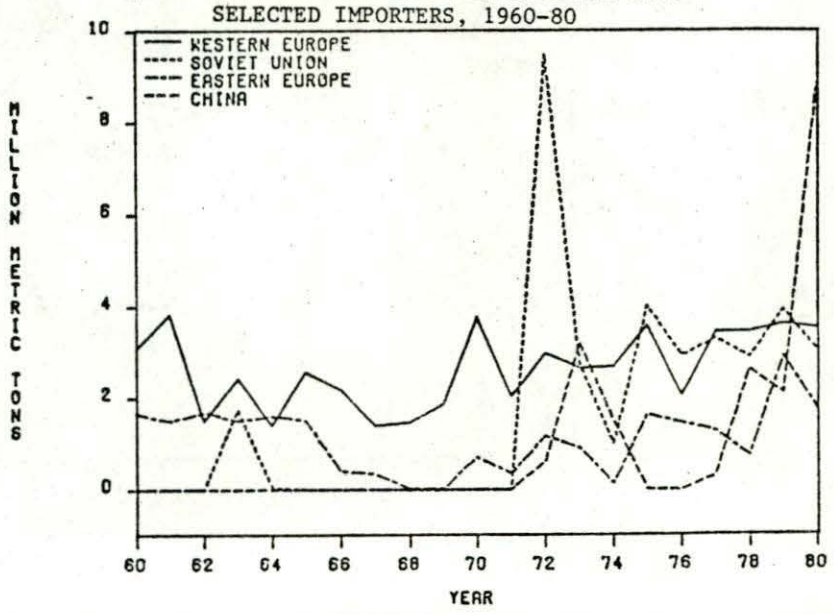


FIGURE 1-10. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS CANADA, 1960-80

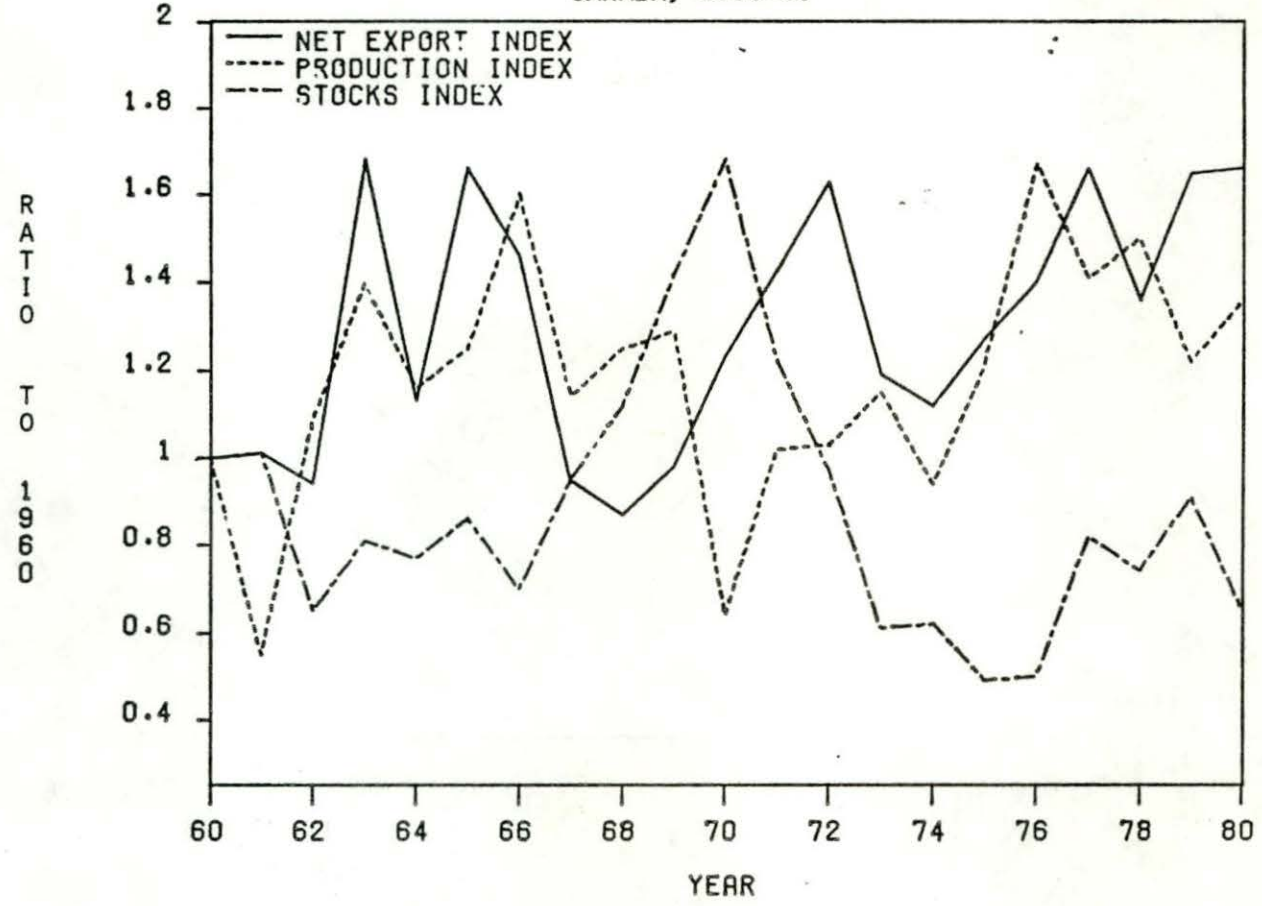


FIGURE 1-11. WHEAT; PRODUCTION, YIELD AND HARVESTED AREA CANADA, 1960-80

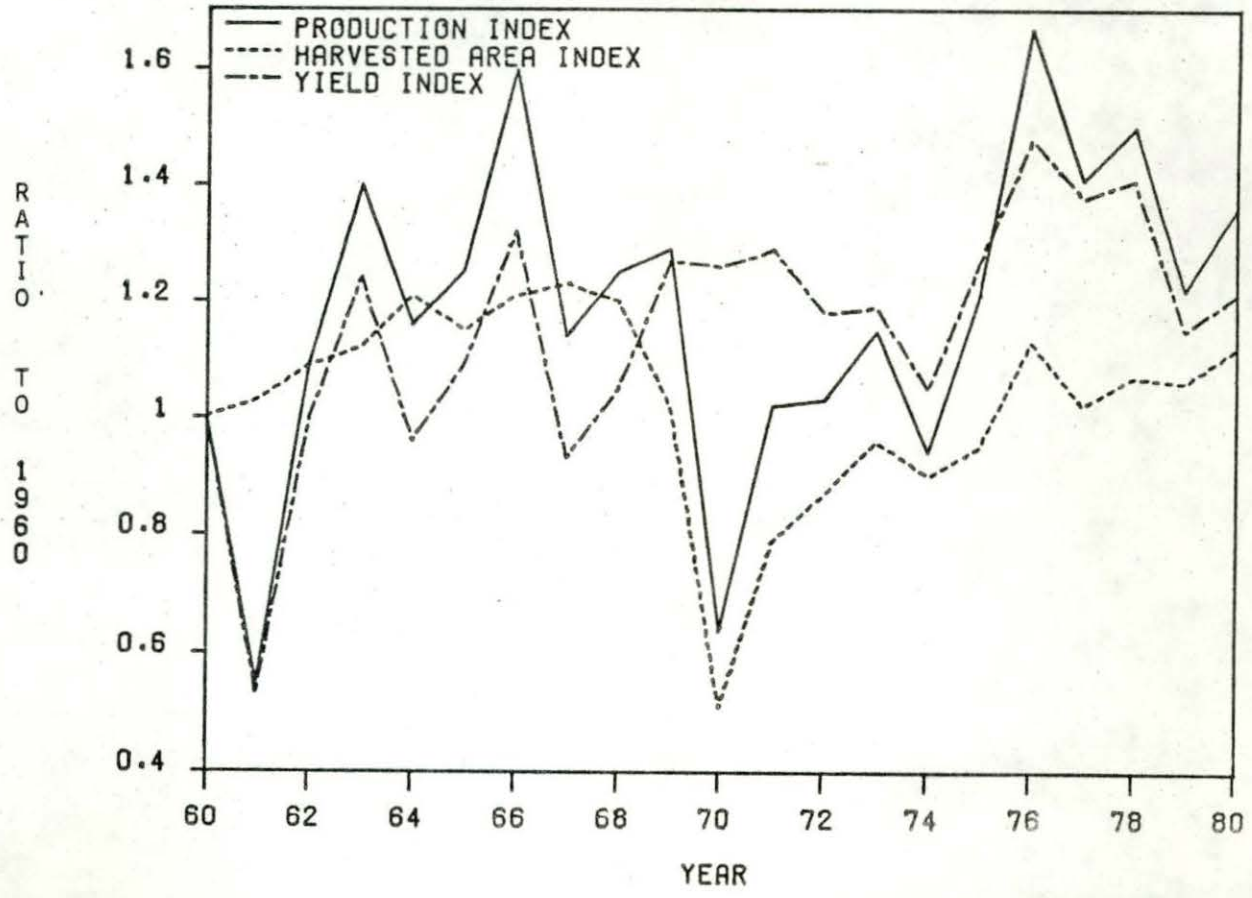


FIGURE 1-08. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS
UNITED STATES, 1960-80

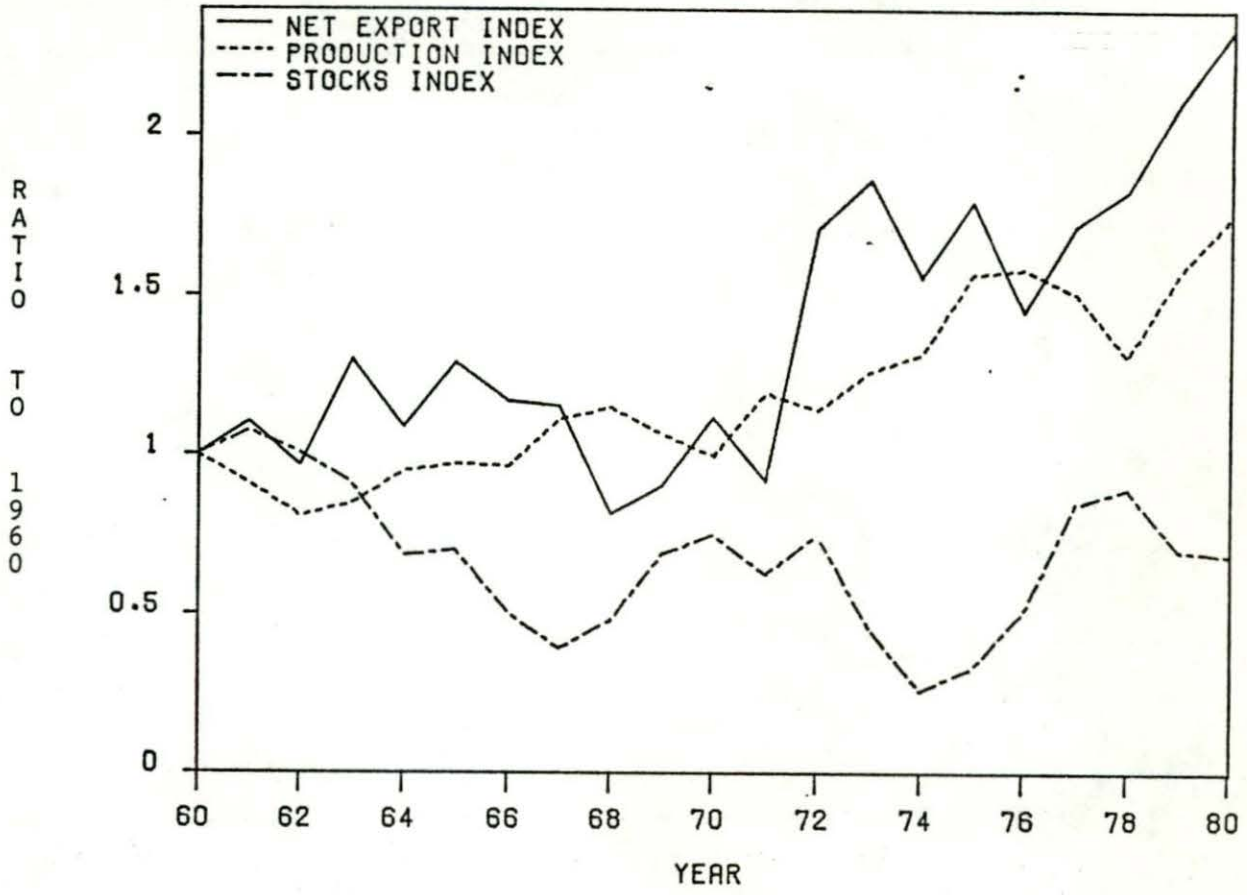


FIGURE 1-09. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA
UNITED STATES, 1960-80

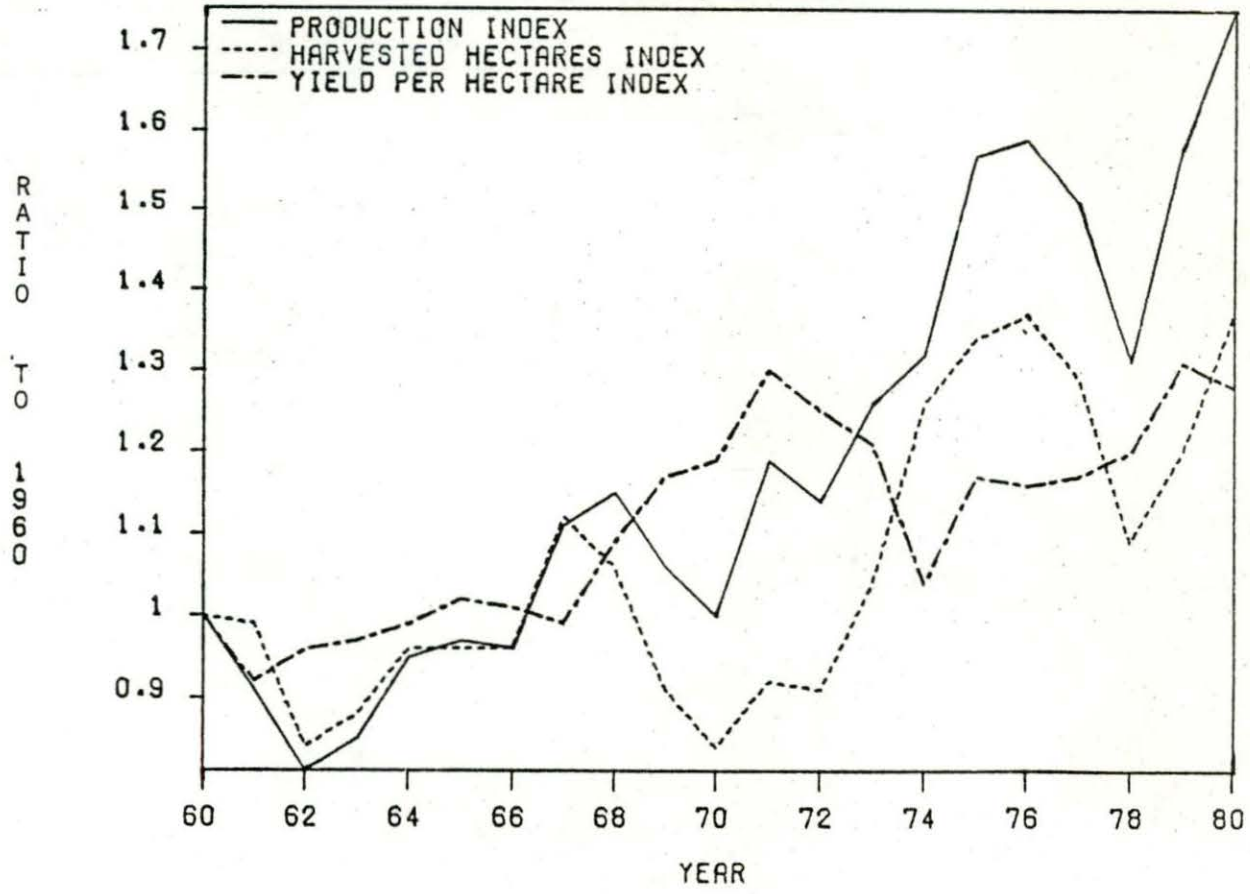


FIGURE 1-12. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS AUSTRALIA, 1960-80

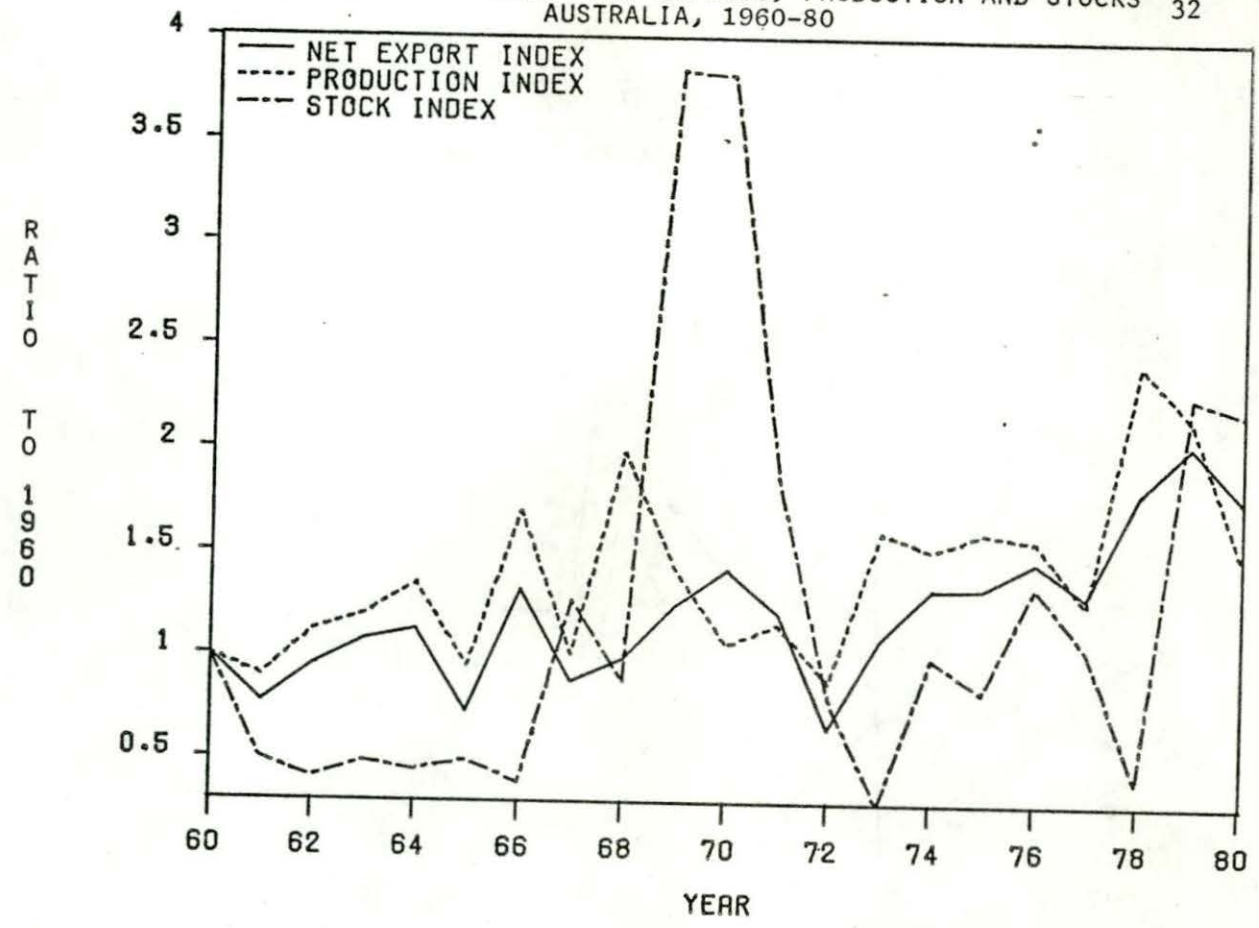


FIGURE 1-13. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA AUSTRALIA, 1960-80

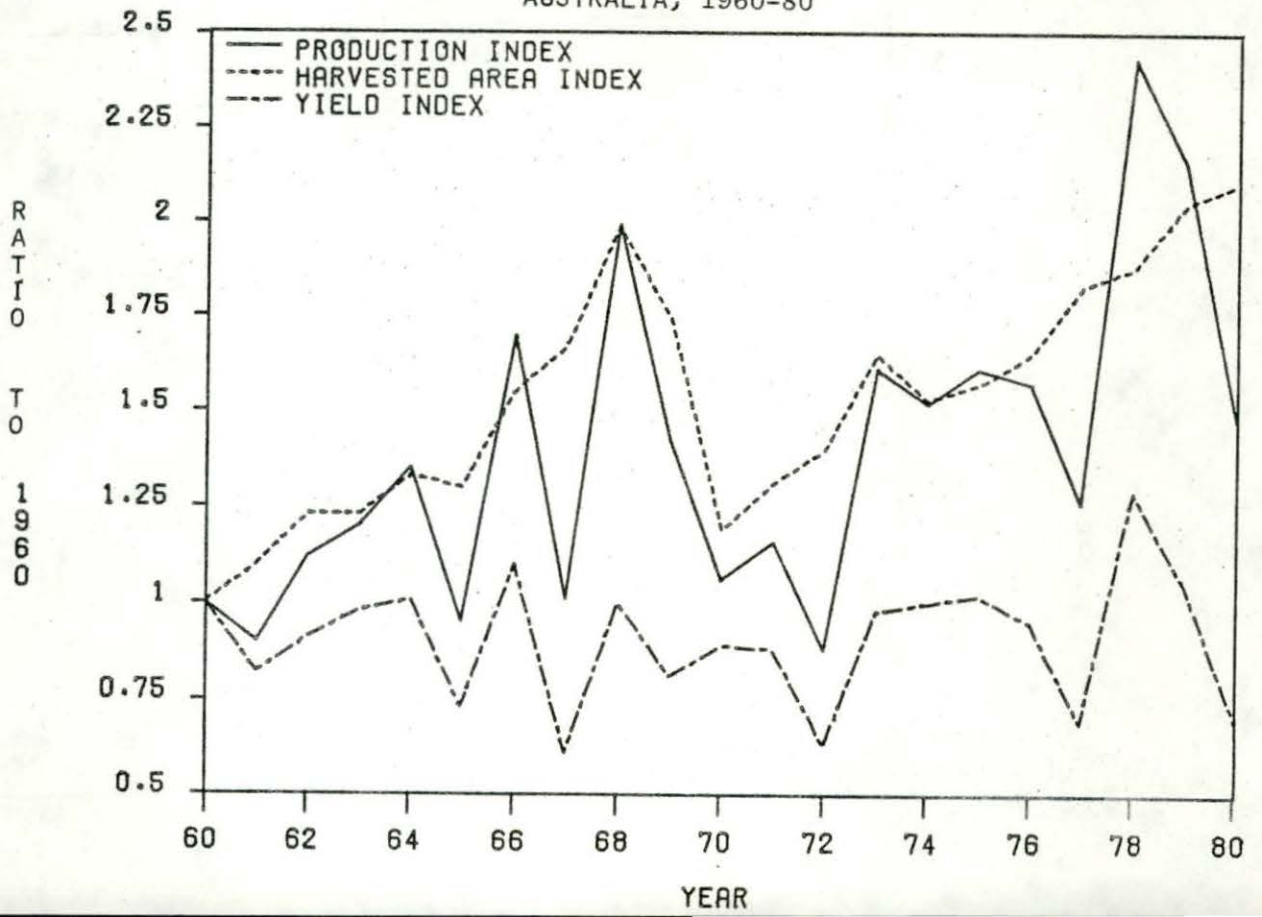


FIGURE 1-14. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS
ARGENTINA, 1960-80

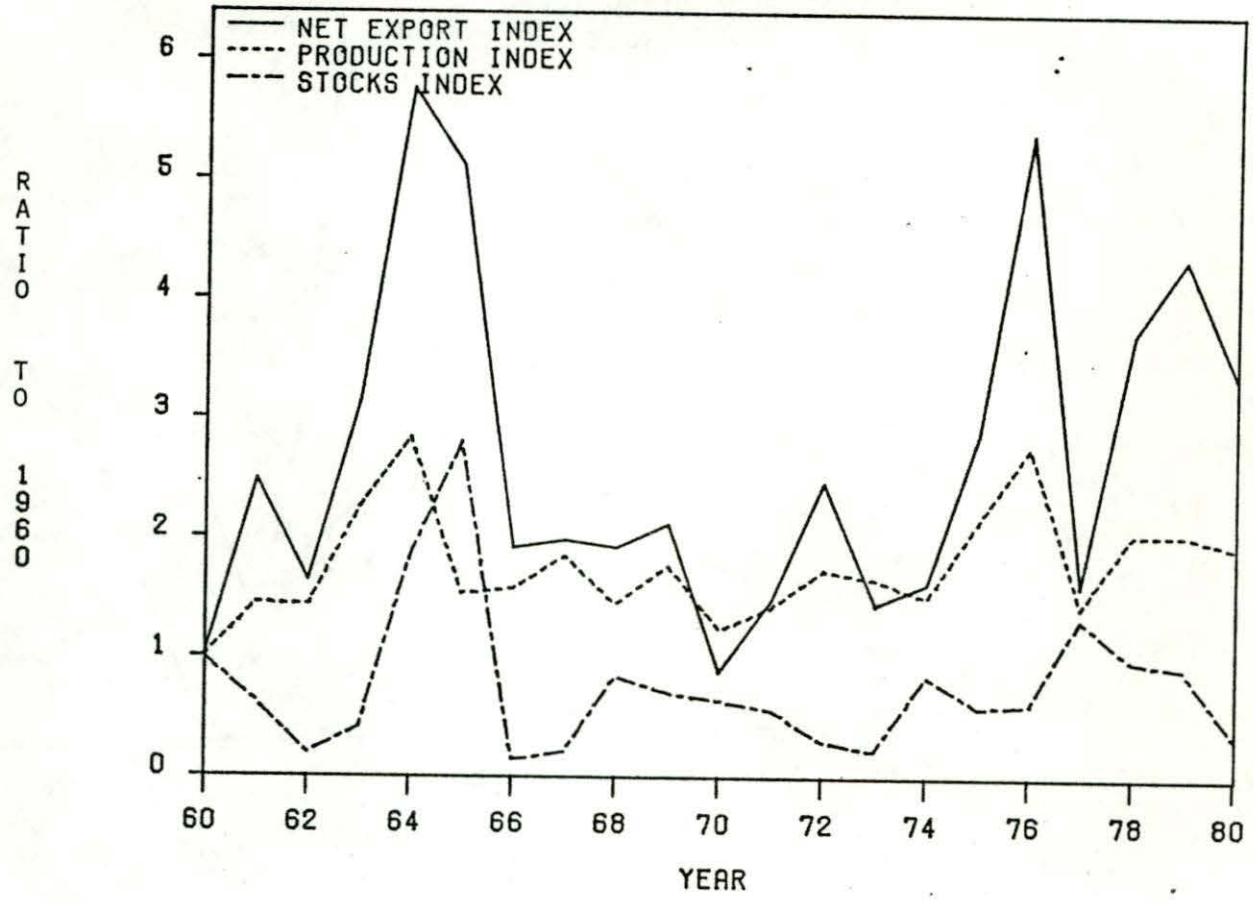


FIGURE 1-15. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA
ARGENTINA, 1960-80

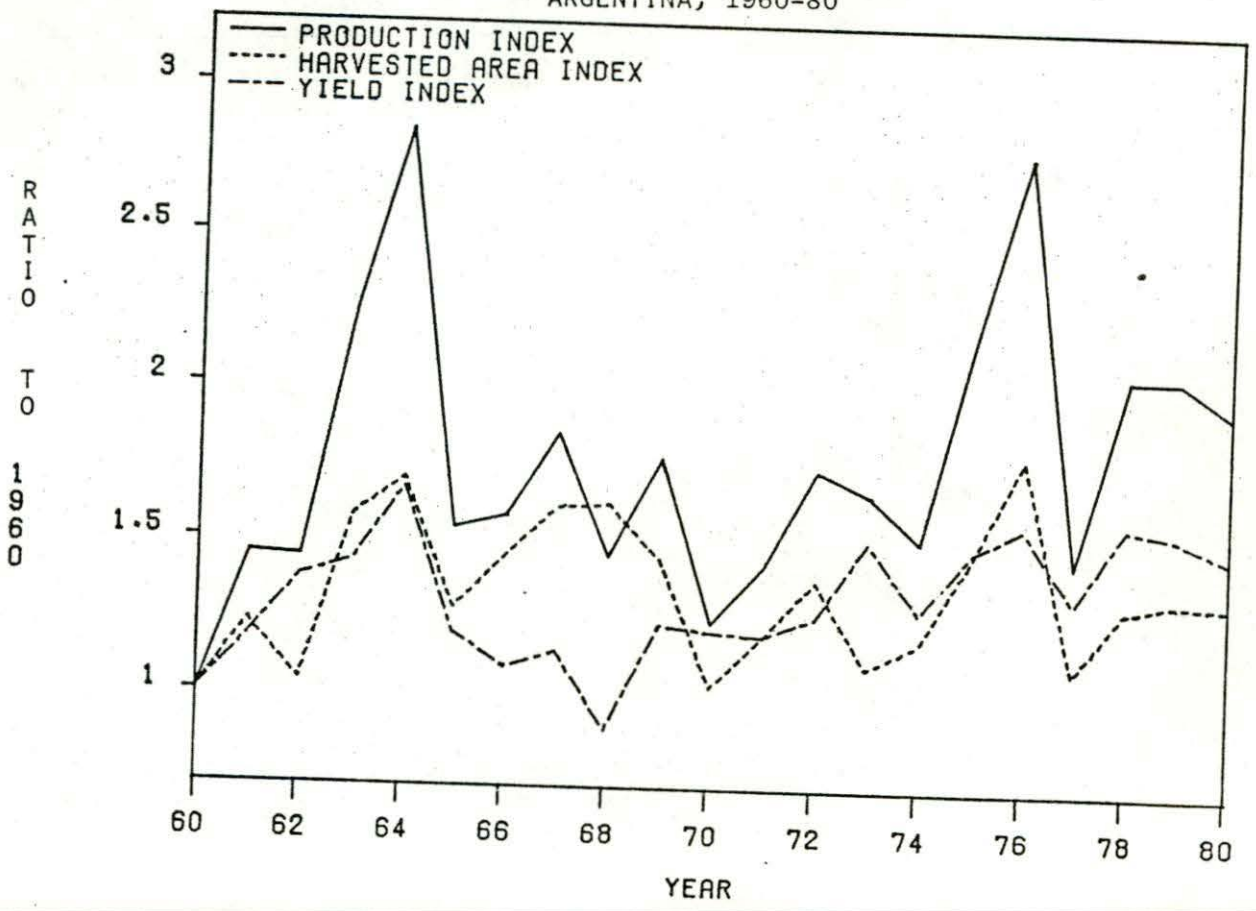


FIGURE 1-16. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS SOUTH AFRICA, 1960-80

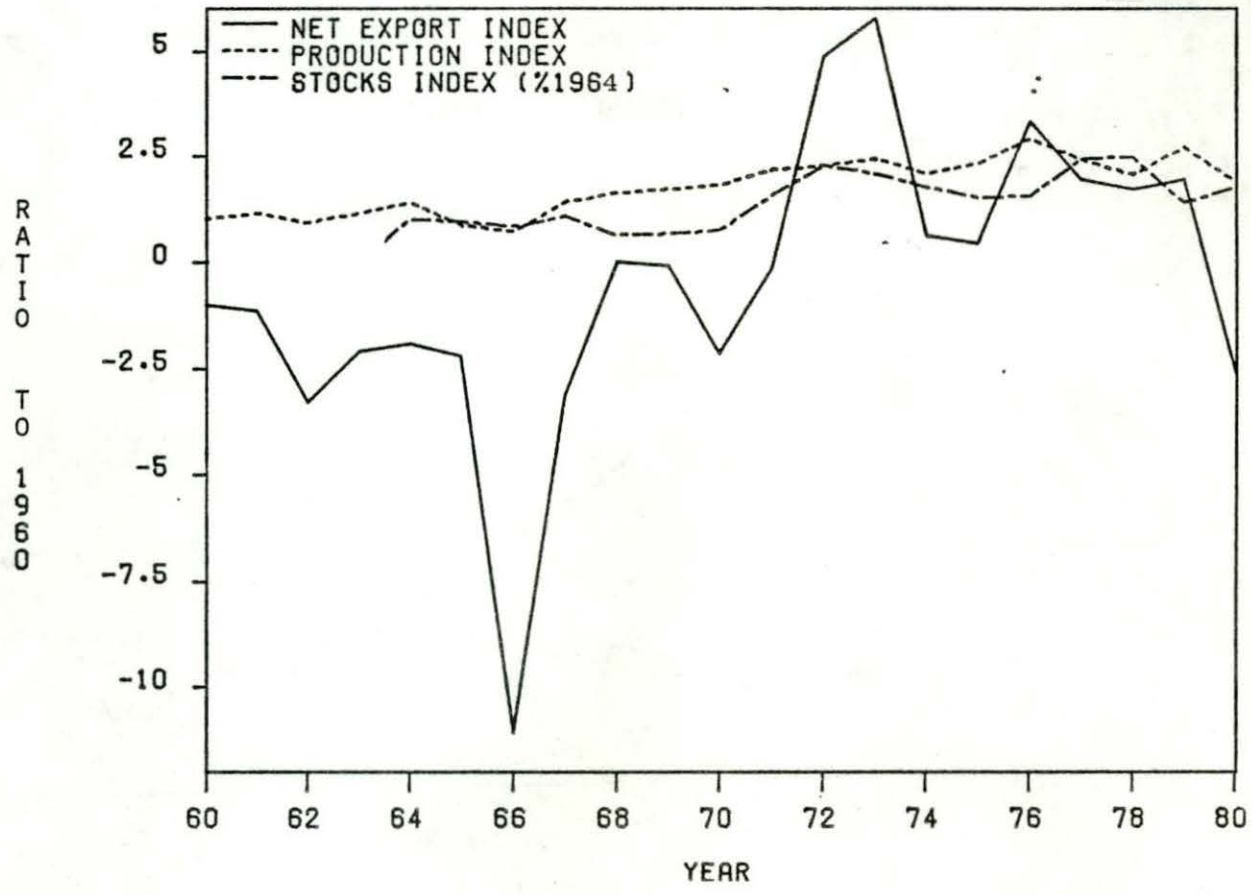


FIGURE 1-17. WHEAT: PRODUCTION, YIELD, AND HARVESTED AREA SOUTH AFRICA, 1960-80

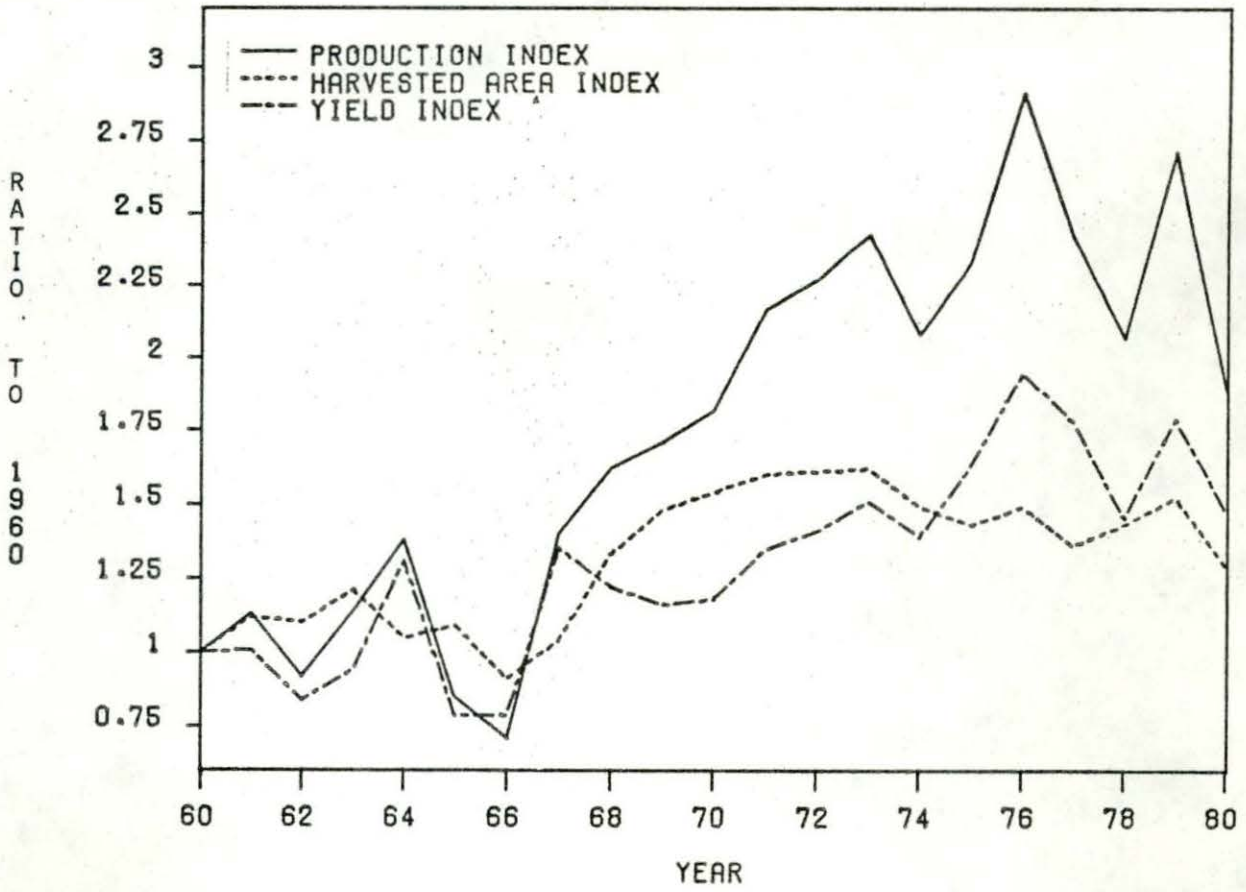


FIGURE 1-18. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS TURKEY, 1960-80

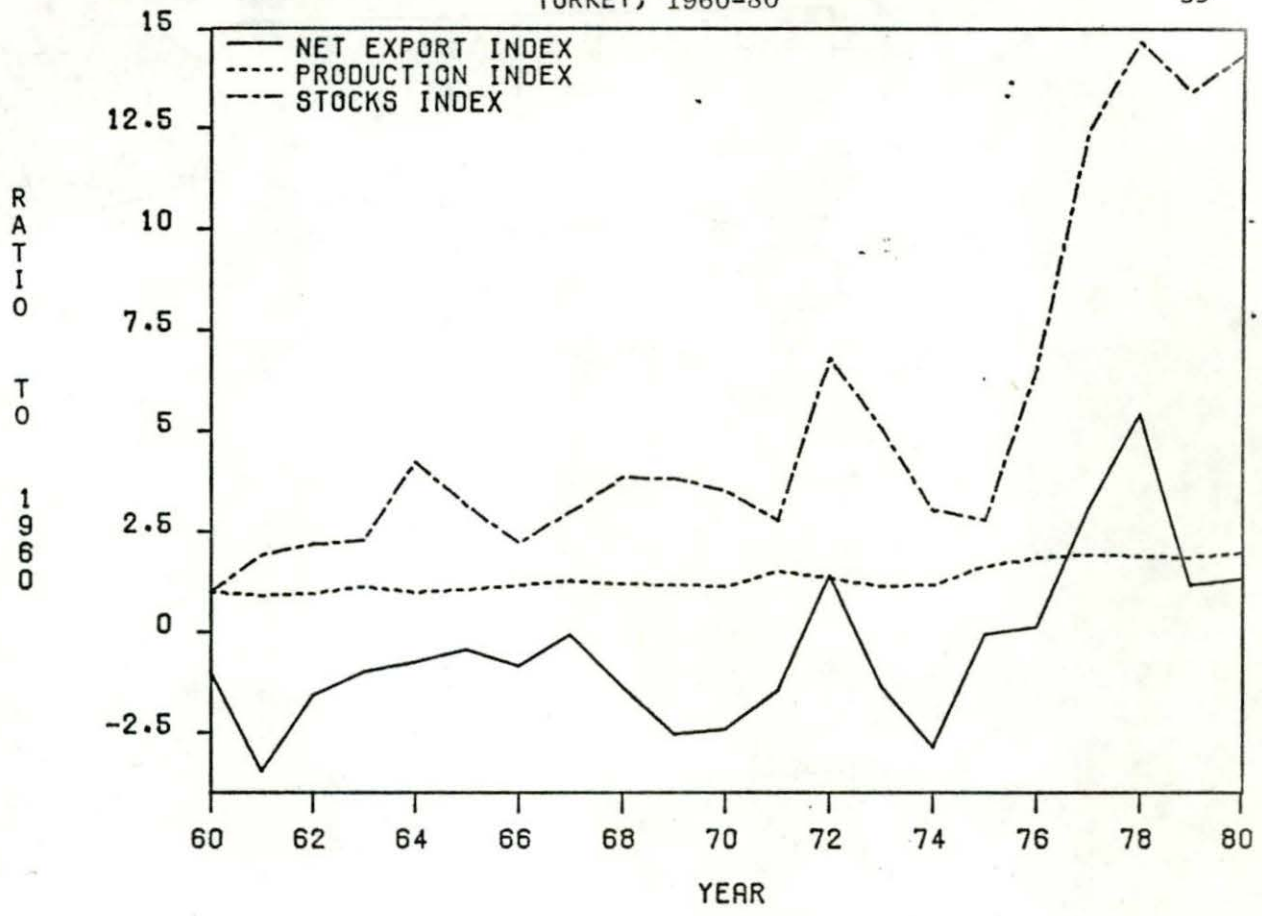


FIGURE 1-19. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA TURKEY, 1960-80

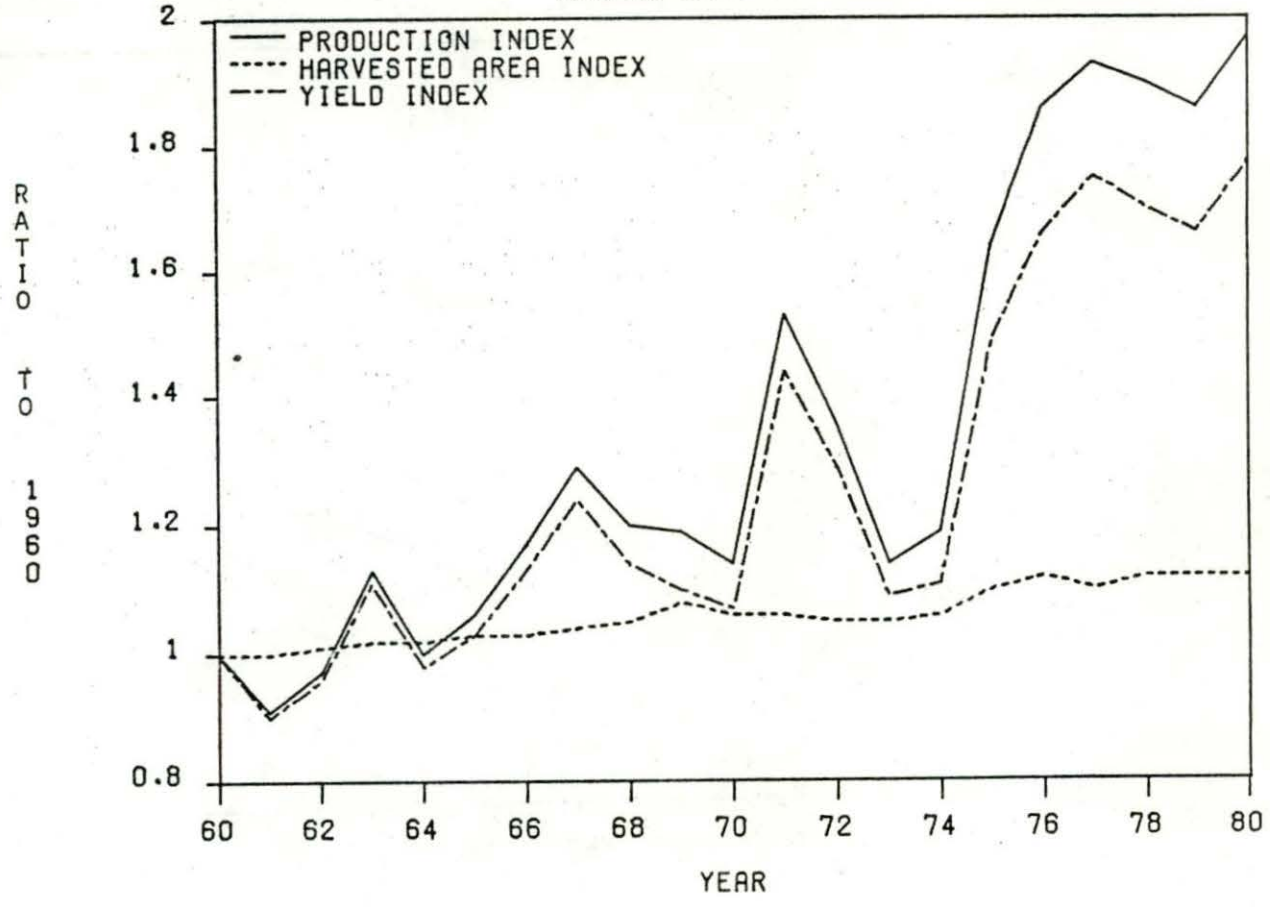


FIGURE 1-20. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS
FRANCE, 1960-80

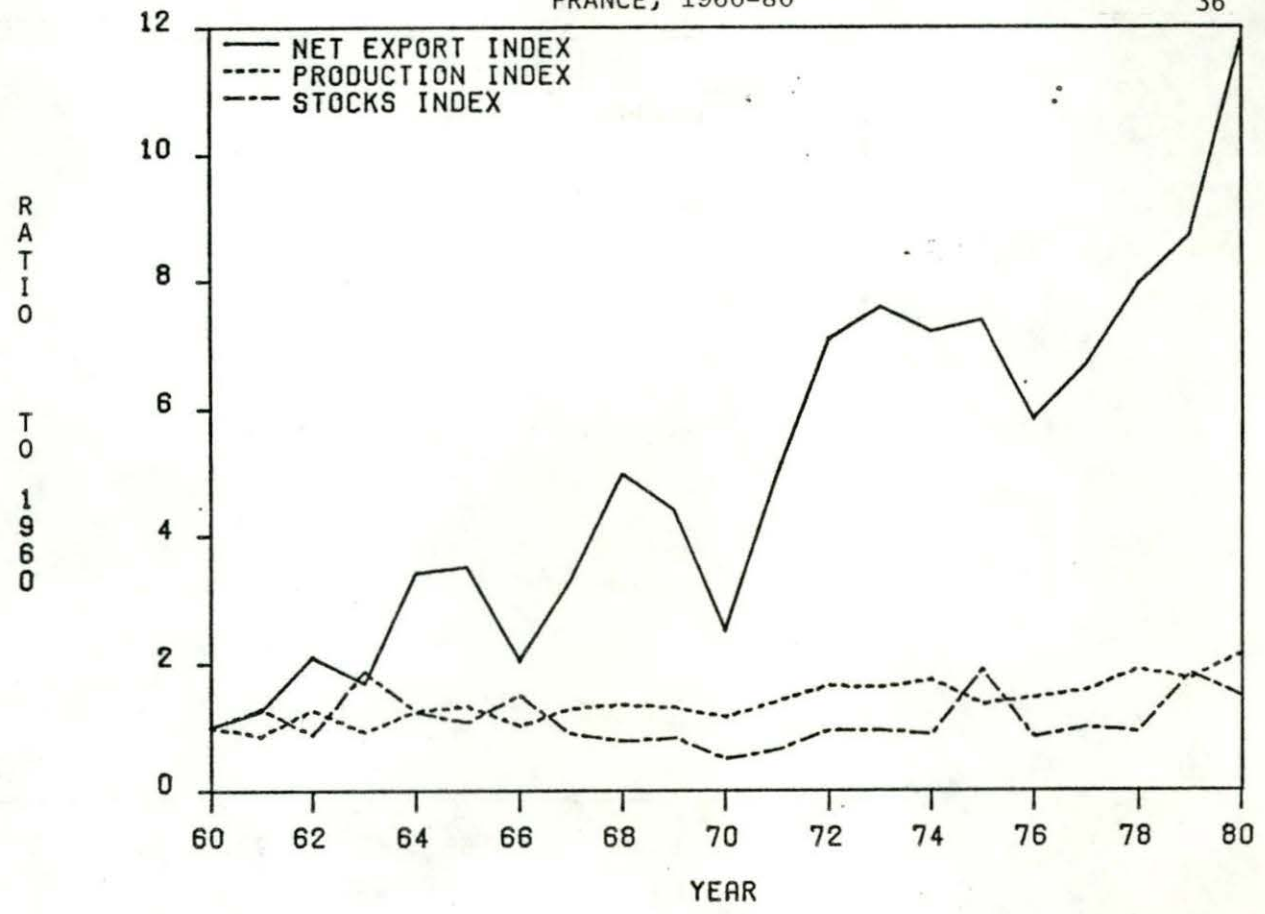


FIGURE 1-21. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA
FRANCE, 1960-80

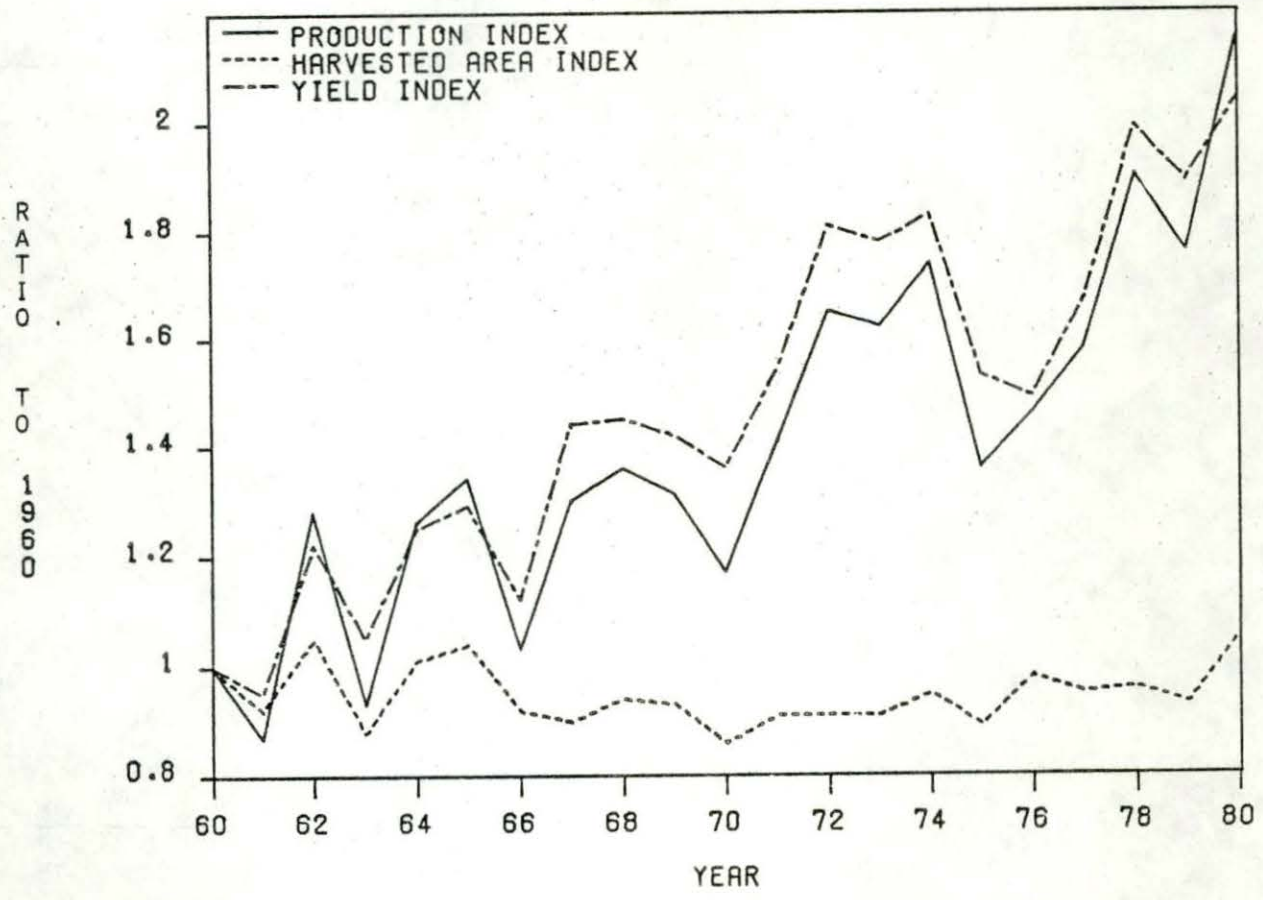


FIGURE 1-22. WHEAT: NET EXPORTS, PRODUCTION AND STOCKS
MAJOR EXPORTERS LESS U.S., 1960-80

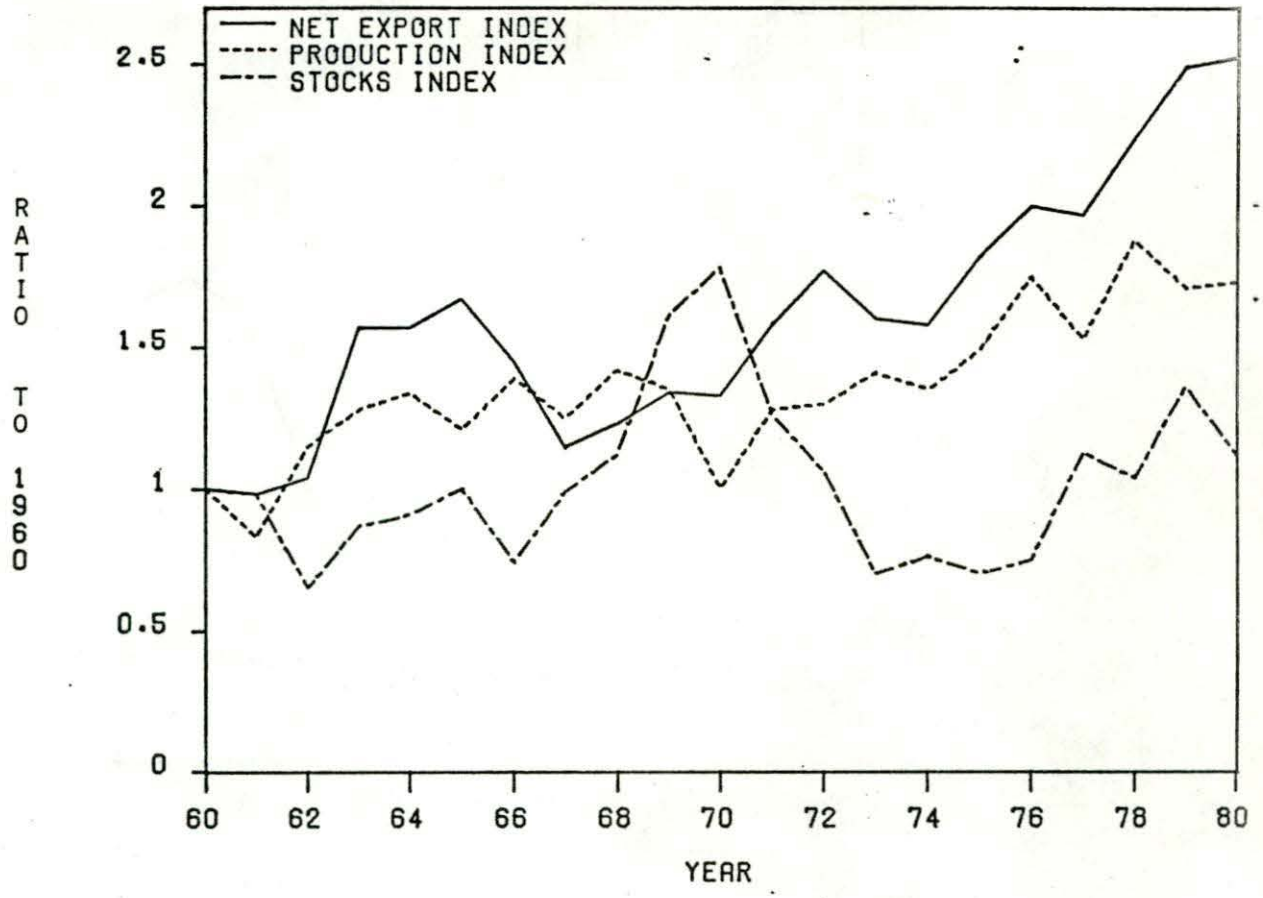


FIGURE 1-23. WHEAT: PRODUCTION, YIELD, AND HARVESTED AREA
MAJOR EXPORTERS LESS U.S., 1960-80

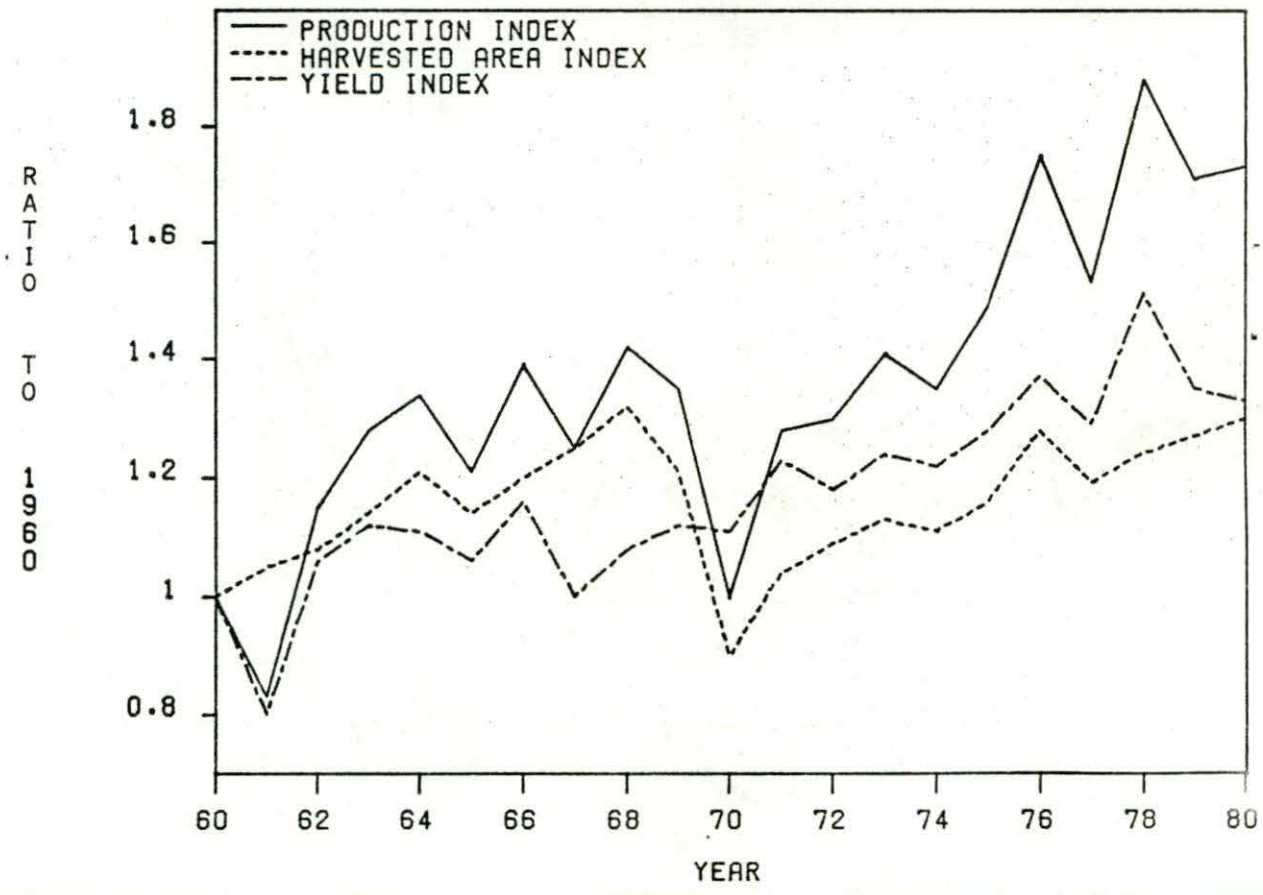


FIGURE 1-24. WHEAT: NET IMPORTS, PRODUCTION AND STOCKS WESTERN EUROPE, 1960-80

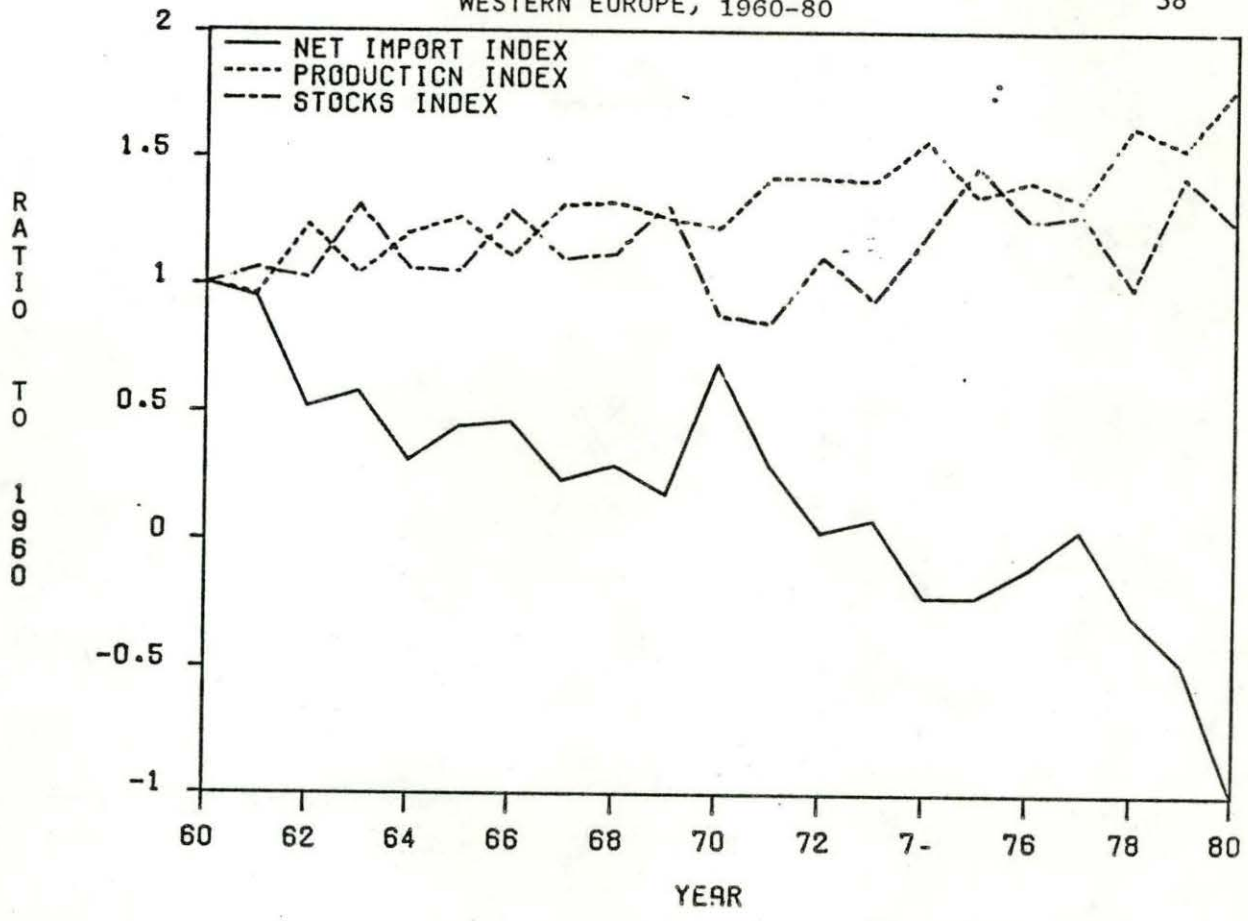


FIGURE 1-25. WHEAT: PRODUCTION, YIELD, AND HARVESTED AREA WESTERN EUROPE, 1960-80

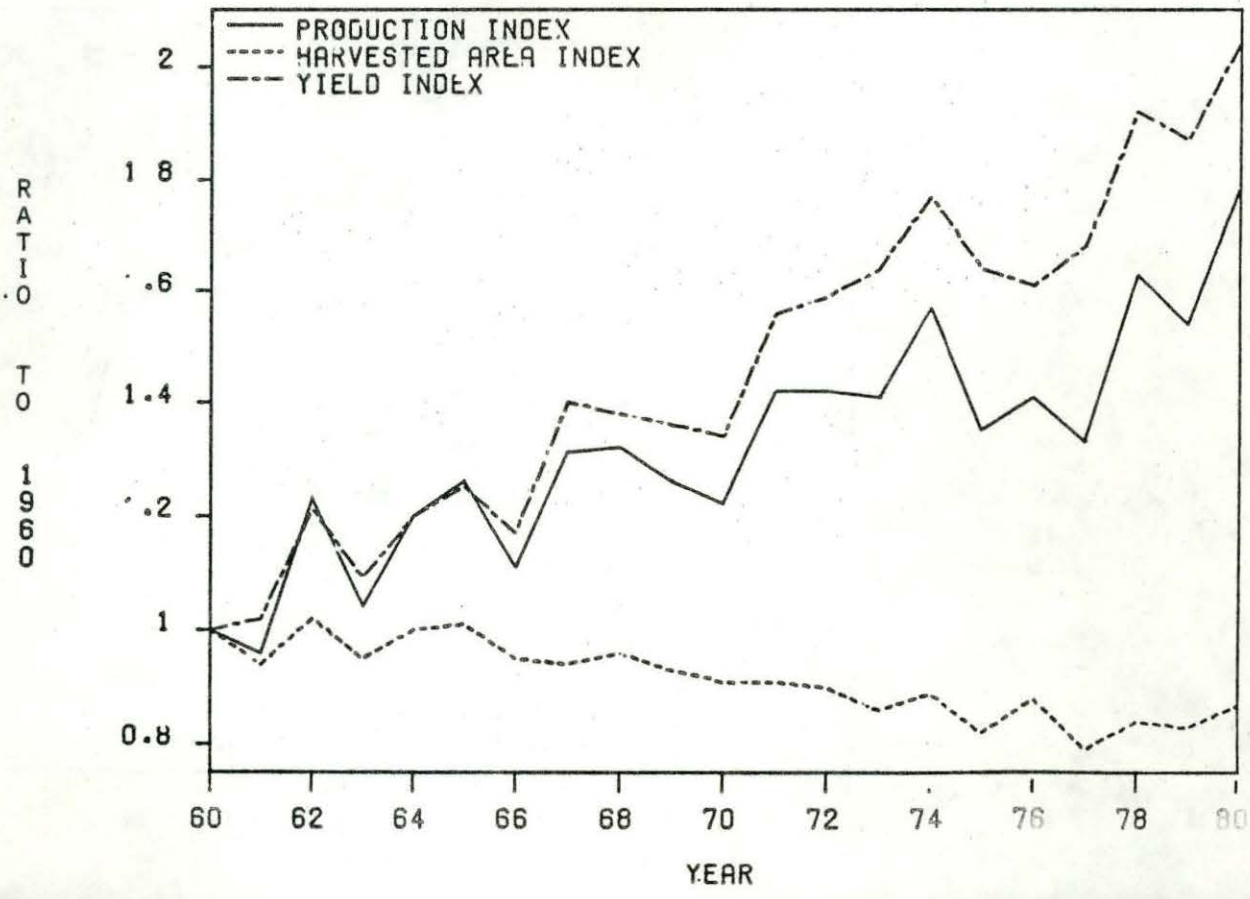


FIGURE 1-26. WHEAT: NET IMPORTS, PRODUCTION AND STOCKS EASTERN EUROPE, 1960-80

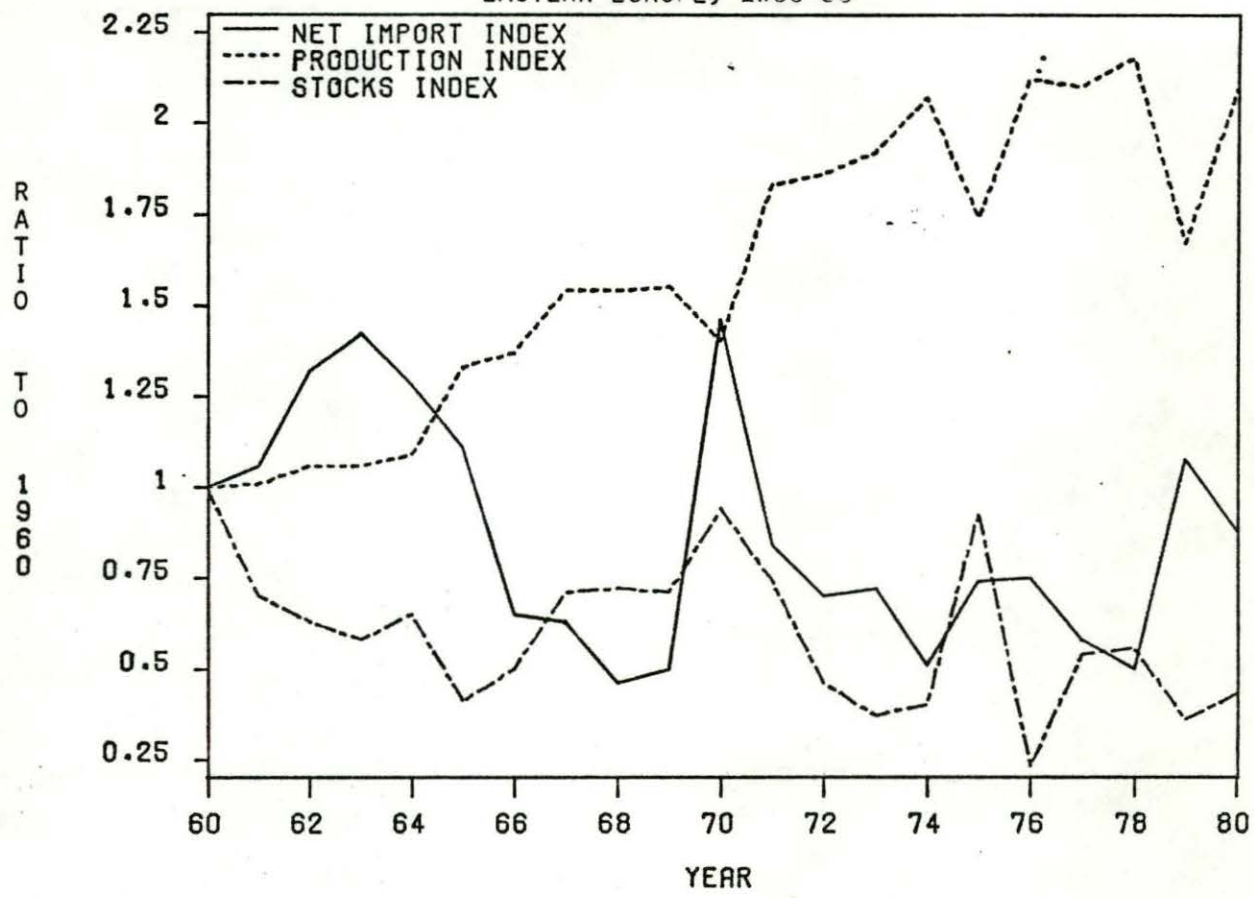


FIGURE 1-27. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA EASTERN EUROPE, 1960-80

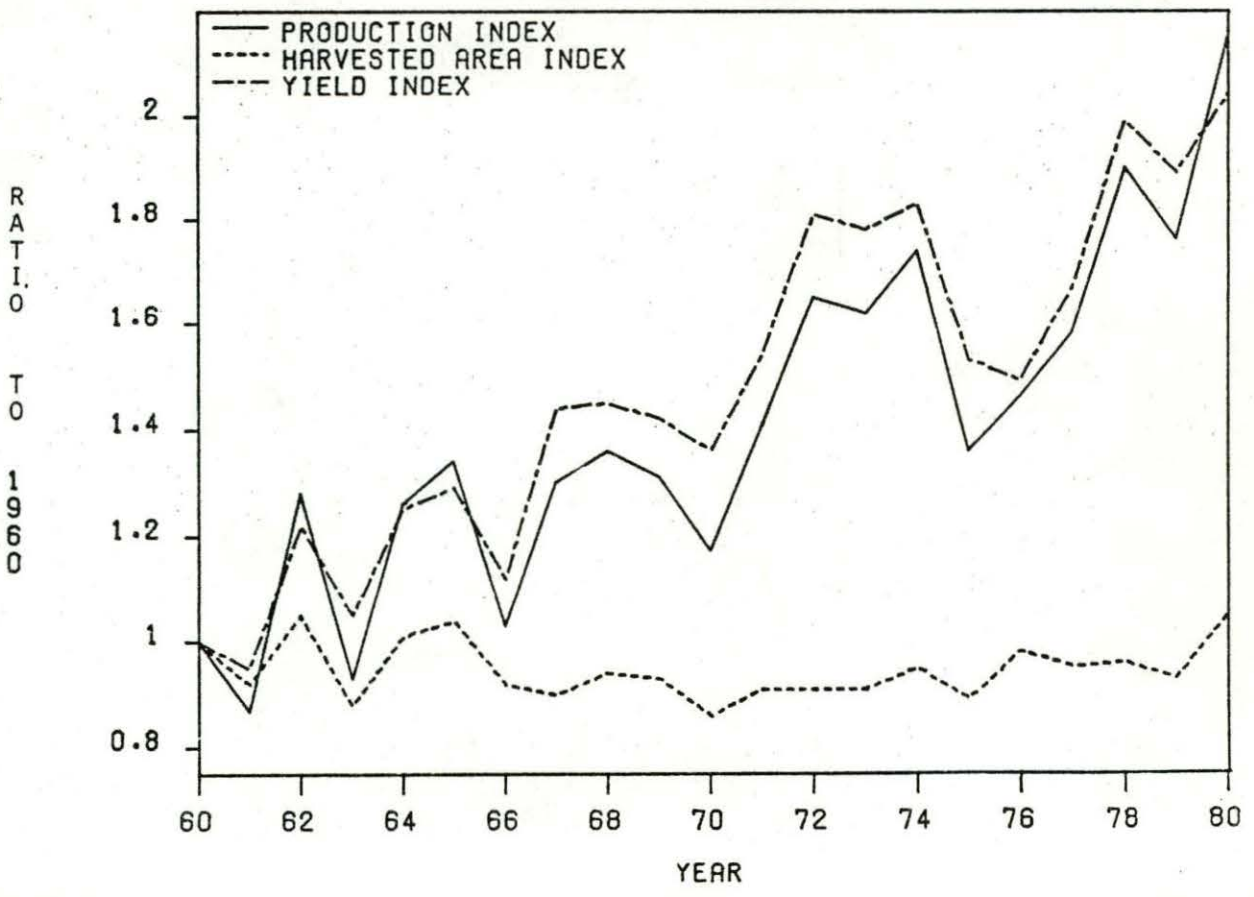


FIGURE 1-28. WHEAT: NET IMPORTS, PRODUCTION AND STOCKS SOVIET UNION, 1960-80

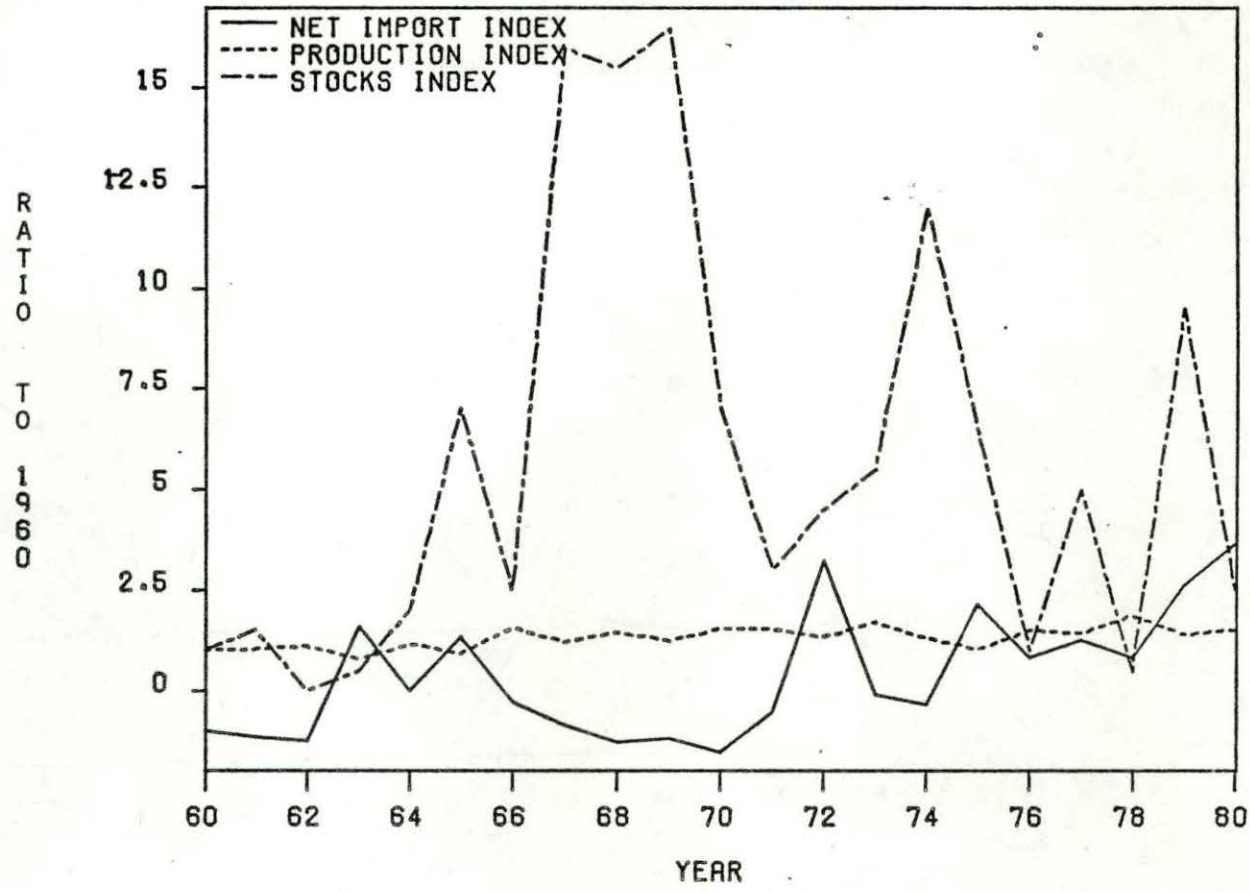


FIGURE 1-29. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA SOVIET UNION, 1960-80

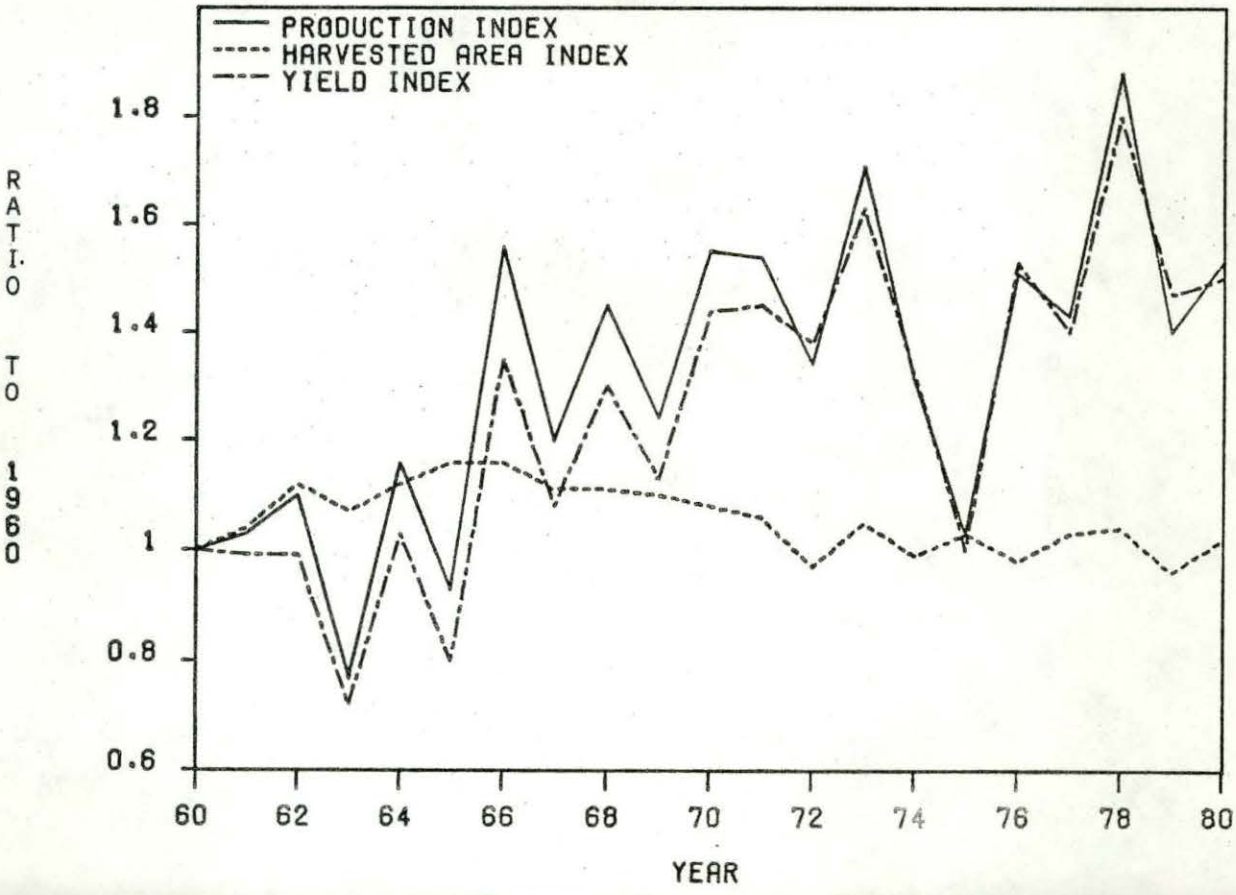


FIGURE 1-30. WHEAT: NET IMPORTS, PRODUCTION AND STOCKS SOVIET BLOC, 1960-80

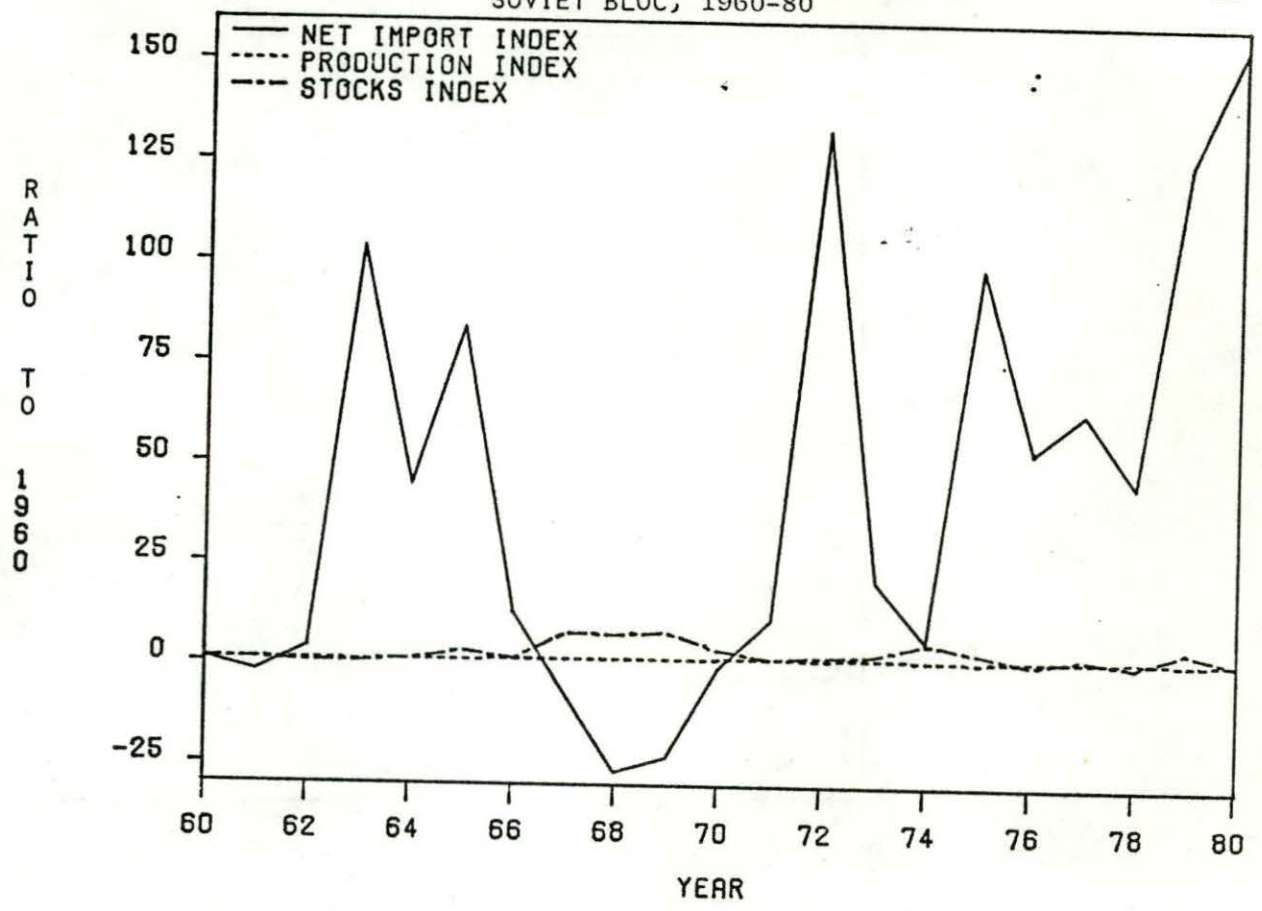


FIGURE 1-31. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA SOVIET BLOC, 1960-80

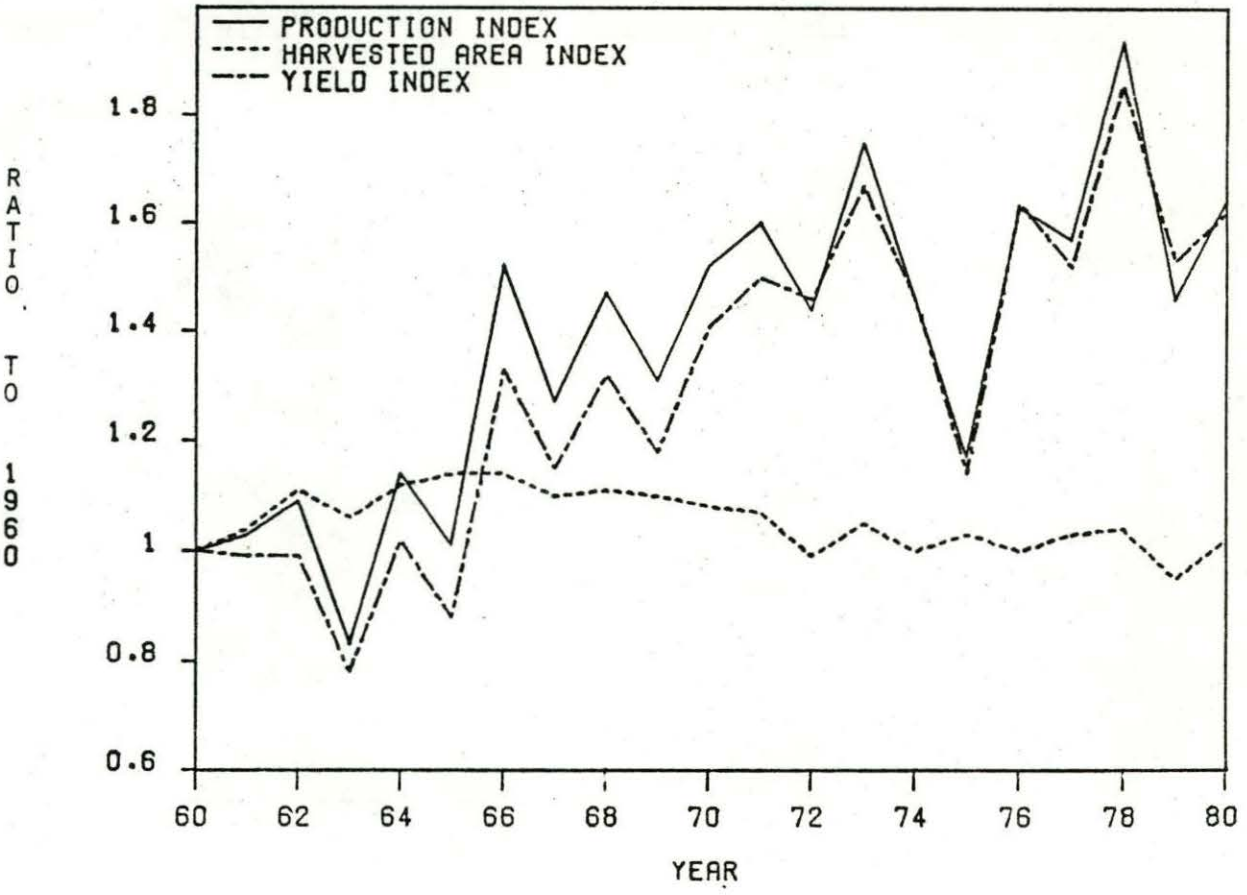


FIGURE 1-32 WHEAT: NET IMPORTS, PRODUCTION AND STOCKS ASIA, 1960-80

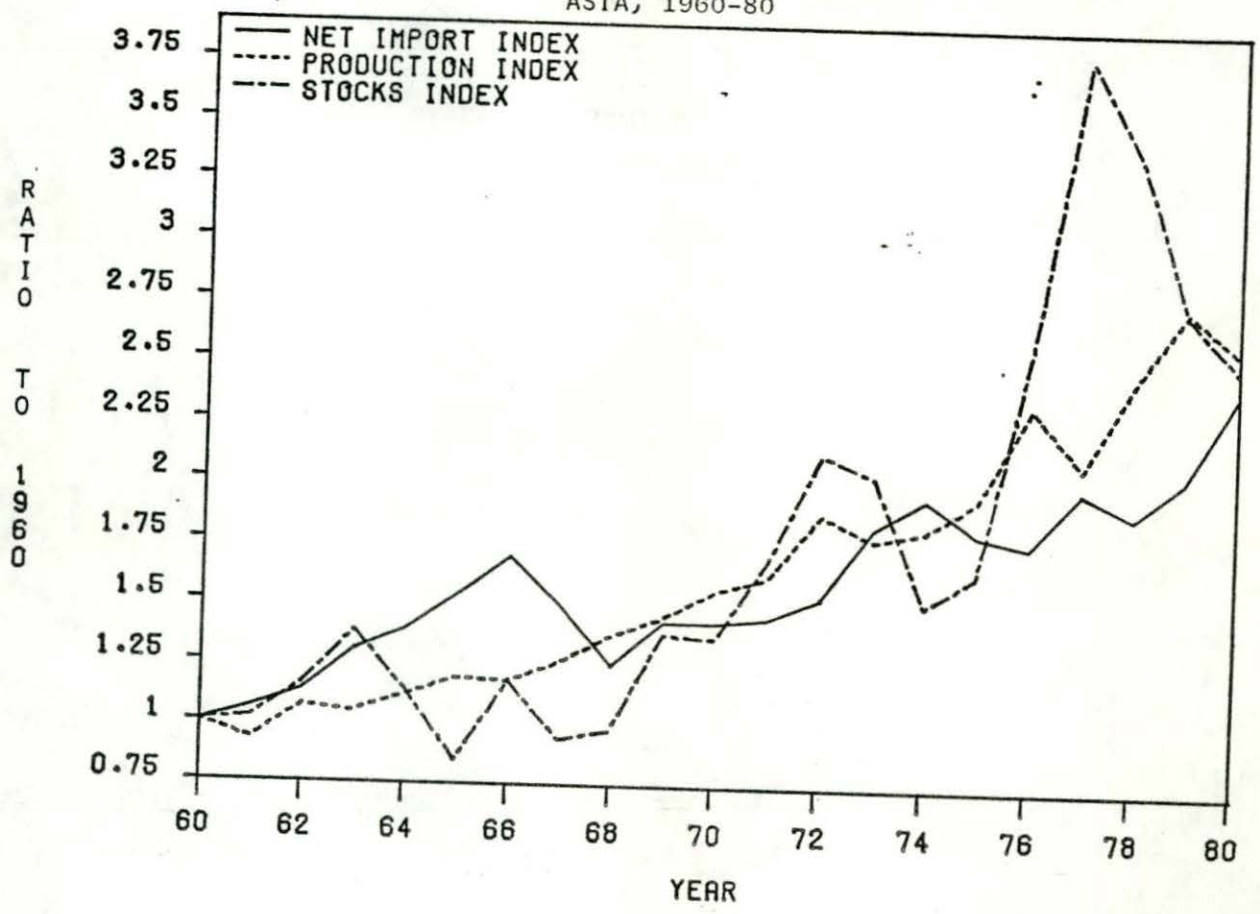


FIGURE 1-33. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA ASIA, 1960-80

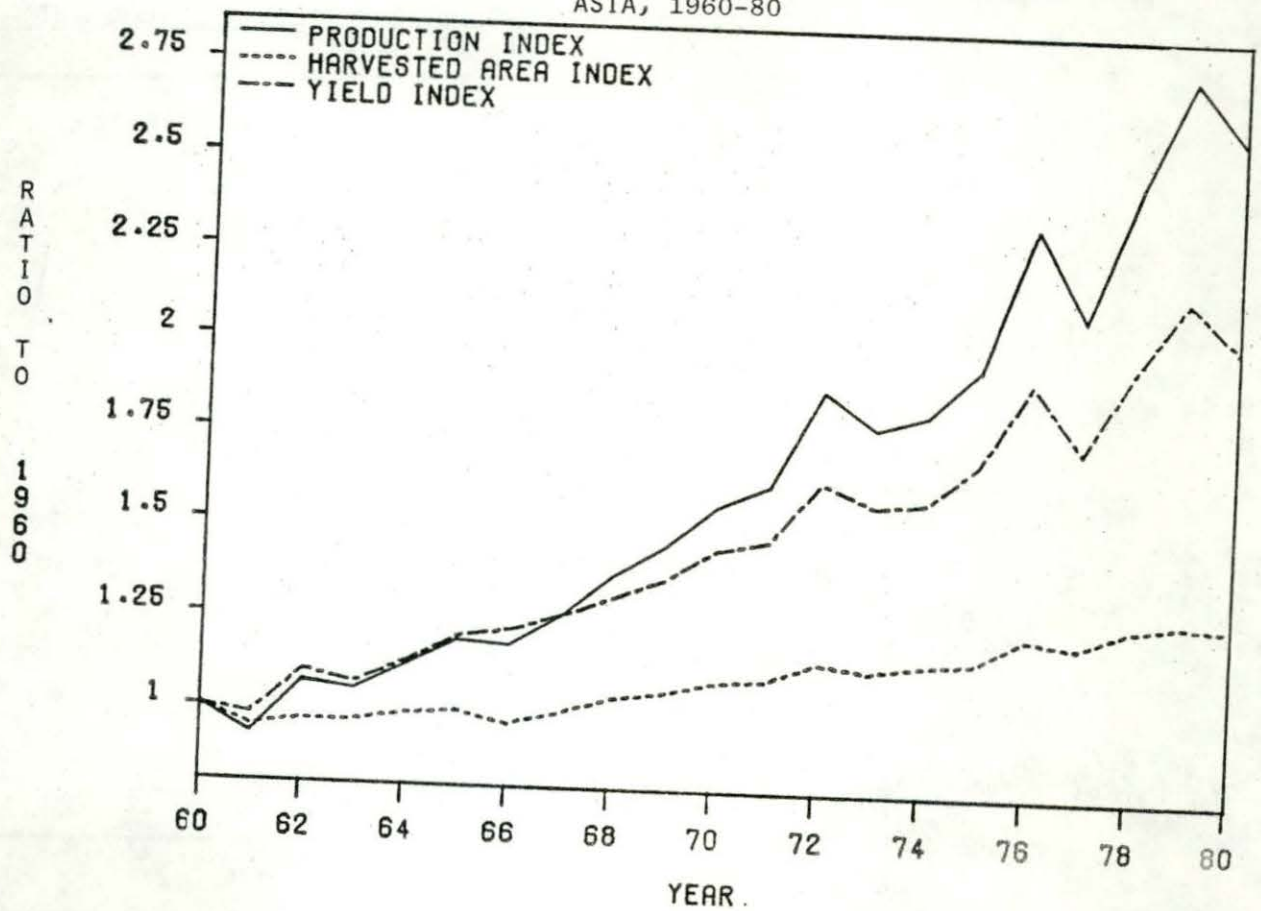


FIGURE 1-34. WHEAT: NET IMPORTS; PRODUCTION AND STOCKS AFRICA, 1960-80

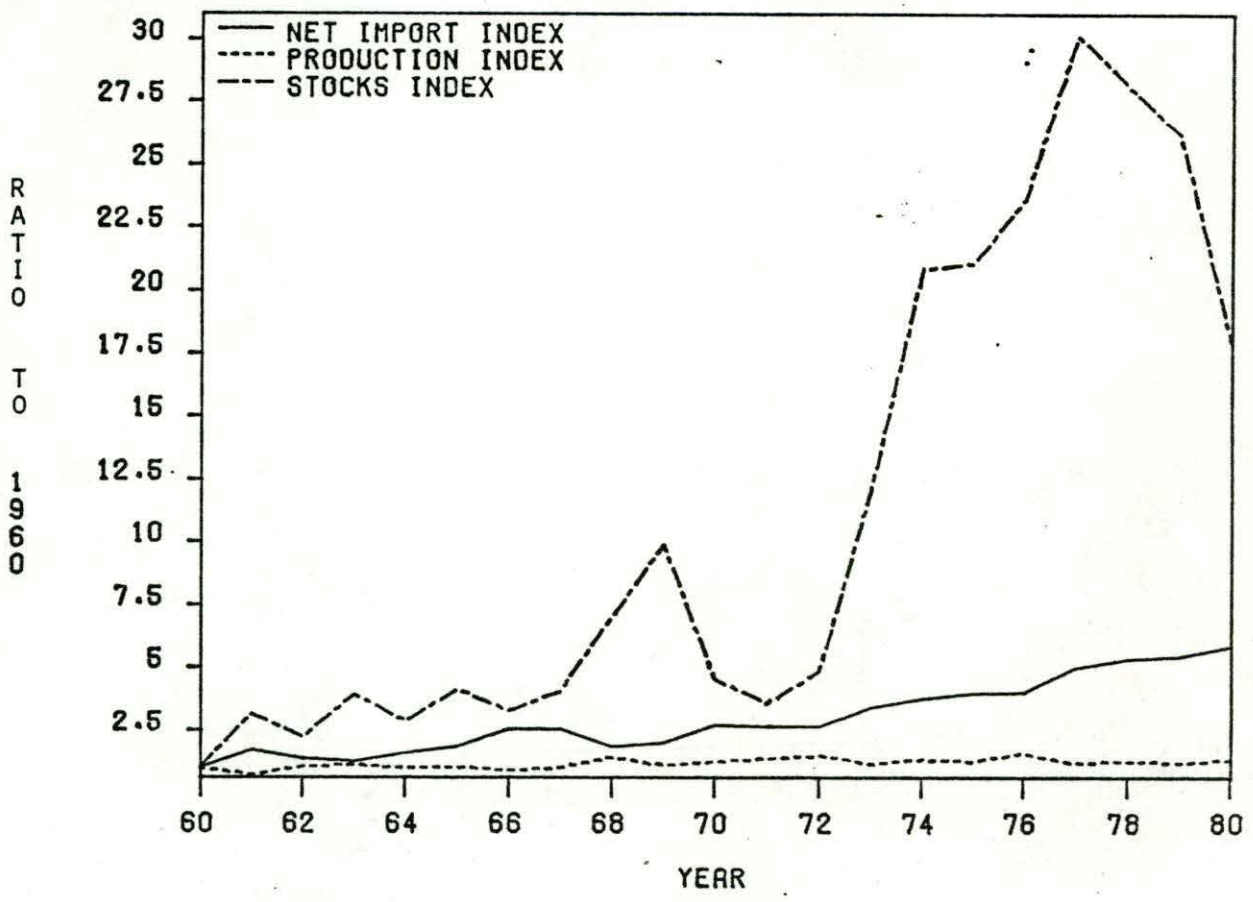


FIGURE 1-35. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA AFRICA, 1960-80

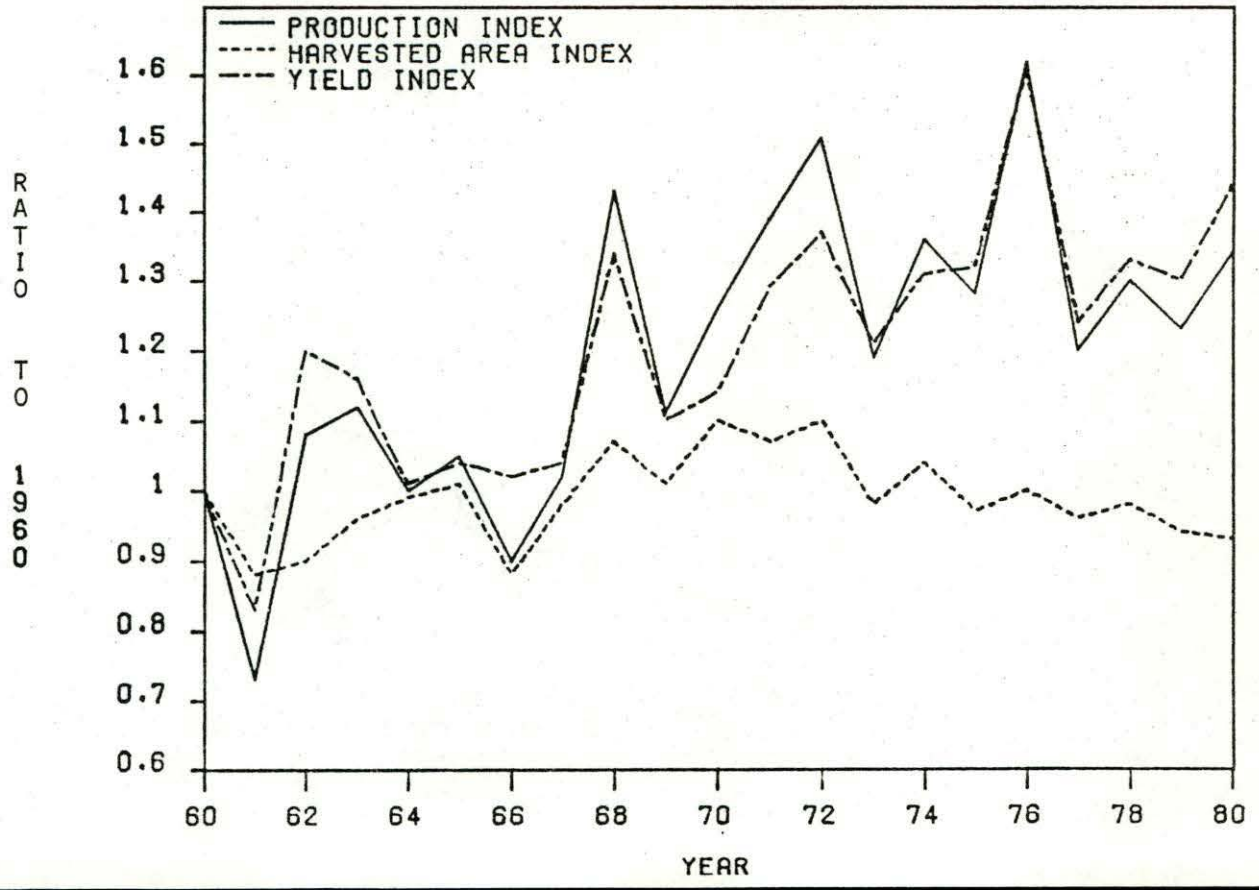


FIGURE 1-36. WHEAT: NET IMPORTS, PRODUCTION AND STOCKS CENTRAL AMERICA, 1960-80

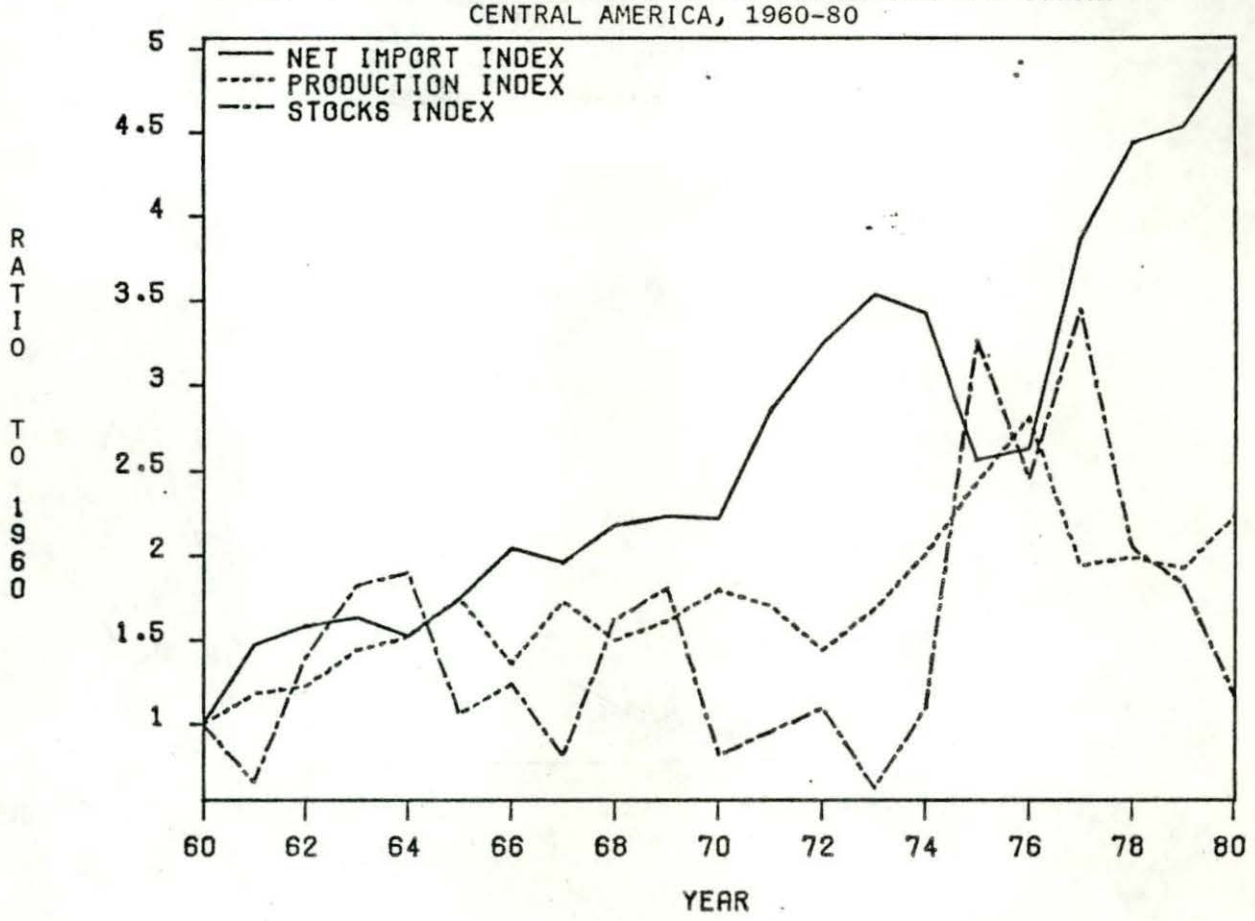


FIGURE 1-37. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA CENTRAL AMERICA, 1960-80

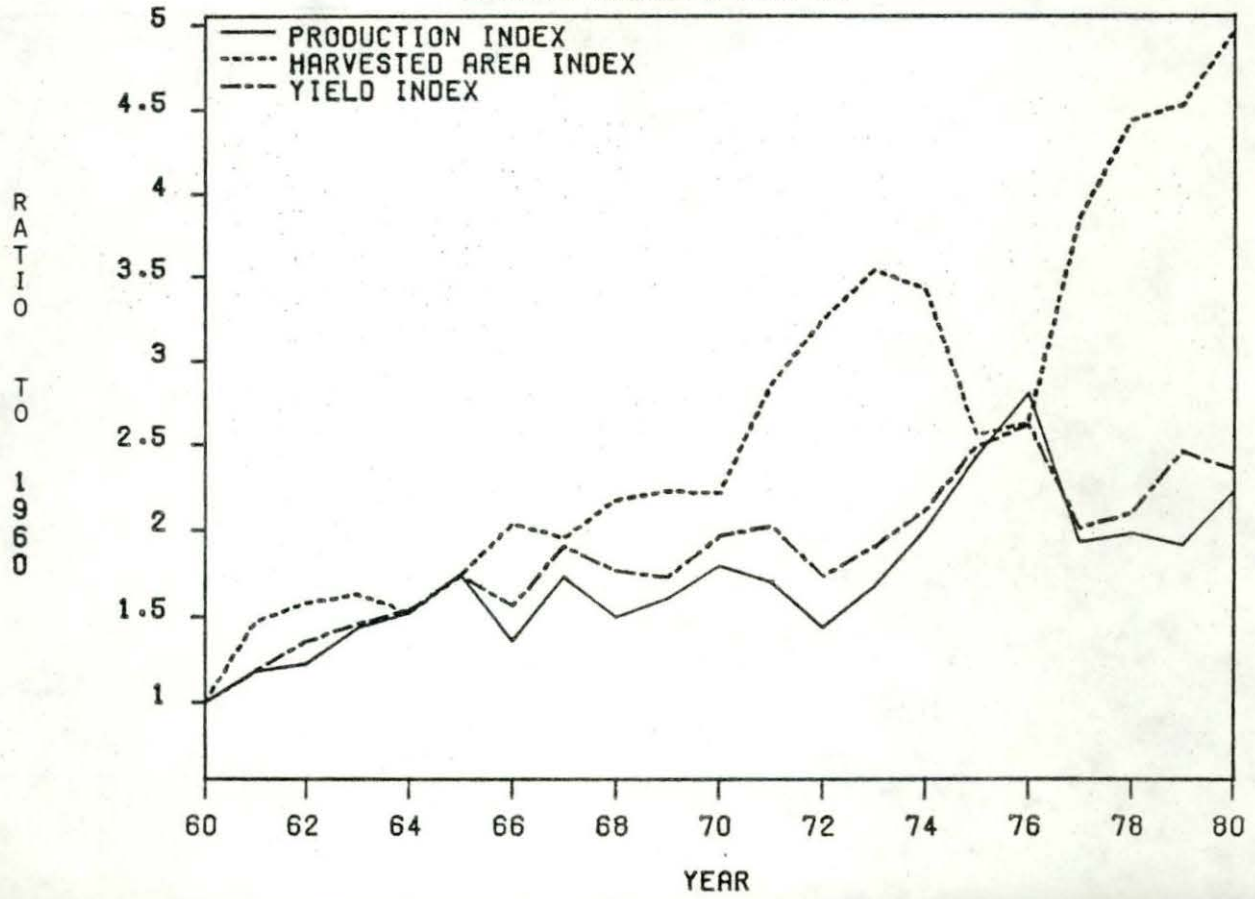


FIGURE 1-38. WHEAT: NET IMPORTS, PRODUCTION AND STOCKS SOUTH AMERICA, 1960-80

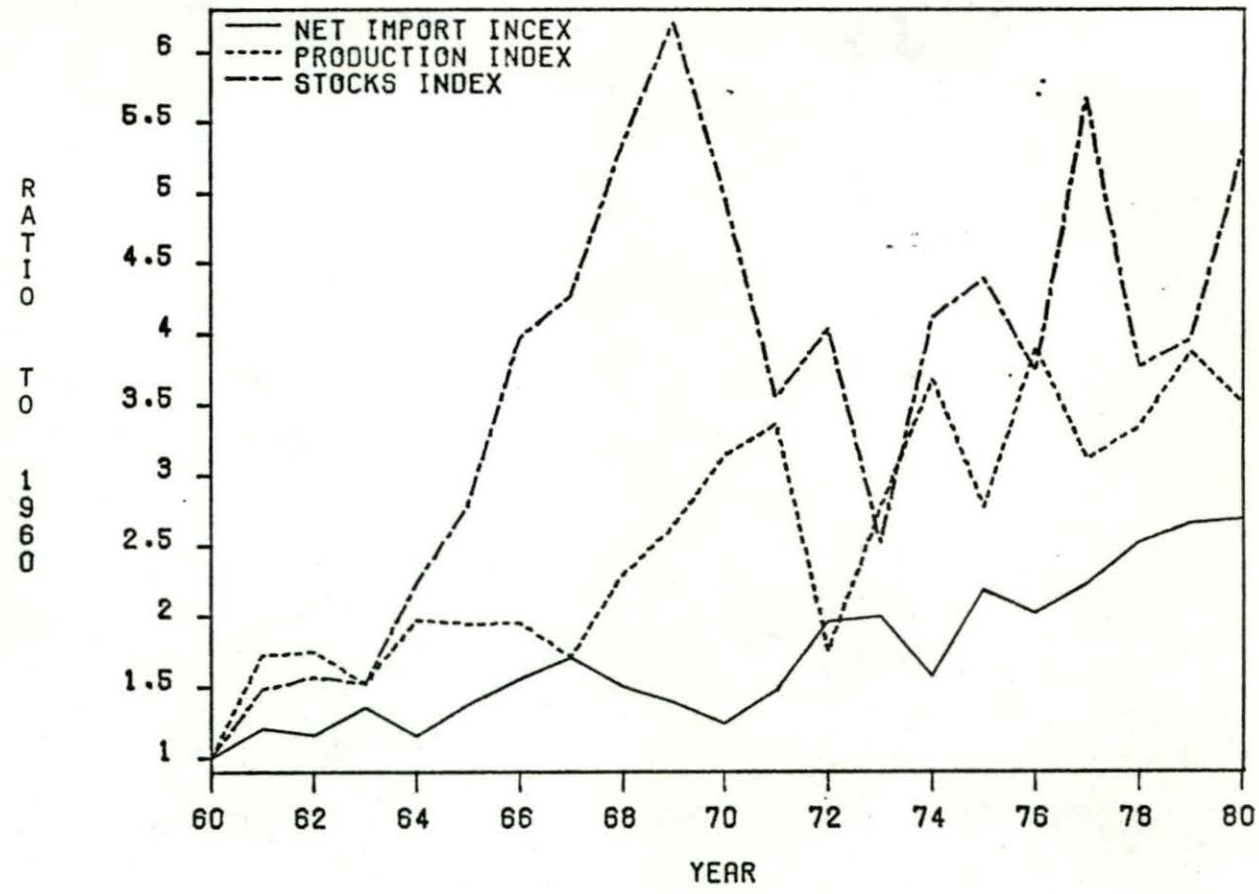


FIGURE 1-39. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA SOUTH AMERICA, 1960-80

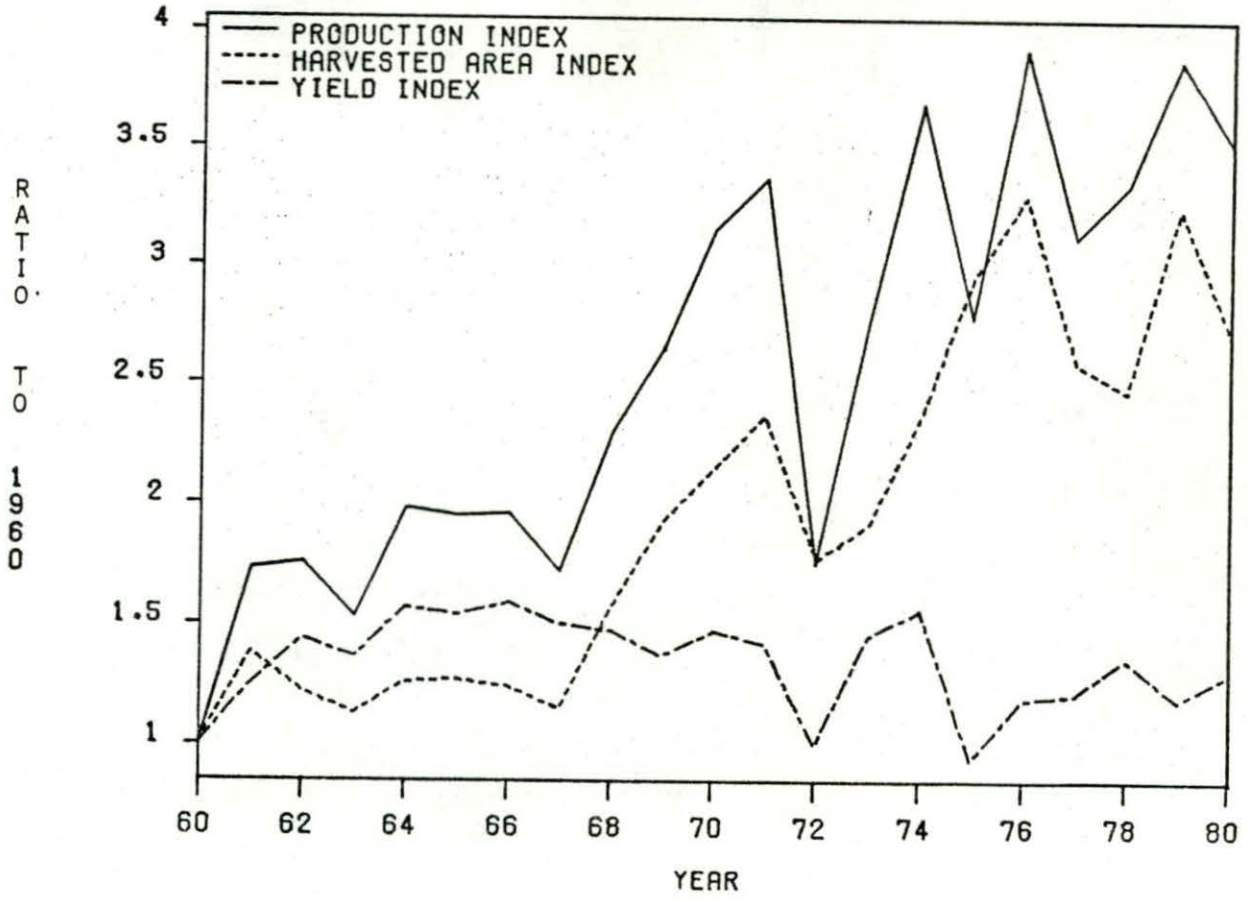


FIGURE 1-40 WHEAT: NET IMPORTS, PRODUCTION AND STOCKS OIL EXPORTING LDC'S, 1960-80

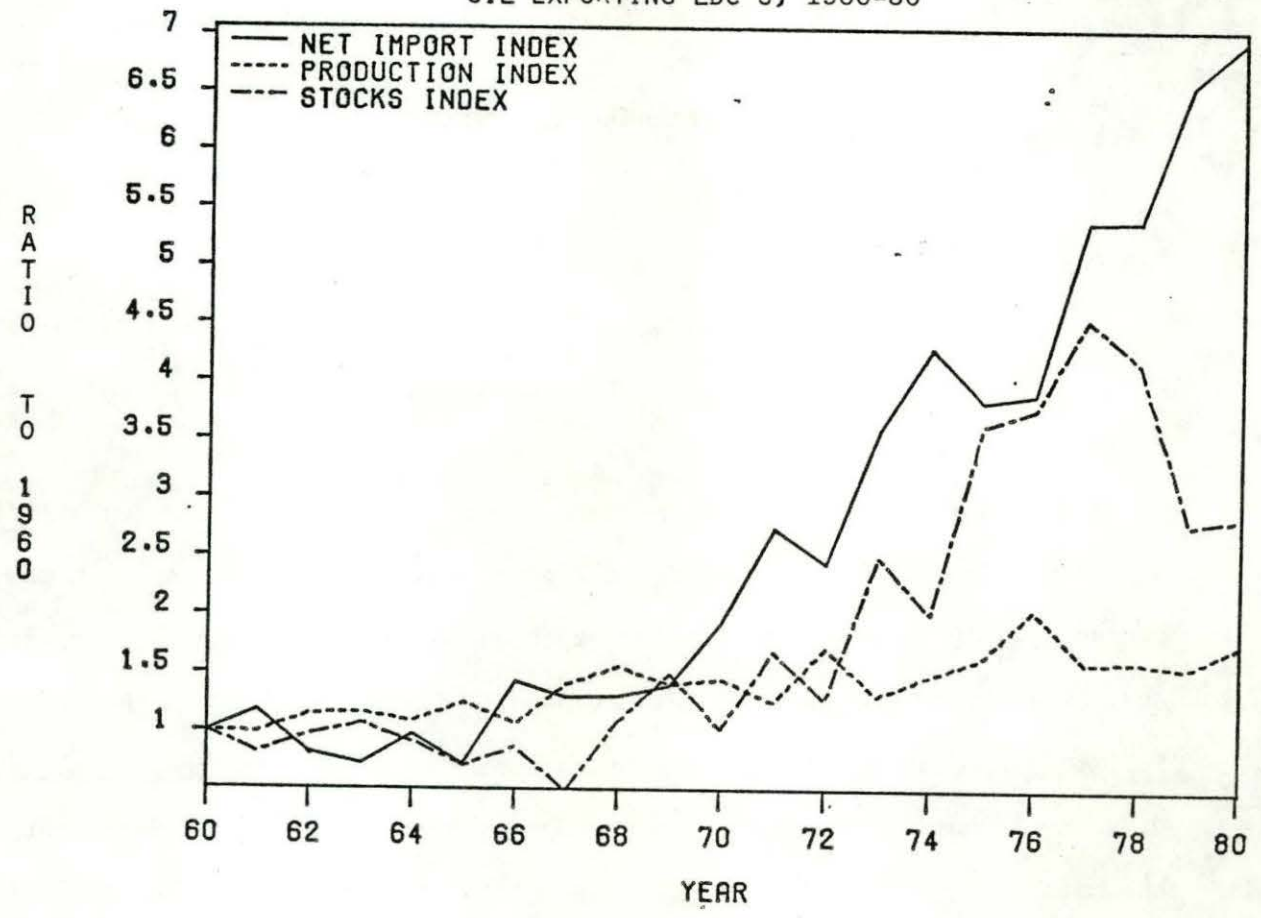
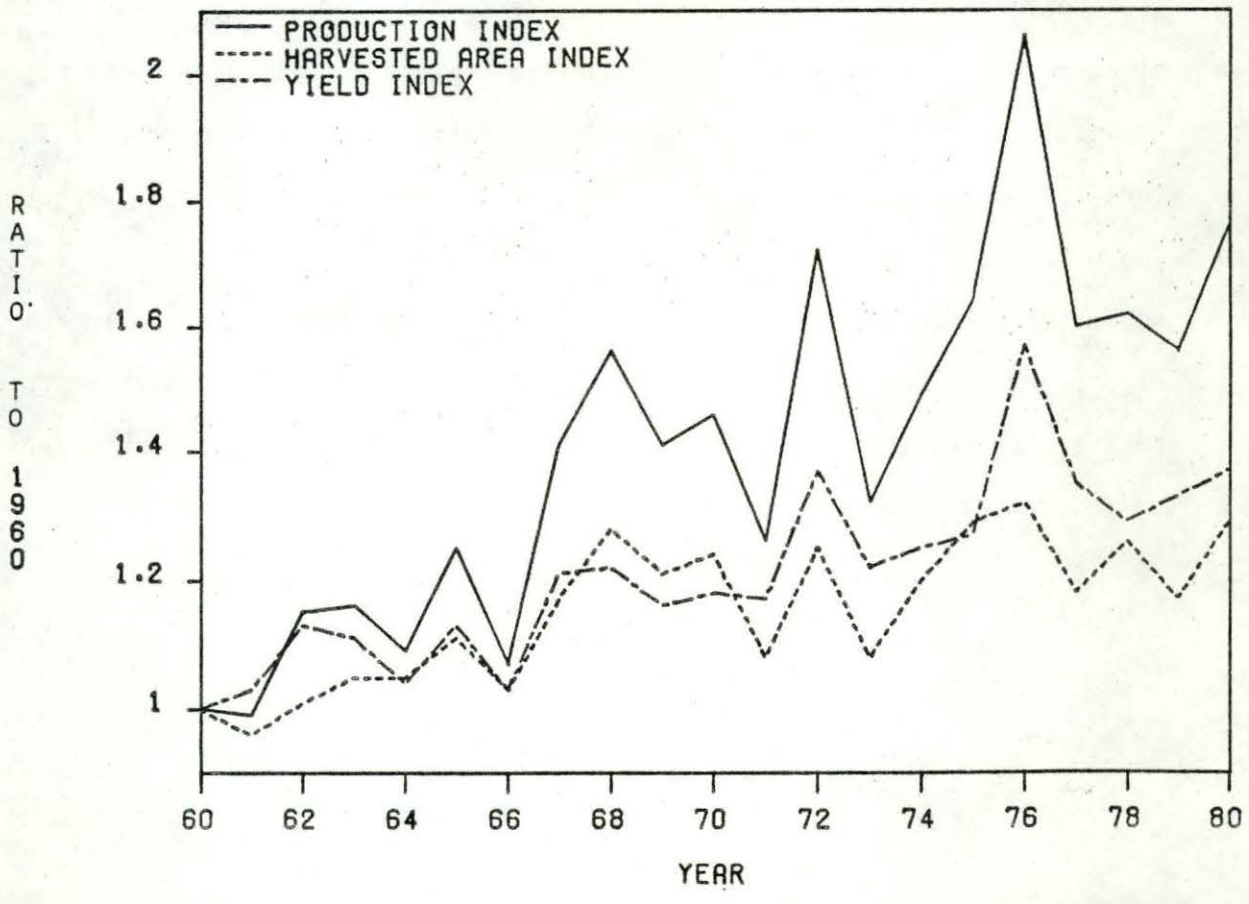


FIGURE 1-41. WHEAT: PRODUCTION, YIELD AND HARVESTED AREA OIL EXPORTING LDC'S, 1960-80



TREND ANALYSIS OF TRADE, PRODUCTION AND CONSUMPTION OF COARSE GRAINS

Exports

Over the 1960-1980 period, the U.S. accounted for an average of 63 percent of "Major Exporters" net exports. Data on net export trends market shares and variability are displayed in Tables 2-01 and 2-02. Argentina was the second major exporter at 13 percent, then France, 9 percent, South Africa, 5 percent, Canada, 4 percent and Thailand and Australia 3 percent. In the period 1960-1980, the United States exported more than all other major exporters, except for 1970 and 1971 (Figure 2-01). In 1970 the U.S. market share fell to 41 percent as Canada, Argentina, and France expanded their exports. U.S. net exports of coarse grain have grown by an average of 8.7 percent (of the mean) per year, a rate of growth equal to or surpassed only by Canada (10 percent).

Figure 2-01 shows that in the period 1970-1980, growth in U.S. net feed grain exports accelerated to about 9 percent while net export growth of some other major exporters, including Australia (Figure 2-02), Canada (Figure 2-03) slowed. Net export growth in other countries are: France (6 percent), Thailand (5.9 percent), Argentina (5.5 percent) and South Africa (4.3 percent). The U.S. and Thailand show the lowest export variability, with coefficients of variation equal to 24 percent and 22 percent, respectively. Argentina has net export variability equal to 31 percent. All other major exporting countries have coefficients of variation between 40-60 percent. The highest variability is found in Canada, 55.7 percent (Table 2-01).

Table 2-01

Coarse Grain: Net Imports and Exports, Selected Regions 1960-80

Region	1000 Metric Tons (mean)	World* Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	32,807	63	8.70	24.00	8.5	.52
Canada	1,990	4	10.30	55.70	5.1	1.13
Australia	1,801	3	8.00	40.50	5.5	1.55
Argentina	6,665	13	5.50	30.80	5.0	2.49
Thailand	1,574	3	5.90	21.80	7.5	2.22
South Africa	2,329	5	4.30	51.10	2.4	1.99
France	4,526	9	6.00	41.20	4.0	1.18
Major Exporters Less U.S.	18,889	37	6.30	16.60	10.5	1.70
Total Exporters	51,696	100				
Importers						
Western Europe	19,054	37	.70	19.10	1.1	1.34
Eastern Europe	3,632	7	9.70	30.00	7.7	.62
U.S.S.R.	3,612	7	9.70	100.80	7.3	2.00
Soviet Bloc	7,243	14	19.40	60.80	8.9	1.15
Total Europe	26,297	51	5.90	16.80	9.7	.92
Middle East Oil	541	1	21.90	115.40	5.3	.37
Middle East Other	947	2	6.30	11.20	15.6	1.42
East Asia Middle Income	2,258	4	15.00	41.70	10.1	.45
Japan	10,363	2	8.50	5.70	41.7	2.10
China	581	1	8.20	143.30	1.6	1.36
S. Asia Major Importers	672	1	1.90	88.00	.6	1.10
Total Asia	15,399	30	9.70	15.70	17.2	.81
Major Africa Importers	483	1	15.60	97.90	4.4	.49
Total Africa	476	1	6.50	41.00	4.4	.48
Mexico	1,127	2	24.90	132.90	5.2	.64
Other C. America Major Importers	439	1	8.20	187.30	12.2	.66
Total C. America	1,672	3	19.80	93.20	5.9	.60
Total S. America	1,439	3	28.10	184.10	4.2	.91
LDC Oil Exporting	2,297	4	21.90	95.90	6.3	.36

*Market share is calculated as a percent of total net exports of major exporters.

Table 2-02

Coarse Grain: Net Imports and Exports, Selected Regions
1960, 1970 and 1980

Region	1960 1000 MT	1960 World* Share (Percent)	1970 1000 MT	1970 World* Share (Percent)	1980 1000 MT	1980 World* Share (Percent)
Exporters						
U.S.	10,830	57	18,250	41	69,210	67
Canada	512	3	4,009	9	3,351	3
Australia	1,347	7	2,915	7	2,368	2
Argentina	2,498	13	9,096	21	14,360	14
Thailand	518	3	1,740	4	2,397	2
South Africa	1,734	9	2,848	6	4,930	5
France	1,546	8	5,193	12	6,560	6
Major Exporters Less U.S.	8,156	43	25,800	59	33,970	33
Total Major Exporters	18,986	100	44,050	100	103,180	100
Importers						
Western Europe	13,880	73	19,720	45	14,170	14
Eastern Europe	514	3	3,176	7	9,714	9
U.S.S.R.	-1,808	-10	- 809	-2	18,000	17
Soviet Bloc	-1,294	- 7	2,367	5	27,710	27
Total Europe	12,590	66	22,090	50	41,880	41
Middle East Oil	107	1	49	--	3,450	3
Middle East Other	490	3	982	2	1,422	1
East Asia Middle Income	172	1	1,262	3	6,456	6
Japan	1,878	11	10,480	24	18,860	18
China	662	3	- 31	--	851	1
S. Asia Major Importers	314	--	- 77	--	1,014	1
Other Asia Less Exporters	-63	--	361	1	364	--
Total Asia	3,560	4	13,020	30	32,420	31
Oil Exporting	6	--	160	--	769	1
Other Major Importers	78	--	-30	--	2,296	2
Other Africa	-460	2	-524	-1	651	1
Total Africa	-375	2	-394	-1	3,716	4
Mexico	81	--	-320	-1	7,291	7
Other C. America Major Importers	55	--	355	1	901	1
Total C. America	140	1	49	--	8,422	8
Total S. America	93	--	-73	--	2,592	3
LDC Oil Exporting	195	1	7	--	12,820	12

*Market share is calculated as a percent of total net exports by major exporters.

Imports

Among coarse grain net importers, over the 20 year period, Europe has the largest share of net imports, 51 percent, on the average followed by Asia (30 percent), South American (3 percent), North and Central America (3 percent) and Africa (1 percent). South American net imports of coarse grain have grown the fastest, followed by Central America, Asia, Africa and Europe. The highest variability by major regions is found in South and Central America followed by Africa, Asia and Europe (see Table 2-01 and Figure 8-04).

West European net imports have shrunk from 73 percent of major exporters net exports to 14 percent. Soviet Bloc countries exported a quantity equal to 7 percent of "Major Exporters" net exports in 1970 and imported 27 percent in 1980. The Soviet Union has the highest coefficient of variation for net imports in Europe, followed by Eastern Europe. In the 1970s there was wide fluctuations and rapid growth in Soviet Union coarse grain imports (Figure 2-26). Eastern Europe's high coefficients of variation is combined with rapid growth in its coarse grain imports after 1968 (Figure 2-28).

Asian net imports have grown from 4 percent of "Major Exporters" net exports in 1970 to 31 percent in 1980 (Table 2-02). The fastest growth in net imports occurred in Middle East oil producing countries who increased from 1 percent in 1970 to 3 percent in 1980. Middle East oil exporters' coarse grain imports began accelerating in 1974 and also became highly variable. Japan showed the largest absolute increase in net imports, from 1.878 MT in 1970 to 18.860 MMT in 1980. As a share of total net exports of Major Exporters, Japan grew from 10 percent in 1960 to 24 percent in 1970 and declined to 18 percent in 1980. Japan also shows very low variability from trend in its import pattern (Table 2-01).

East Asia Middle Income countries also increased net imports of coarse grain significantly from 1 percent to 3 percent of Major Exporters net exports. Import growth in these countries began accelerating in 1966 with moderate variability. China shows high variability in net imports as does Middle East Oil Exporters and South Asia Major Importers. China has been a minor factor in feedgrain markets throughout the period. South Asia Major Importers barely show a positive trend and also have a relatively high variability in coarse grain imports.

Africa changed from a net exporter in 1970 (2 percent) to a net importer in 1980 (4 percent) (Table 2-02). Africa shows a trend of decreasing net imports 1960-1971 and increasing net imports 1972-1980 (Figure 2-04).

Central America has increased its net import share from 1 percent in 1970 to 8 percent in 1980 (Table 2-02). This increase comes mainly from import growth in Mexico during the latter part of the period. South America increased net imports from less than 1 percent in 1960 to 3 percent in 1980.

LDC Oil Exporting countries show major growth in coarse grain imports in the 1970s increasing from 1 percent or less in 1960 to 12 percent in 1980 (Table 2-02 and Figure 2-05).

Imports from the U.S.

Western Europe was the major importer from the U.S., importing 42 percent of U.S. coarse grain exports 1960-1980 (Table 2-03 and Figure 2-06). The rate of growth in Western European imports from the U.S., slowed after the mid-1970s. Soviet Bloc countries increased coarse grain imports from an overall average of 17 percent to a volume that surpassed Western Europe in 1979

Table 2-03

Coarse Grain: Imports from the United States, June to July
Selected Regions, 1960-1980

Region	1000 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Western Europe	13,235	42	5.10	25.20	5.6	1.15
Eastern Europe	2,327	7	14.80	60.00	6.2	2.02
U.S.S.R.	2,948	9	17.20	77.30	6.4	.68
Soviet Bloc	5,276	17	16.20	57.70	7.8	1.30
Total Europe	18,511	58	8.30	26.50	8.7	.79
Middle East Oil	142	--	17.30	90.40	5.3	1.11
Middle East Other	733	2	6.70	11.20	16.4	2.37
East Asia Middle Income	1,332	4	17.20	68.20	7.0	.28
Japan	6,505	21	10.00	22.50	12.3	1.41
China	382	1	18.00	180.70	2.8	1.65
S. Asia Major Importers	354	1	-2.30	156.40	.4	1.65
Total Asia	9,516	30	10.70	26.90	11.0	1.03
Major Africa	454	1	10.40	76.00	3.8	.57
Total Africa	658	2	11.60	76.00	4.3	.65
Mexico	1,282	4	18.00	102.80	4.9	.44
Other C. America Major Importers	164	1	12.70	22.20	15.8	.99
Total C. America	2,109	7	17.20	88.60	5.4	.45
Total S. America	723	2	16.80	90.00	5.2	.44
LDC Oil Exporting	1,808	6	17.30	83.60	5.7	.40
World Total	31,730	100	9.60	24.60	10.8	.55

(Figure 2-07). The Soviet Union imported no coarse grains from the U.S. from 1960 through 1971. East European coarse grain imports from the U.?S. have also accelerated since 1972.

Asia was the second largest importer of U.S. coarse grains, importing 30 percent of U.S. coarse grain exports in the period 1960-1980. Figure 2-06 shows growth in their imports accelerating after 1972. Figure 2-07 shows the steady growth of Japanese coarse grain imports. The highest growth areas overall, have been China and Mexico (18 percent), Middle East Oil Exporters (17.3 percent), and East Asia Middle Income countries (17.2 percent). Other importing regions share of coarse grain net imports include Central America (7 percent), Africa (2 percent) and South America (2 percent). Figure 2-06 shows that growth in U.S. exports to these three regions accelerated in the late 1970s. As shown in Table 2-03, "LDC Oil Exporters" accounted for an average of 6 percent of U.S. coarse grain exports. LDC oil exporters also show fast growth in coarse grain imports from the U.s. during the last half of the 1970s (Figure 7) as do East Asia Middle Income countries.

China and major South Asian Importers show virtually no growth trend in coarse grain imports from the U.S. with occasional large purchases. For example, China imported 2.636 MMT, 1971-1973, and 4.317 MMT, 1978-80, and no coarse grains from the U.S. during the remaining years. The highest coefficient of variation in coarse grain imports from the U.S. appear in China (181 percent), South Asian Major Importers (156 percent) and Mexico (102 percent) (Table 2-03).

Production

Coarse grain production trends are shown in Table 2-04. Total world production of coarse grains averaged 588.230 million metric tons and grew at an

Table 2-04

Coarse Grain: Production, Selected Regions, 1960-80

Region	1000 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	168,143	29	2.8	9	8.5	1.94
Canada	17,442	3	3.1	13.8	6.3	1.44
Australia	4,162	1	4.4	20.7	5.9	2.21
Argentina	12,768	2	4.0	20.1	5.5	2.41
Thailand	1,904	—	7.8	18.9	11.5	2.08
South Africa	8,240	1	4.2	25.1	4.6	2.29
France	18,427	3	3.7	11.8	8.6	1.20
Major Exporters Less U.S.	62.944	11	3.8	8.8	12.0	1.72
Importers						
Western Europe	73,192	12	2.9	5.8	14.2	1.50
Eastern Europe	50,780	9	2.5	4.9	5.2	2.25
U.S.S.R.	74,669	13	3.0	16.3	14.3	1.68
Soviet Bloc	125,449	21	2.8	10.1	7.8	2.04
Total Europe	198,641	34	2.9	6.4	12.3	1.87
Middle East Oil	1,938	—	.1	10.9	.3	1.50
Middle East Other	1,106	—	1.0	31.3	.9	1.30
East Asia Middle Income	1,545	—	.3	21.5	.4	1.10
Japan	945	—	-11.1	34.6	9.0	.63
China	60,774	10	3.5	7.2	13.6	.75
S. Asia Major Importers	33,042	6	1.5	6.9	6.0	2.42
Total Asia	110,832	19	2.4	5.0	13.5	1.22
Major Africa Importers	7,661	1	2.0	11.1	5.1	1.70
Total Africa	34,518	6	1.7	4.1	11.5	1.50
Mexico	10,395	2	3.8	9.6	11.1	2.22
Other C. America Major Importers	121	—	-4.7	3.0	4.3	.22
Total C. AMerica	12,891	2	3.5	8.0	12.0	2.27
Total S. America	18,689	3	3.6	8.4	12.0	1.67
LDC Oil Exporting	24,562	4	2.2	5.0	12.2	2.10
World Total	588,230	100	2.8	3.2	24.2	2.27

average rate of 2.8 percent per year over the 1960-1980 period. For the period 1960-80, Europe (both East and West) accounted for 34 percent of the world's coarse grain production. European coarse grain production has grown at an average rate similar to the world average (2.9 percent per year) with higher variability (6.4 percent). Two-thirds of European coarse grain production, or 21 percent of the world total came from the Soviet Bloc countries, including 13 percent from Russia and 9 percent from Eastern Europe. Coarse grain production in each of the European sub-regions has grown at a rate of about 3 percent per year (Eastern Europe a little slower--2.5 percent). Eastern and Western European coarse grain production variability is equal to 5-6 percent, while Soviet production varied by 16.3 percent from the mean. Although not the highest variability of any region, Soviet production variability does have considerable impact on world output because of the size of its coarse grain production. Variability in Soviet coarse grain production is especially pronounced after 1972 (see Figure 2-27).

The United States accounting for an average of 29 percent of world coarse grain production from 1960 through 1980. Production of coarse grains grew at an average of 2.8 percent over the twenty year period with annual variation of 9 percent.

Asia produced an average of 19 percent of the world's coarse grain production, with its major producers, China accounting for 10 percent. Asian production has growth more slowly than the world average (2.4 percent vs. 2.8 percent). Production of coarse grains in China has grown faster than the world average (3.5 percent) and major South Asian Importers, slower (1.5 percent). Japan appears to be pulling out of coarse grain production. Production variability has been moderate in China and Major South Asian Importers (5-7 percent) but higher in other Asian regions (Table 2-04).

Africa accounted for an average of 6 percent of world coarse grain production, growing slower than world average rate at 1.7 percent with 4 percent variability. Central and South America accounted for 3 and 4 percent of world coarse grain production, but growth has been faster than the world average (3.5-3.6 percent) with variation of about 8 percent of the mean.

Among major exporters, Canada and France accounted for an average of 3 percent of world coarse grain production, Argentina 2 percent, and Australia and South Africa each 1 percent. Growth in coarse grain production for these major exporters has been higher than the U.S. (over 3 percent vs. 2.8 percent). Variability for Major Exporters Less U.S. is very close to the U.S. average, (8.8 percent vs. 9 percent). Variability for each exporting country is higher than "Major Exporters Less U.S." overall. The two largest producers in this category, France and Canada, have variability equal to 12 percent and 14 percent. Australia, Argentina, Thailand and South Africa have variability ranging from 19 percent to 25 percent.

Yield

World yields of coarse grain averaged 1.76 metric tons per hectare and grew at an average rate of 2.4 percent per year over the 1960-1980 period. The coefficient of variation of yields over the twenty year period is 3.2 percent (Table 2-05).

Yields were highest on the average in U.S. (4.01 MT/HA, France (3.42) and Western Europe (3.05). A second tier of country/regions had yields over 2 MT/HA including Japan (2.71), Eastern Europe (2.54), Canada (2.06), Argentina (2.05) and Thailand (2.01). The lowest yields are found in South Asian Major Importers (.64 MT/HA) and Africa (.81) (Table 2-05).

Table 2-05

Coarse Grain: Yields, Selected Regions, 1960-1980

Region	Yield (MT Per Hectare)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters					
U.S.	4.01	2.8	8.3	9.5	1.88
Canada	2.06	2.4	7.9	8.5	1.76
Australia	1.17	1.5	14.8	2.7	2.62
Argentina	2.05	3.5	13.0	7.4	2.03
Thailand	2.01	-.3	15.2	.6	1.66
South Africa	1.52	4.3	23.0	5.2	2.14
France	3.42	3.0	9.3	8.9	1.23
Major Exporters Less U.S.	2.12	2.8	5.6	14.0	2.13
Importers					
Western Europe	3.05	2.3	5.2	12.2	1.55
Eastern Europe	2.54	3.2	4.4	3.5	2.22
U.S.S.R.	1.40	1.9	15.2	20.4	1.36
Soviet Bloc	1.71	2.2	9.8	6.2	2.02
Total Europe	2.03	2.2	7.1	8.8	1.66
Middle East Oil	.84	.1	6.8	2.6	1.63
Middle East Other	.95	1.6	85.1	.5	2.02
East Asia Middle Income	1.99	3.3	13.6	6.8	1.85
Japan	2.71	1.1	12.3	2.6	1.54
China	1.62	4.5	10.4	12.1	.53
S. Asia Major Importers	.64	1.7	5.7	8.5	1.86
Total Asia	1.09	3.0	5.5	15.2	.72
Major Africa Importers	1.28	1.1	12.4	2.5	1.36
Total Africa	.81	2.1	4	1.4	1.45
Mexico	1.21	2.2	6.5	9.7	2.43
Other C. America Importers	1.19	2.2	7.7	7.8	1.02
Total C. America	1.16	2.2	5.7	10.5	2.41
Total S. America	1.39	1.5	6.2	6.6	1.69
LDC Oil Exporting	.91	1.1	3.4	9.1	2.07
World Total	1.76	2.4	3.2	20.9	1.91

European yields overall grew at 2.2 percent per year with variation about the mean equal to 7.1 percent. Western European yields grew a little slower than Eastern Europe and varied more (2.3 percent and 5.2 percent) as compared with (3.2 percent and 4.4 percent). Yields in the USSR grew more slowly and varied more, (1.9 percent and 15.2 percent). The yield trend in the Soviet Union appear to be almost flat in the period 1970-1980 (Figure 2-27). Partial explanation can be found in the increase in harvested area by 24 percent during this period. Conversely, the faster than average growth of yields in Eastern Europe can be partially explained by 16 percent decrease in harvested area from 1960 through 1980 (Figure 2-29).

Yields in South America grew more slowly than the world average and varied moderately (1.5 percent and 6.2 percent). Yield growth in Central America has been somewhat higher (2.2 percent and 5.7 percent) (see Figure 2-37 and 2-39).

Yield of coarse grain in Asia grew rapidly and appear to have accelerated from 1972 through 1980 (Figure 2-33). Overall Asian yields grew by 3 percent per year and varied 5.5 percent. Leading yield growth rates are found in China, 4.5 percent and East Asia Middle Income, 3.3 percent.

Among exporters, yields in South Africa and Argentina grew the most rapidly at 4.3 percent and 3.5 percent respectively. South Africa had higher variability than Argentina (23 percent vs. 13 percent). Harvested area in Argentina decreased in the 1970s, while South African harvested area remained relatively constant (Figures 2-15 and 2-19). Yields in France grew by about 3 percent per year and varied by 9.3 percent. Canadian yields grew by only 2.4 percent per year and varied by 7.9 percent. Australian yields increased 1.5

percent with 14.8 percent variability. Overall major exporters less U.S. increased yields by 2.8 percent per year with 5.6 percent variability.

Harvested Area

Total world harvested area averaged 332.654 million hectares and grew at a rate of 4 percent per year over the 1960-1980 period. Asia accounted for the largest major region share of world coarse grain harvested area at 31 percent. Major South Asian importers accounted for the largest component of Asian harvested acres 16 percent of world total followed by China at 11 percent. Asian harvested area has grown only slowly, .5 percent, while major South Asian and Chinese harvested area have actually decreased. Major South Asian Importers increased harvested area during the period 1962-1968, and generally decreased harvested area during the period 1969-1980. Chinese harvested area was constant at about 40 million hectares 1961-1975 then abruptly dropped to 34 million hectares in 1976 and continued to decline thereafter. European harvested area averaged 29 percent of the world total including the Soviet Union 16 percent; Eastern Europe, 6 percent; and Western Europe, 7 percent. Western Europe has slowly increased harvested area at .7 percent per year with low variability (1.7 percent). Eastern Europe has decreased harvested area by an average of .8 percent per year, also with low variability (2.9 percent). The decrease was more rapid 1960-1974 and at a slower rate 1974-1980. The region total, however, is dominated by Russia where harvested acres declined slightly from 1961 through 1971 and increased after 1971 (Figure 2-27).

Africa has the next highest average of coarse grain harvested area, accounting for an average of 13 percent of world total. Harvested area has grown by an average of 1.5 percent per year 1960-1980 and varied at 2.4 percent (Table 2-06).

The United States also accounted for an average of 13 percent of total world harvested area 1960-1980.

Among major exporters of coarse grains, Canada, Argentina, South Africa and France each accounted for about 2 percent of the world total. Australia and Thailand harvested area grew at 3 percent and 8 percent while South Africa harvested area remained virtually unchanged. These growth rates are reasonably captured by a linear trend. A linear trend does not represent changes in harvested area for Canada, Argentina and France.

Stocks

The United States held 55 percent of coarse grain stocks, on the average, 1960-1980. Other major exporters together held 12 percent, including half by Australia, 6 percent (Table 2-07). Australia and South Africa show a few periods of large fluctuations (build up) in stocks, for example, in 1968-1971 and 1978-1979 for Australia (Figure 2-12 and 2-18). Argentina and Thailand show many smaller fluctuations (Figure 2-14 and 2-16). Canada and France show relatively less fluctuation (Figure 2-10 and 2-20). Europe held 21 percent of stocks on the average, 11 percent in Western Europe and 10 percent in the Soviet Bloc. Asia held 9 percent of stocks, mainly in the South Asian Major Importing countries (6 percent). Africa, Central America and South America each held 2 percent or less of world coarse grain stocks on the average 1960-1980. African coarse grain stocks surged 580 percent 1973-1977 (Figure 2-34). Importer sub-regions showing coefficients of variation equal to or greater

Table 2-06

Coarse Grain: Harvested Area, Selected Regions, 1960-1980

Region	1000 Hectares (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	42,007	13	-.2	6.90	.8	.98
Canada	7,988	2	.1	10.60	2.3	.88
Australia	3.497	1	3.1	11.20	7.6	1.01
Argentina	6,164	2	.1	13.30	1.4	1.32
Thailand	961	--	8.2	9.80	23.1	1.03
South Africa	5,396	2	--	5.10	.6	2.10
France	5,322	2	.1	4.60	5.0	1.39
Major Exporters Less U.S.	29,330	9	1.1	5.80	5.5	.60
Importers						
Western Europe	23,884	7	.7	1.70	11.2	1.23
Eastern Europe	20,185	6	-.8	2.90	4.1	.50
U.S.S.R.	53,120	16	1.1	7.30	7.5	.74
Soviet Bloc	73,304	22	.1	5.80	2.8	.47
Total Europe	97,188	29	.1	4.30	3.9	.49
Middle East Oil	2,315	1	-.5	6.90	2.2	1.54
Middle East Other	1,321	--	2.7	33.60	.2	1.73
East Asia Middle Income	802	--	.3	13.80	5.3	.43
Japan	364	--	-12.0	29.00	11.5	.16
China	38,181	11	-.1	5.60	3.93	.52
S. Asia Major Importers	51,630	16	-.2	3.20	1.8	1.49
Total Asia	102,556	31	.5	3.30	4.44	.90
Major Africa Importers	6,365	2	1.0	7.60	3.7	1.50
Total Africa	42,620	13	1.5	2.40	17.7	1.46
Mexico	8,489	3	1.8	5.90	8.2	.71
Other C. America Major Importers	109	--	-7.0	32.90	5.9	.21
Total C. America	10,959	3	1.4	5.60	7.1	.47
Total S. America	13,322	4	2.2	3.50	17.1	1.36
LDC Oil Exporting	26,974	8	1.1	2.10	14.5	1.81
World Total	332,659	100	4.0	1.30	8.5	1.17

than Africa (59.2 percent) are Middle East Oil Exporters (83.4 percent) and Major African Importers (64.4 percent) (Table 2-07).

Consumption

Europe was the largest user of feed grains, consuming 38 percent of the world's feed grains on the average 1960-1980. Of this amount 16 percent was used in Western Europe, 13 percent in the Soviet Union and 9 percent in East Europe. Annual growth of 2.5 percent and 3.7 percent occured in West Europe and the Soviet Bloc respectively appears to be fairly linear for each with variability equal to 3 percent and 7.7 percent (Table 2-08).

The United States was the second largest user of feed grains (23 percent) 1960-1980 with slower than world growth (1.14 percent vs. 2.8 percent) and with variability of 7.7 percent.

Asia consumed 21 percent of the world's feed grains 1960-1980 with 3.3 percent growth and 4.8 percent variability. Asian consumption includes China (10 percent) Major Asian Importers (6 percent) Japan (2 percent) and East Asia Middle income (1 percent). East Asia Middle Income countries show the fastest growth (9.4 percent), followed by Japan (6.9 percent), and Middle East Oil Exporters (4.8 percent). The highest variability in this region comes from Middle East Oil Exporters (27 percent), whose coarse grain imports began to accelerate in 1974 and East Asia Middle Income countries (21 percent).

Africa accounted for 6 percent of the world's coarse grain consumption 1960-1980, growing at an average rate of 2 percent with variability of 3.5 percent. South America accounted for 3 percent of world coarse grain consumption, growing at an average annual rate of 4.3 percent and varying 6.9

Table 2-07

Coarse Grain: Beginning Stocks, Selected Regions, 1960-1980

Region	1000 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbin Watson
Exporters						
U.S.	44,507	55	4.00	28.00	3.9	.60
Canada	5,279	6	1.60	21.00	2.1	1.63
Australia	608	1	9.20	67.00	3.8	.86
Argentina	473	1	2.20	53.00	1.2	1.95
Thailand	189	--	-6.00	46.00	3.6	.87
South Africa	1,359	2	4.30	50.00	2.4	2.48
France	1,472	2	-.70	27.00	.07	2.00
Major Exporters Less U.S.	9,380	12	2.10	18.00	3.3	1.88
Importers						
Western Europe	8,893	11	2.20	12.60	4.8	1.78
Eastern Europe	2,007	2	4.50	23.80	.9	1.68
U.S.S.R.	6,142	8	-1.00	31.10	5.3	.91
Soviet Bloc	8,150	10	.30	22.20	.4	1.98
Total Europe	17,043	21	1.30	11.70	3.07	2.02
Middle East Oil	113	--	5.70	83.40	1.9	.35
Middle East Other	206	--	5.70	22.00	7.1	1.68
East Asia Middle Income	802	1	11.70	34.80	5.3	.45
Japan	1,147	1	9.00	26.00	9.6	.71
China	na	--	na	na	--	--
S. Asia Major Importers	4,476	6	-3.10	26.70	4.6	.78
Total Asia	7,470	9	1.70	17.60	2.6	.82
Major Africa Importers	935	1	16.40	64.40	7.1	.87
Total Africa	1,411	2	13.20	59.20	7.4	.67
Mexico	805	1	2.90	44.20	1.9	.94
Other C. America Major Importers	9	--	18.10	56.30	8.9	.67
Total C. America	990	1	2.80	38.40	2.0	.85
Total S. America	1,978	2	5.30	46.80	-3.1	.83
LDC Oil Exporting	1,103	1	5.00	36.80	3.8	.74
World Total	81,307	100	-1.30	15.00	2.5	.69

Table 2-08

Coarse Grain: Consumption, Selected Regions, 1960-1980

Region	100 Metric Tons (mean)	World Share (Percent)	Annual Growth (% of mean)	Coefficient of Variation (SE/mean)	T Statistic	Durbi Watso
Exporters						
U.S.	136,989	23	1.14	7.70	4.1	1.13
Canada	15,470	3	2.34	9.10	7.2	.89
Australia	2,326	--	2.02	20.50	2.7	1.37
Argentina	6,111	1	2.29	18.30	3.5	1.17
Thailand	341	--	15.98	45.50	9.7	.62
South Africa	5,714	1	3.62	4.00	25.4	1.92
France	13,847	2	2.90	3.60	22.4	2.15
Major Exporters Less U.S.	43,808	7	2.77	5.40	14.3	.83
Importers						
Western Europe	92,103	16	2.50	3.00	23.4	.78
Eastern Europe	54,359	9	3.20	4.90	10.0	1.55
U.S.S.R.	78,424	13	4.20	11.60	17.9	.96
Soviet Bloc	132,783	23	3.70	7.70	13.6	1.27
Total Europe	224,884	38	3.30	4.80	18.7	1.23
Middle East Oil	670	--	4.80	27.20	5.3	.37
Middle East Other	2,038	--	3.40	17.40	15.6	1.42
East Asia Middle Income	3,759	1	9.40	20.70	10.1	.45
Japan	11,210	2	6.90	5.40	41.7	2.07
China	61,355	10	3.60	7.10	14.0	.89
S. Asia Major Importers	33,636	6	1.60	6.20	.6	1.08
Total Asia	125,977	21	3.30	4.80	17.2	.81
Major Africa Importers	8,126	1	2.90	7.20	11.2	1.95
Total Africa	34,898	6	2.00	3.50	16.3	1.38
Mexico	11,325	2	5.60	4.70	33.2	1.00
Other C. America Major Importers	560	--	5.40	20.10	7.5	.36
Total C. America	14,363	2	5.10	4.20	34.0	.89
Total S. America	19,251	3	4.30	6.90	17.41	1.29
LDC Oil Exporting	26,620	5	3.70	7.80	13.3	.37
World Total	586,325	100	2.80	2.60	29.7	1.83

percent. Central America accounted for 2 percent of world coarse grain consumption 1960-1980 but grew at an above average rate of 5.1 percent and varied by 4.2 percent.

Among Major Exporters other than the U.S., Canada accounted for 3 percent of world coarse grain utilization, France 2 percent, Argentina 1 percent and South Africa 1 percent. Thailand showed the highest growth (16 percent) and variability (46 percent). Thailand coarse grain consumption appears to be accelerating. Consumption in the U.S., Australia and Argentina may be slowing down.

FIGURE 2-01. COARSE GRAIN: NET EXPORTS, U.S. AND OTHER MAJOR EXPORTERS, 1960-80

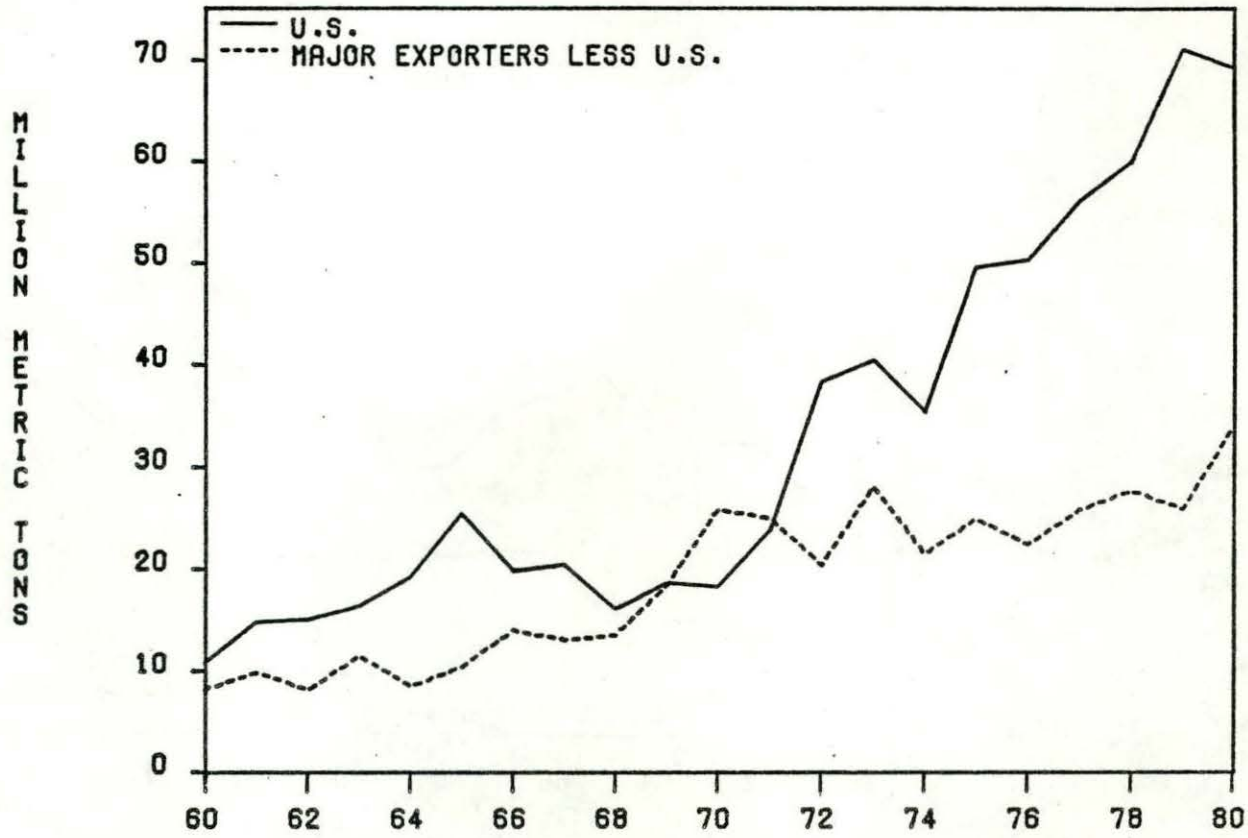


FIGURE 2-02. COARSE GRAIN: NET EXPORTS, AUSTRALIA, SOUTH AFRICA, 1960-80

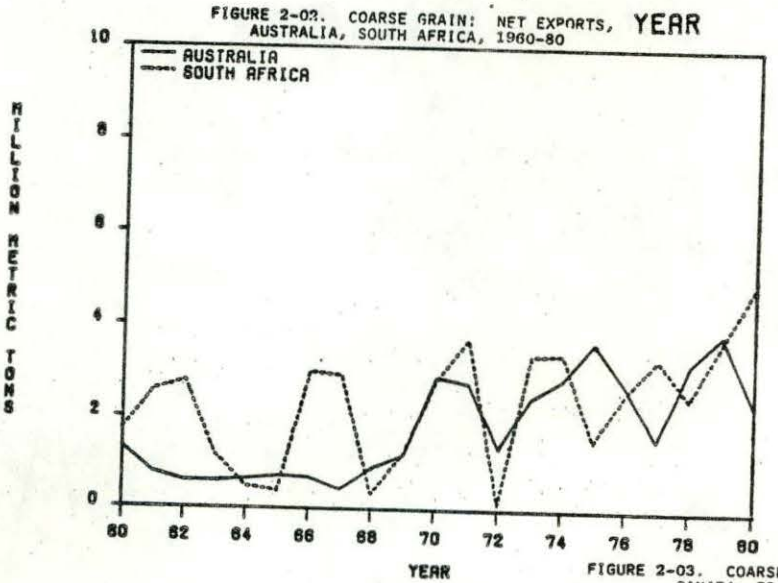


FIGURE 2-03. COARSE GRAIN: NET EXPORTS, CANADA, FRANCE, 1960-80

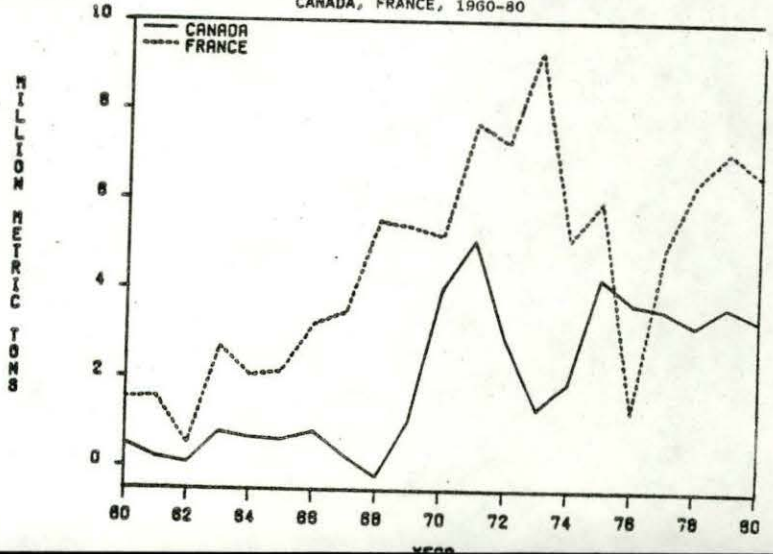


FIGURE 2-04. COARSE GRAIN: NET IMPORTS
MAJOR REGIONS, 1960-80

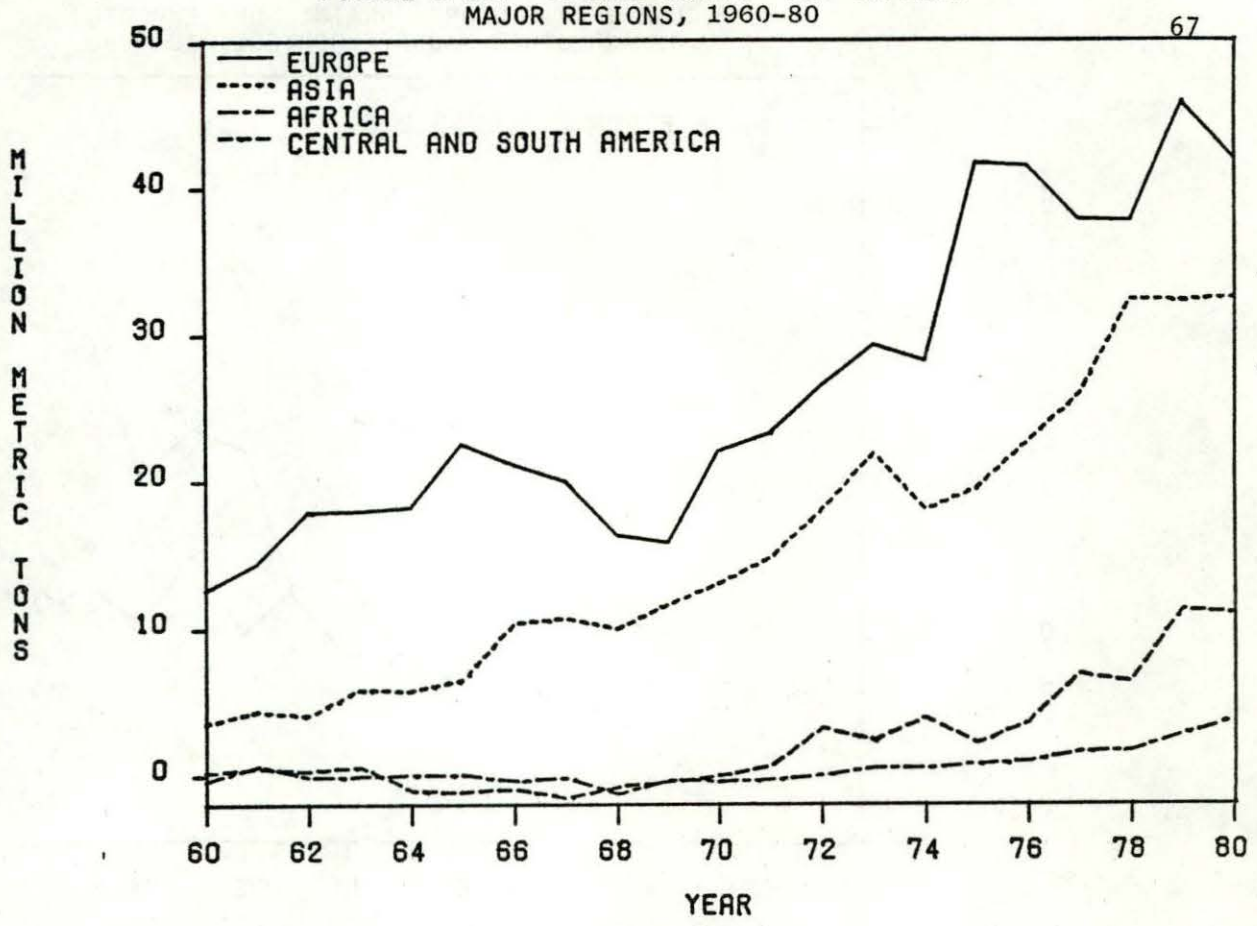


FIGURE 2-05. COARSE GRAIN: NET IMPORTS
SELECTED IMPORTERS, 1960-80

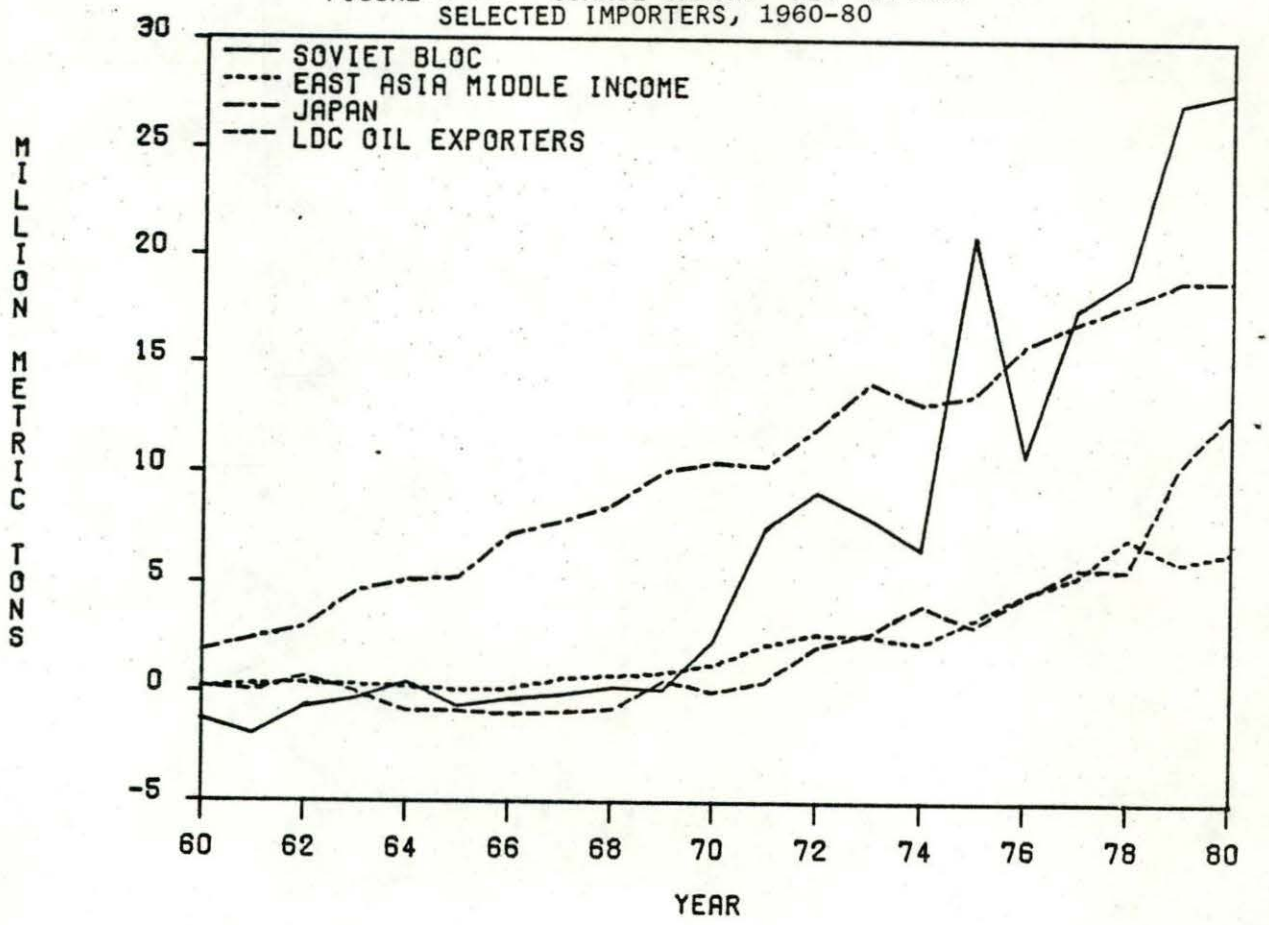


FIGURE 2-06. COARSE GRAIN: IMPORTS FROM THE U.S. MAJOR REGIONS, 1960-80

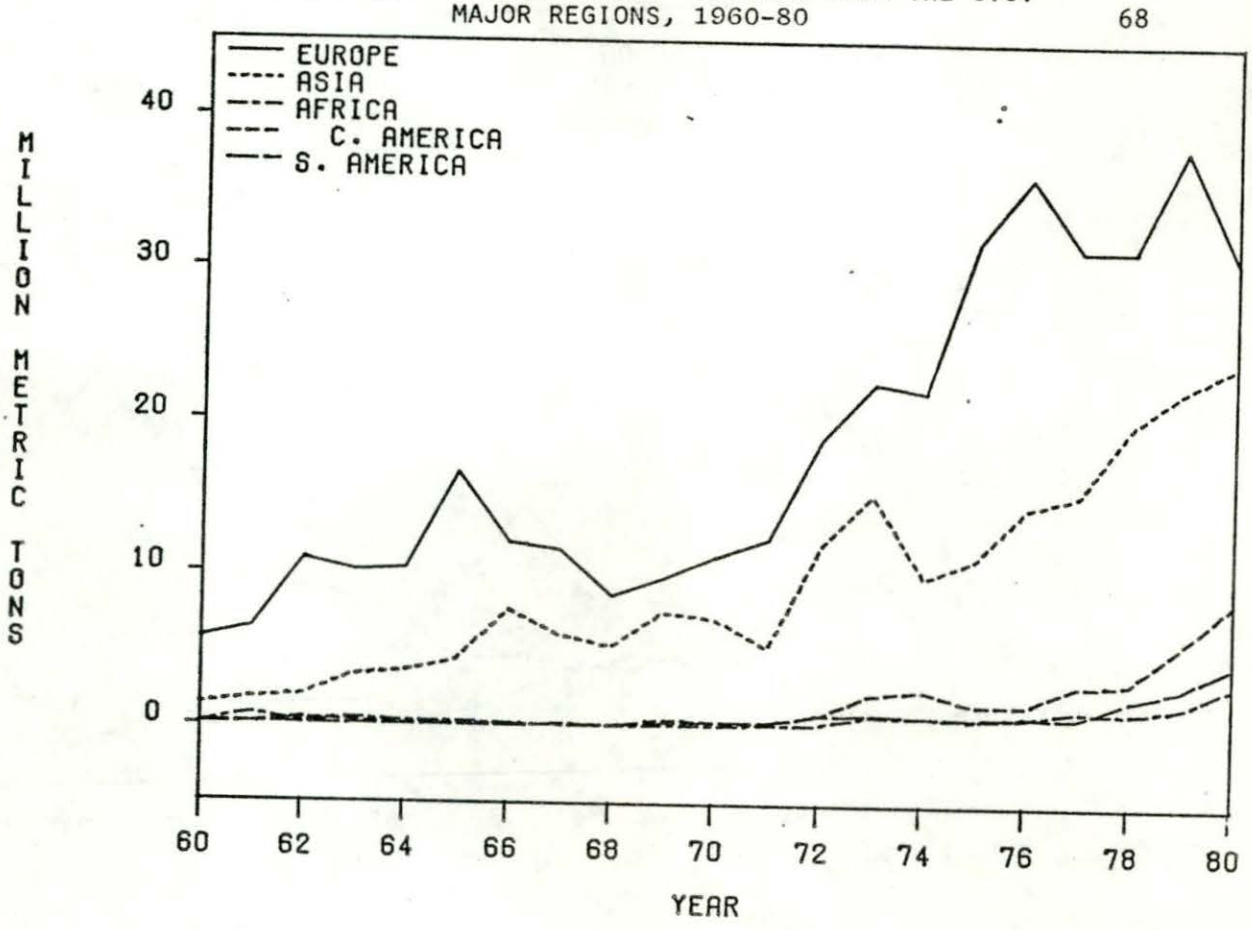


FIGURE 2-07. COARSE GRAIN: IMPORTS FROM THE U.S. SELECTED IMPORTERS, 1960-80

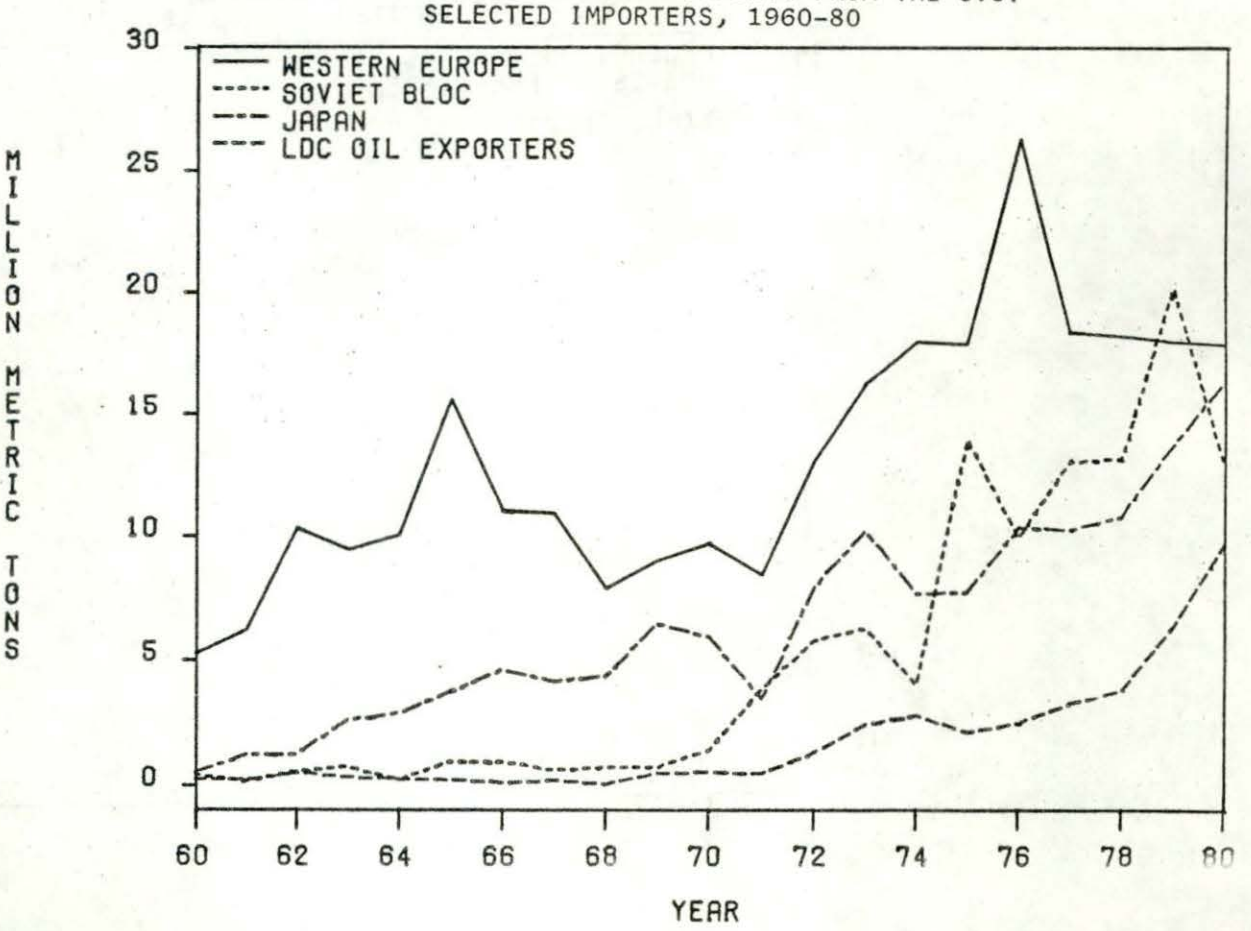


FIGURE 2-08. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS UNITED STATES, 1960-80

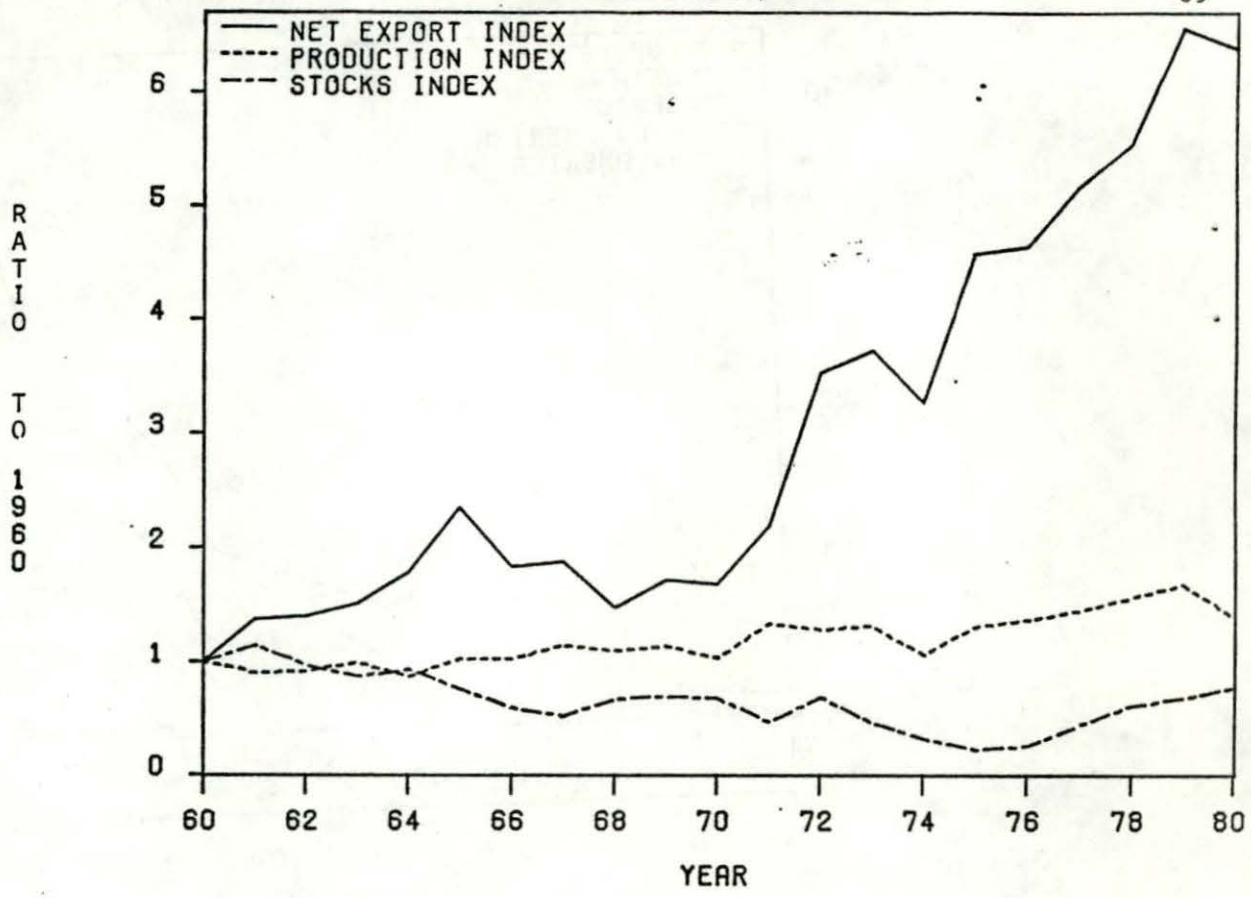


FIGURE 2-09. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA UNITED STATES, 1960-80

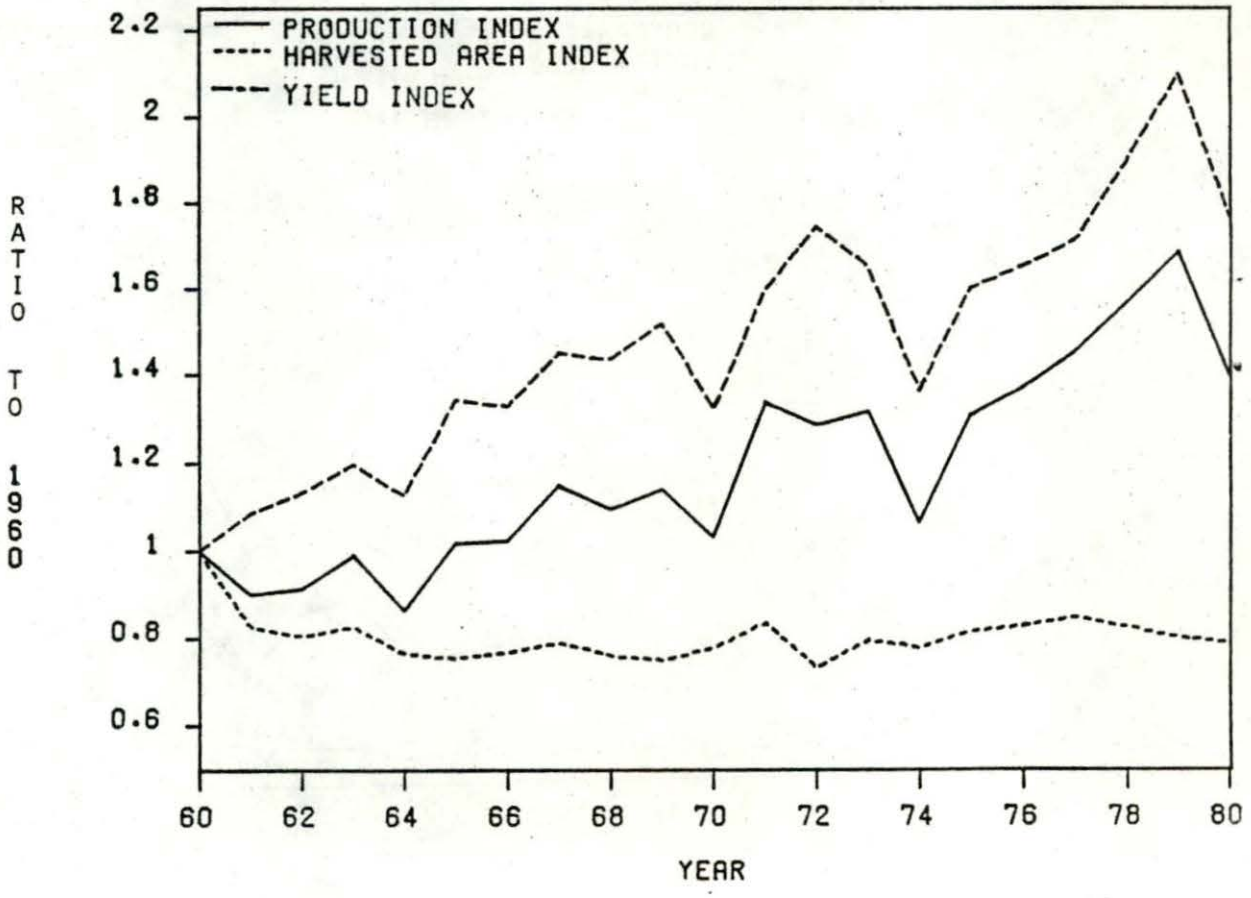


FIGURE 2-10. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS CANADA, 1960-80

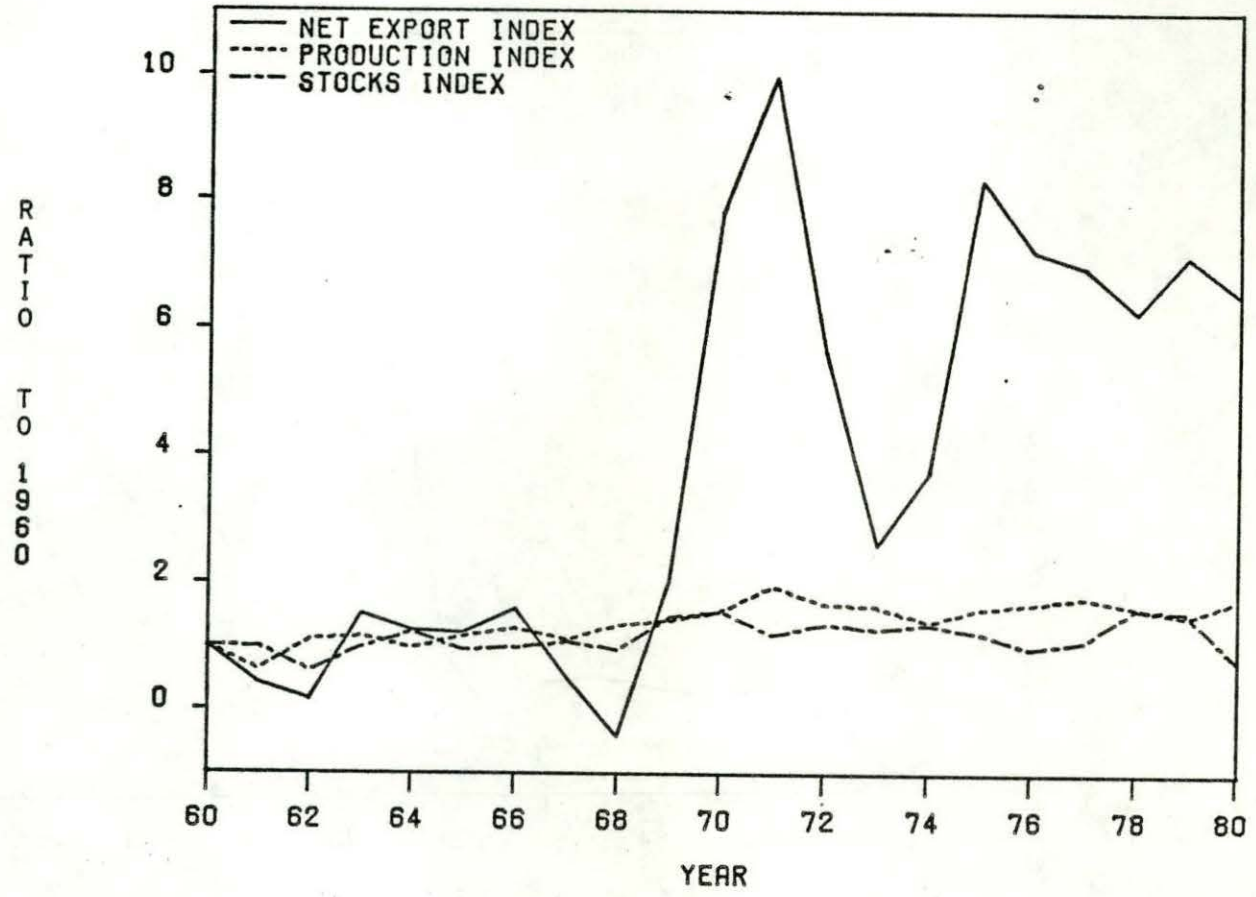


FIGURE 2-11. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA CANADA, 1960-80

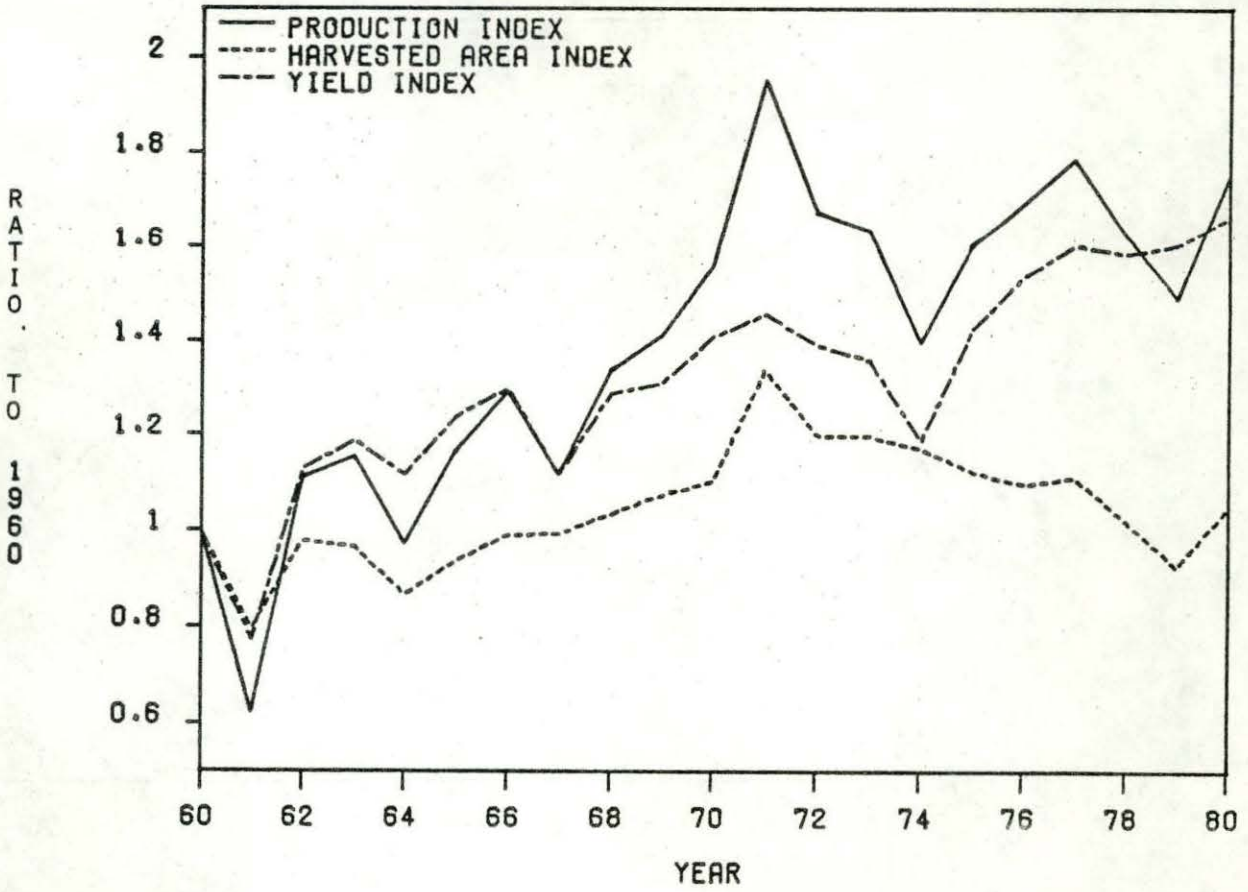


FIGURE 2-12. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS AUSTRALIA, 1960-80

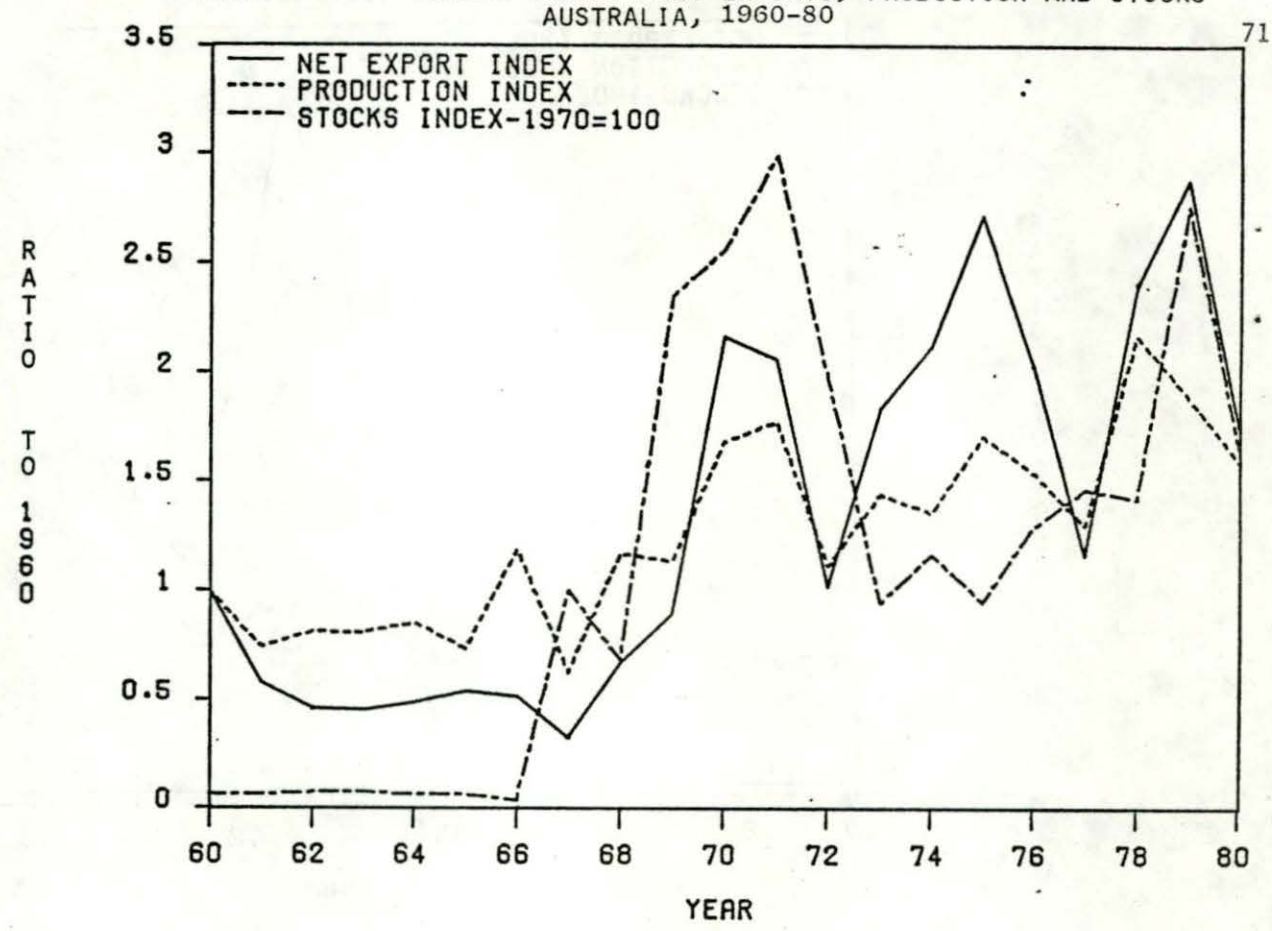


FIGURE 2-13. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA AUSTRALIA, 1960-80

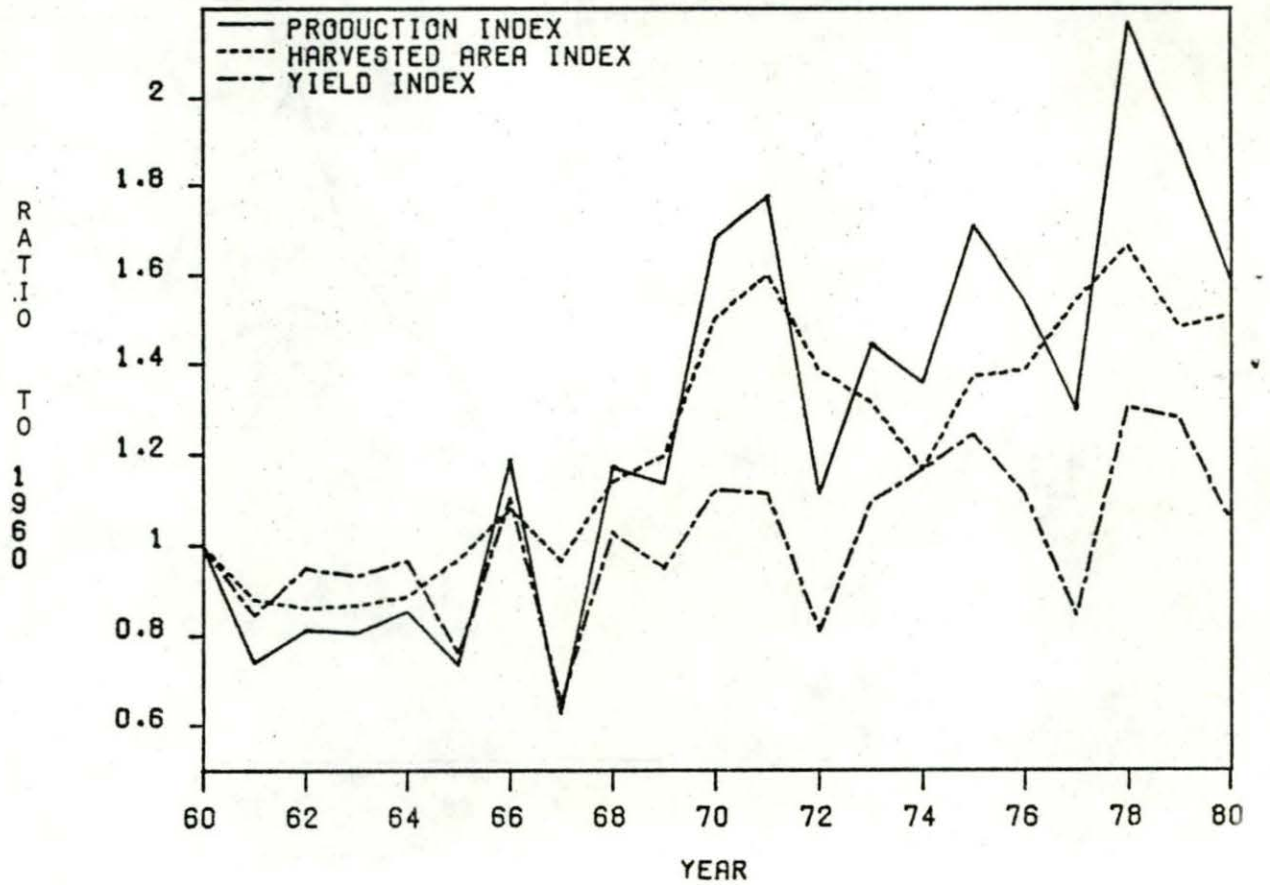


FIGURE 2-14. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS ARGENTINA, 1960-80

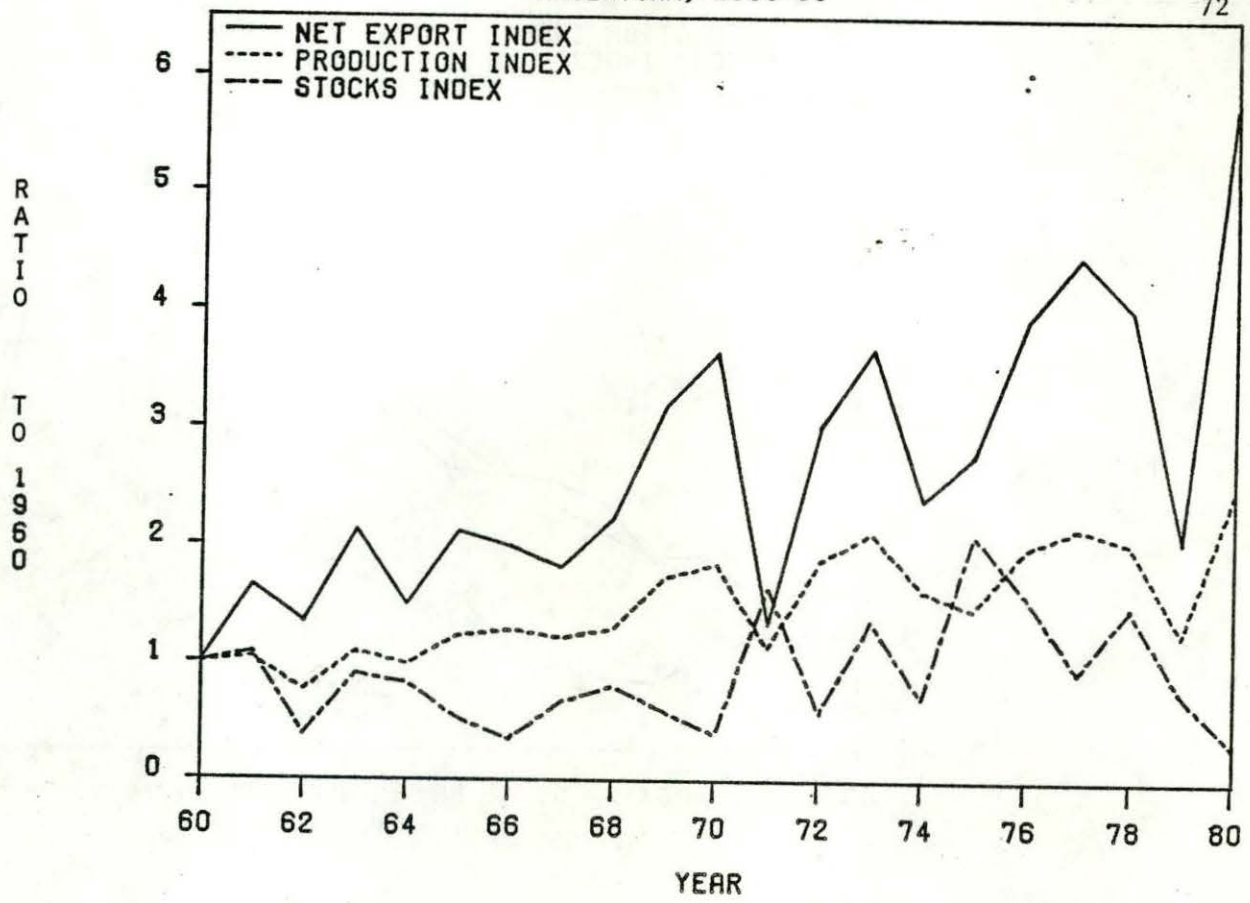


FIGURE 2-15. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA ARGENTINA, 1960-80

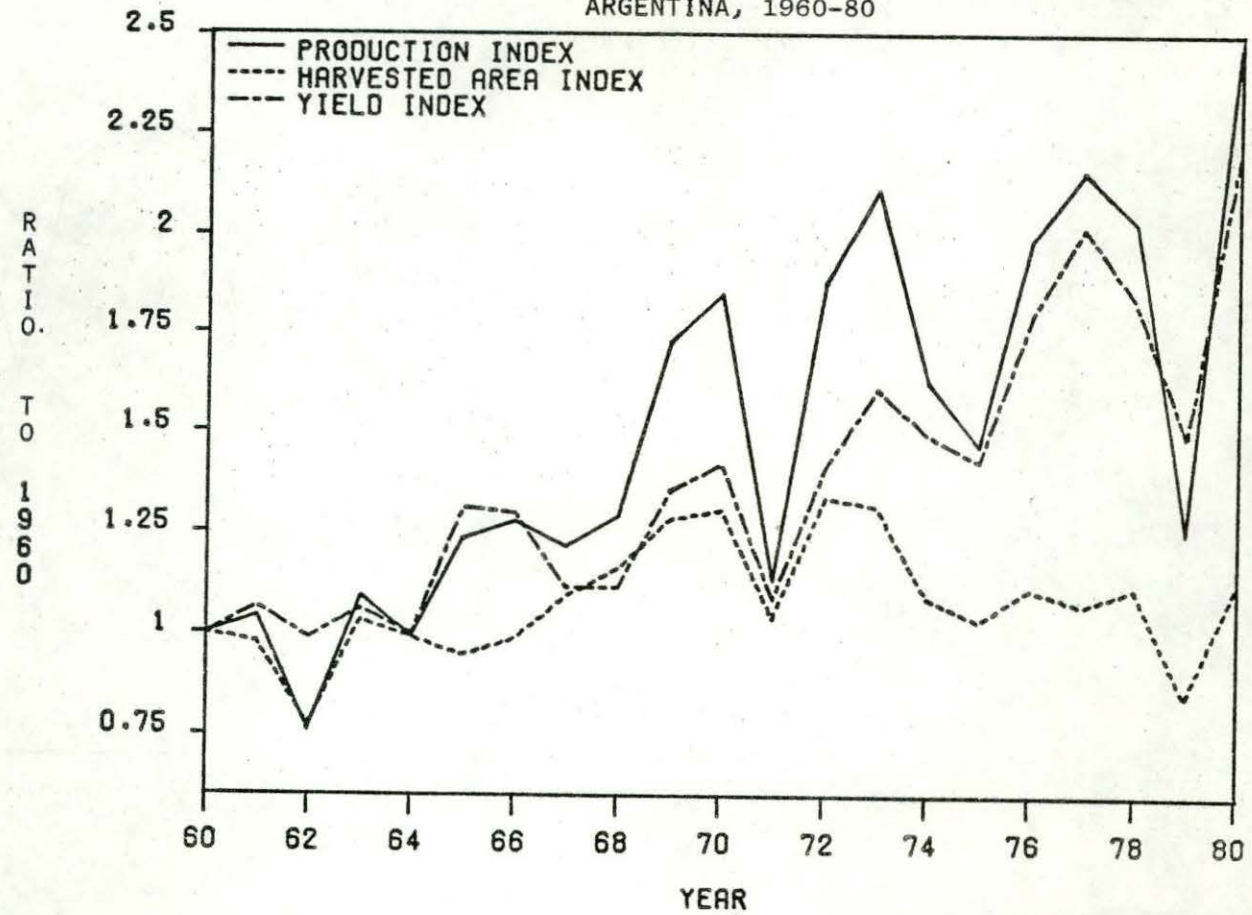


FIGURE 2-16. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS
THAILAND, 1960-80

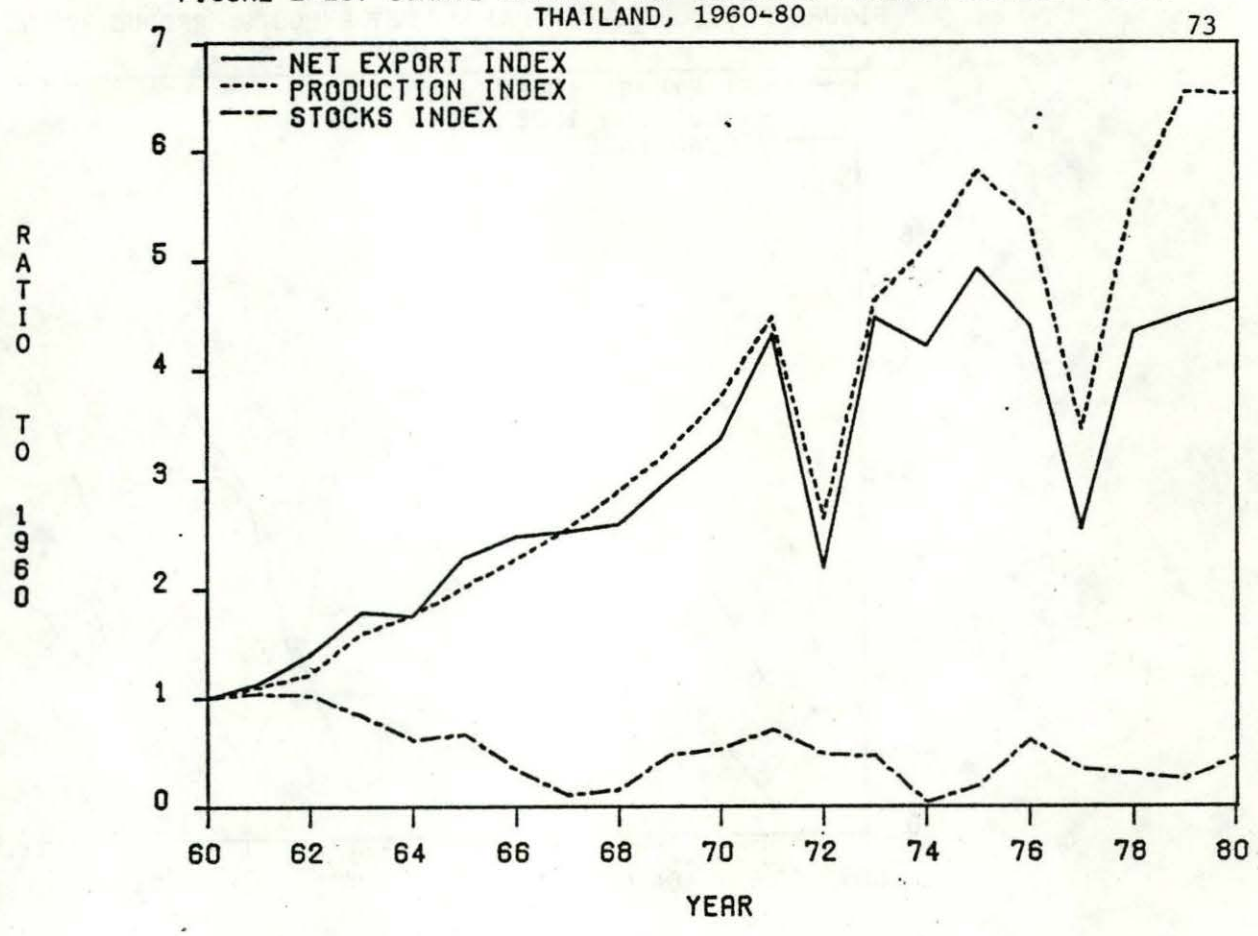


FIGURE 2-17. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA
THAILAND, 1960-80

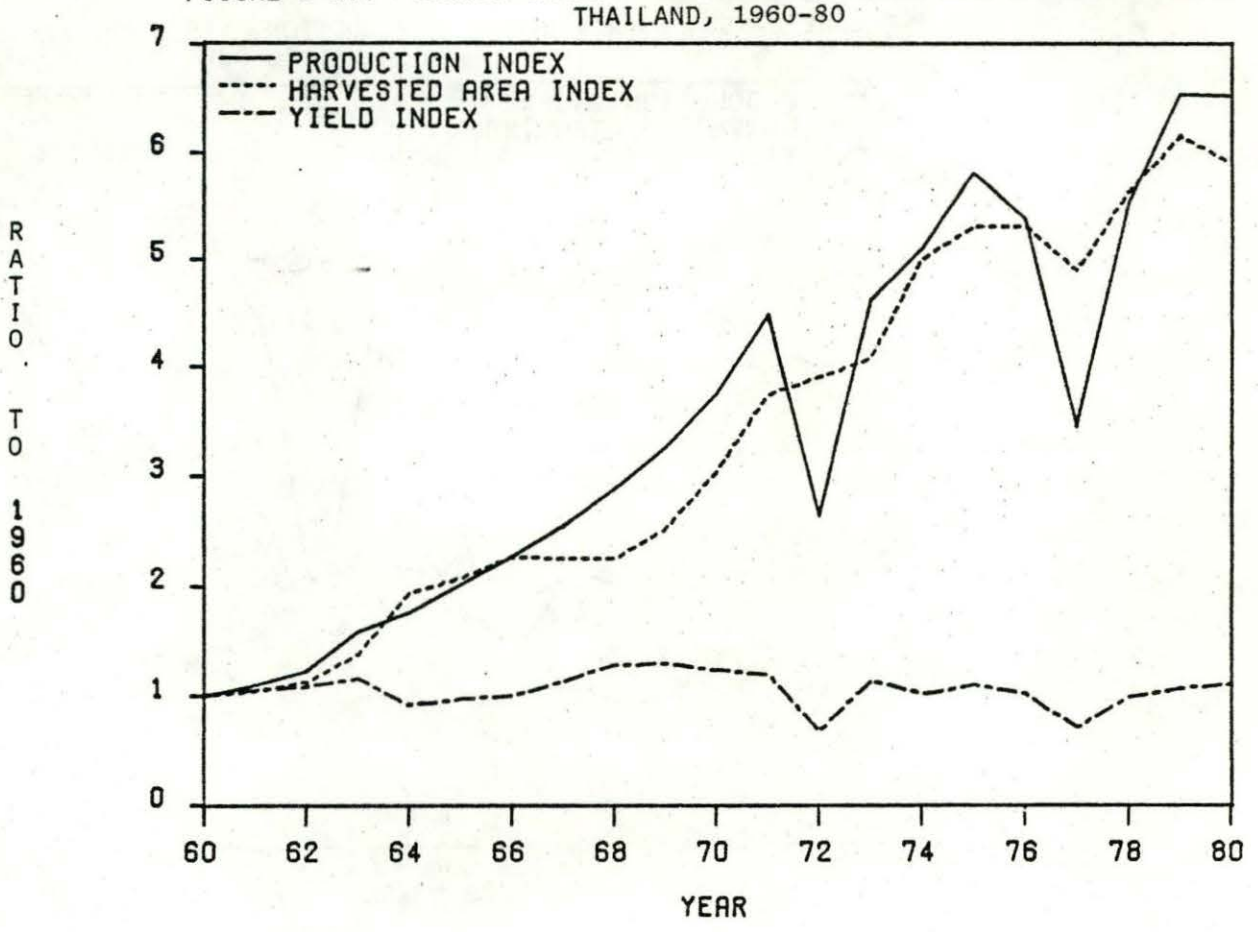


FIGURE 2-18. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS SOUTH AFRICA, 1960-80

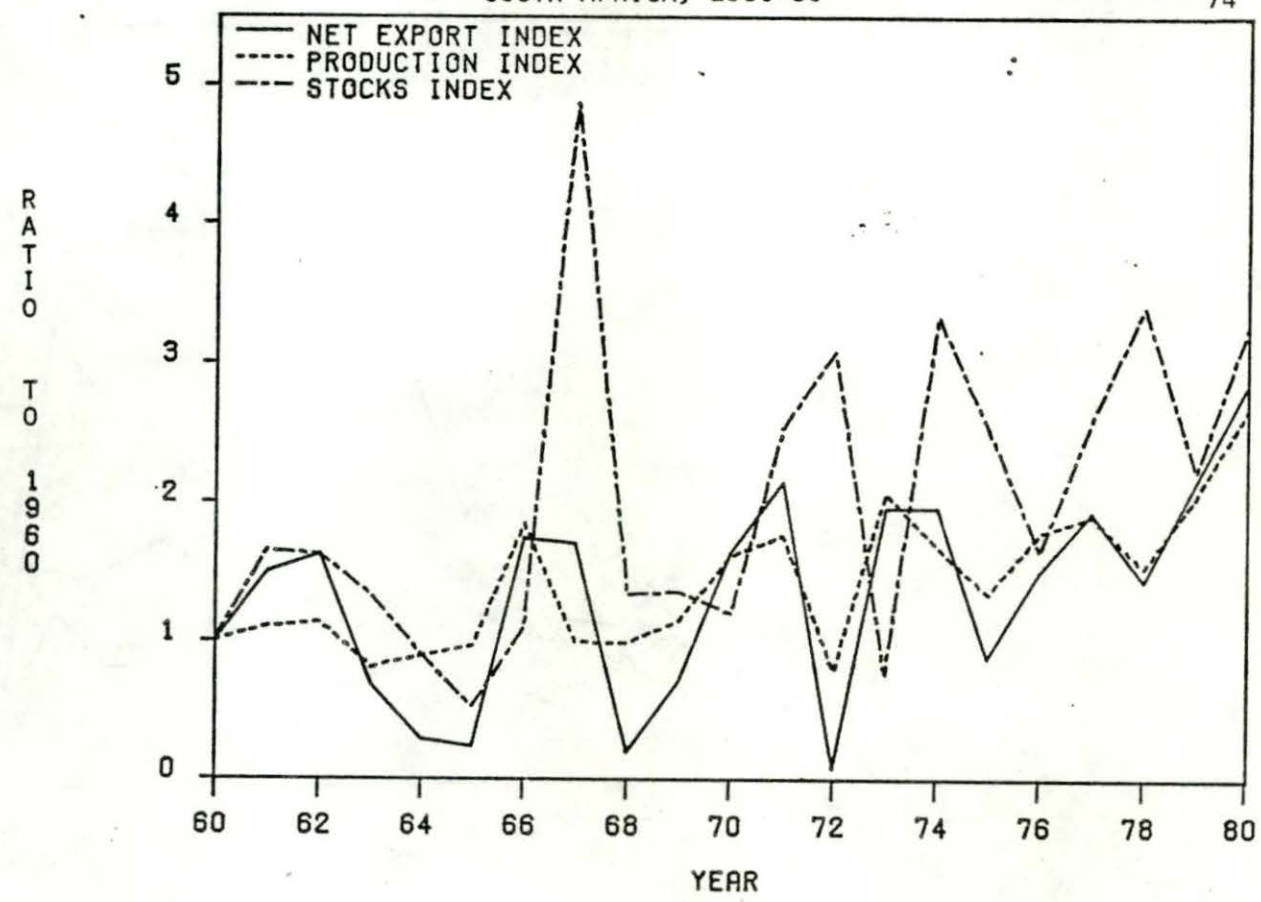


FIGURE 2-19. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA SOUTH AFRICA, 1960-80

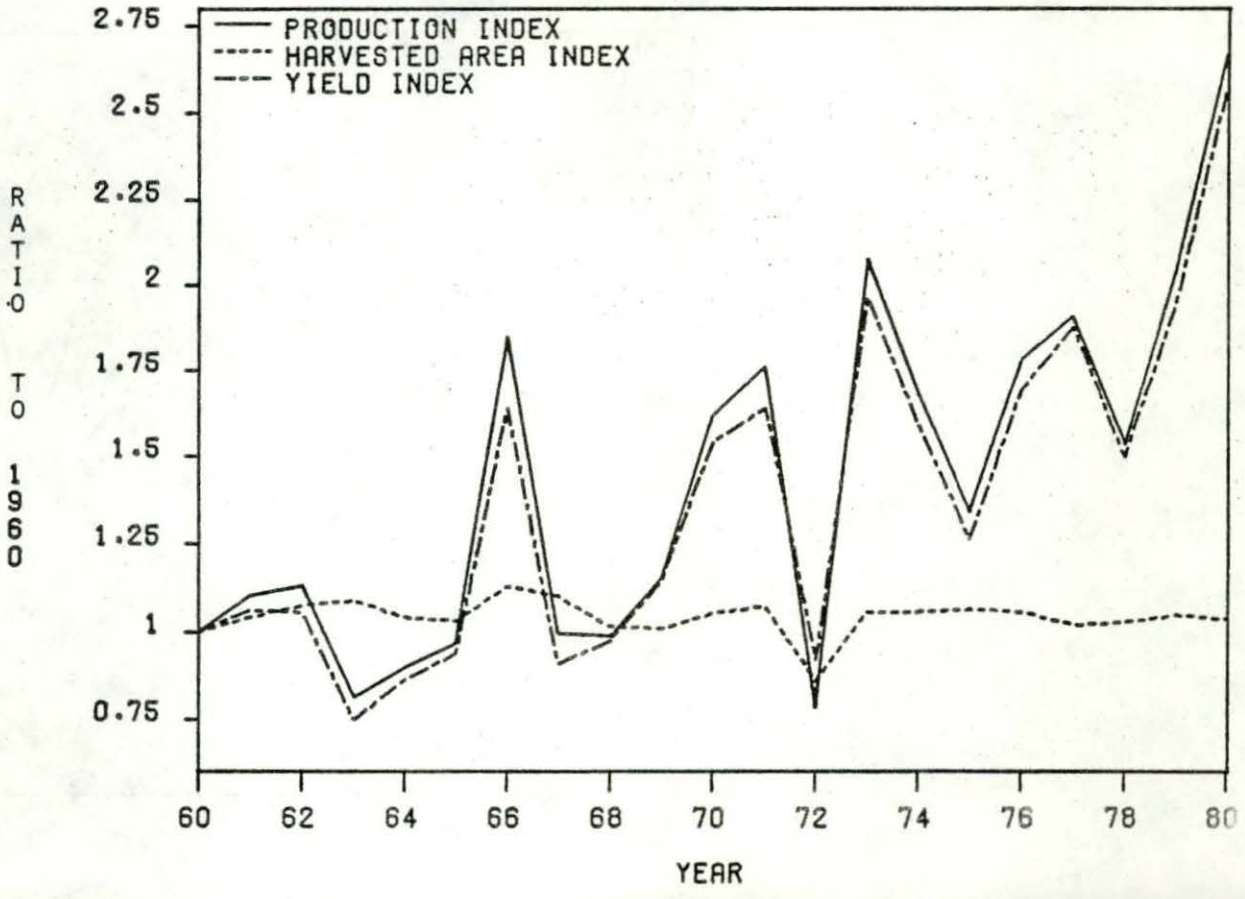


FIGURE 2.20. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS FRANCE, 1960-80

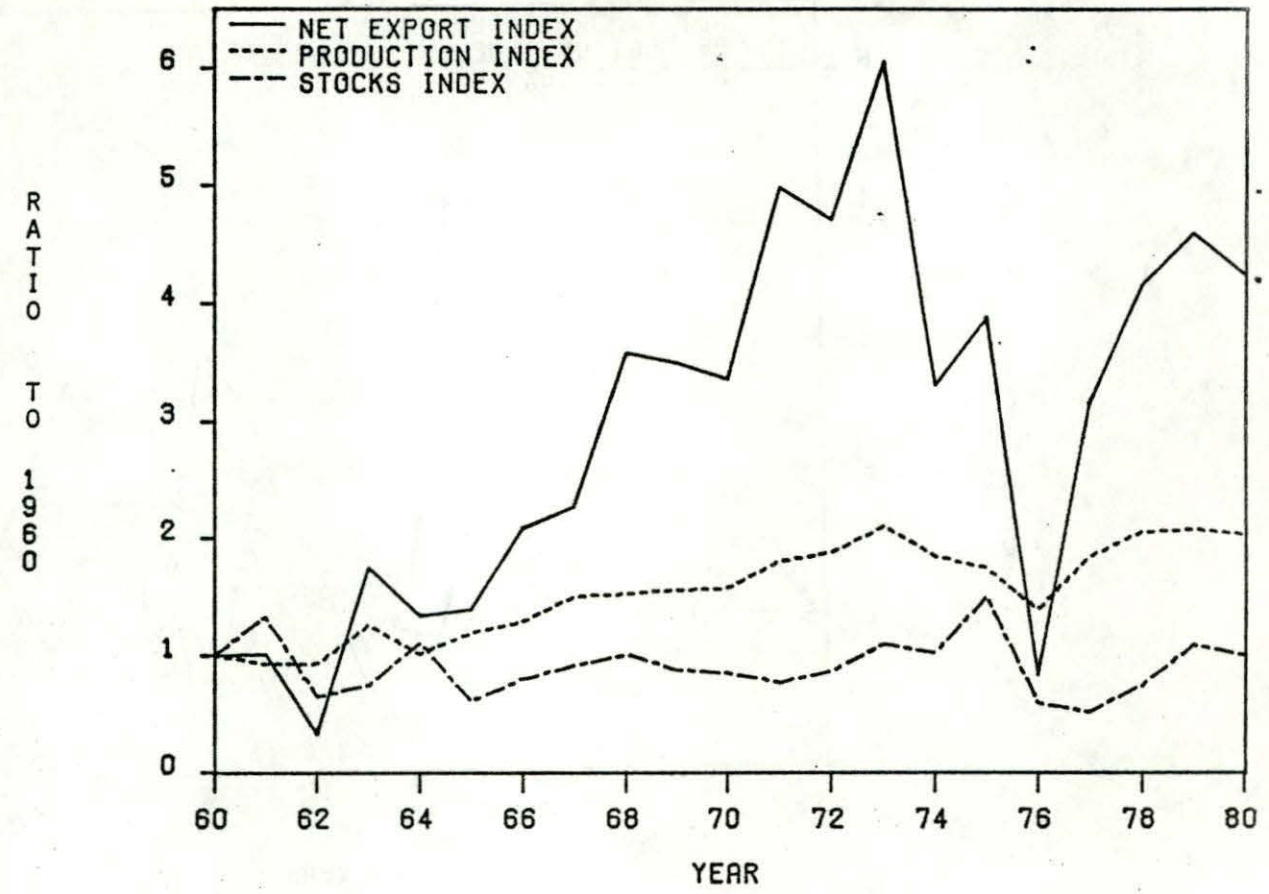


FIGURE 2.21. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA FRANCE, 1960-80

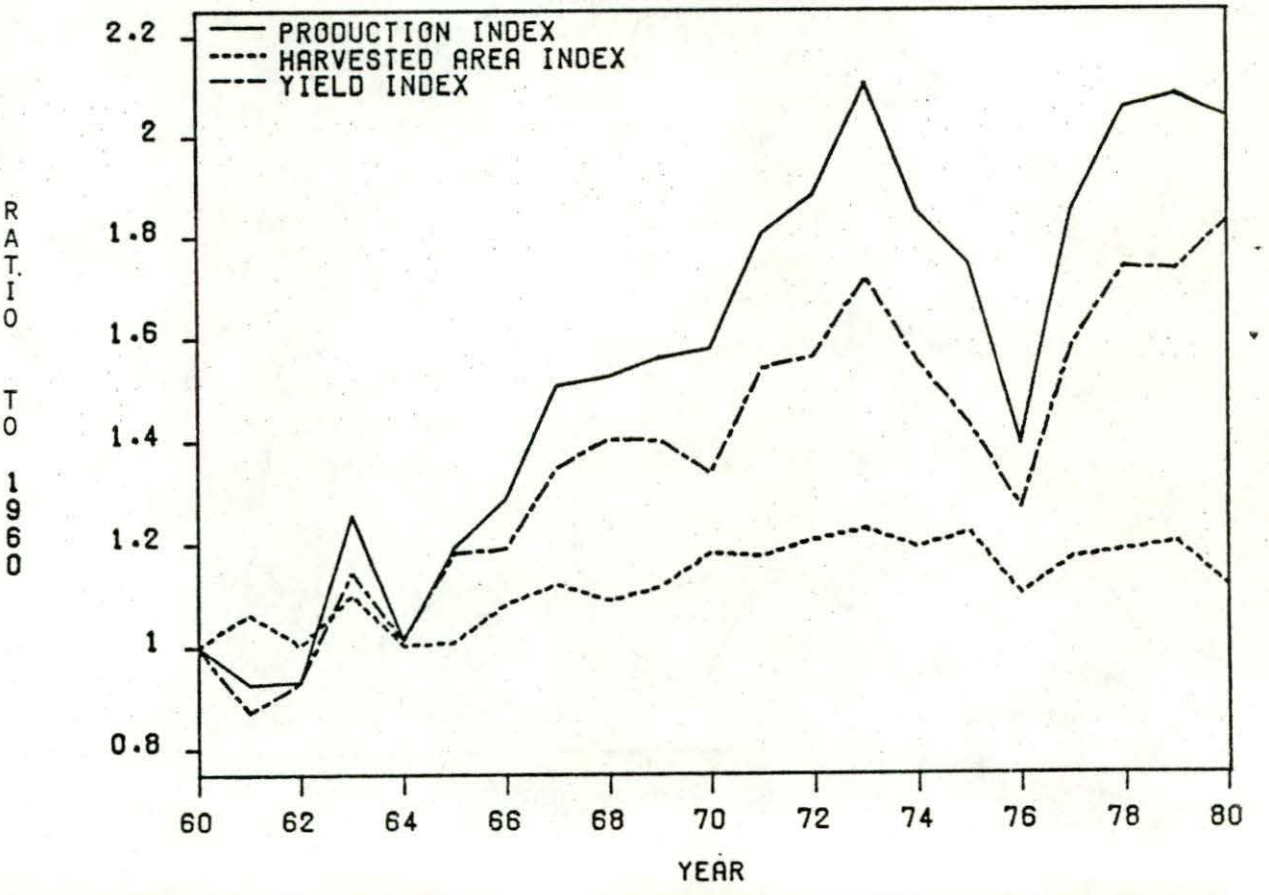


FIGURE 2.22. COARSE GRAIN: NET EXPORTS, PRODUCTION AND STOCKS MAJOR EXPORTERS LESS U.S., 1960-80

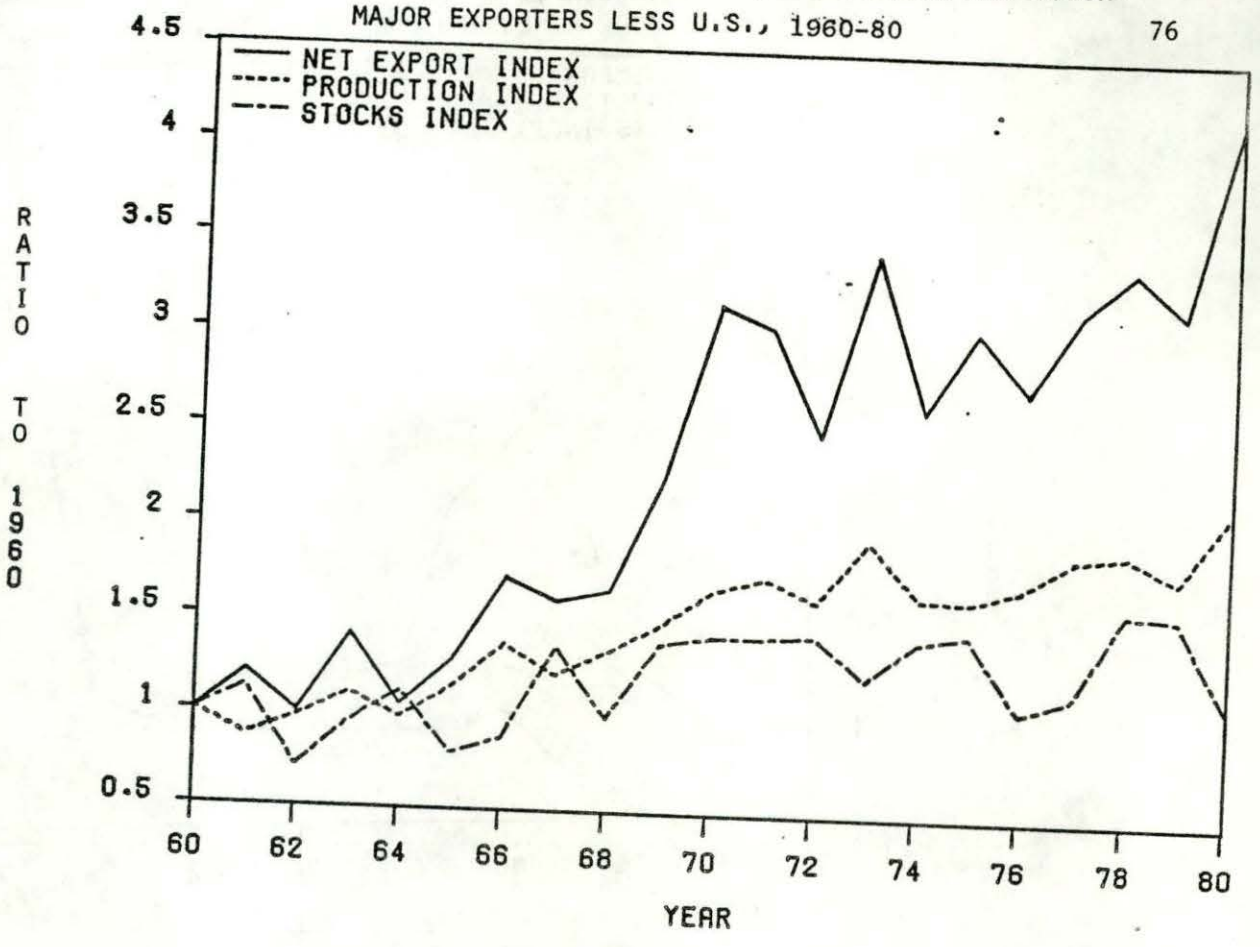


FIGURE 2.23. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA MAJOR EXPORTERS LESS U.S., 1960-80

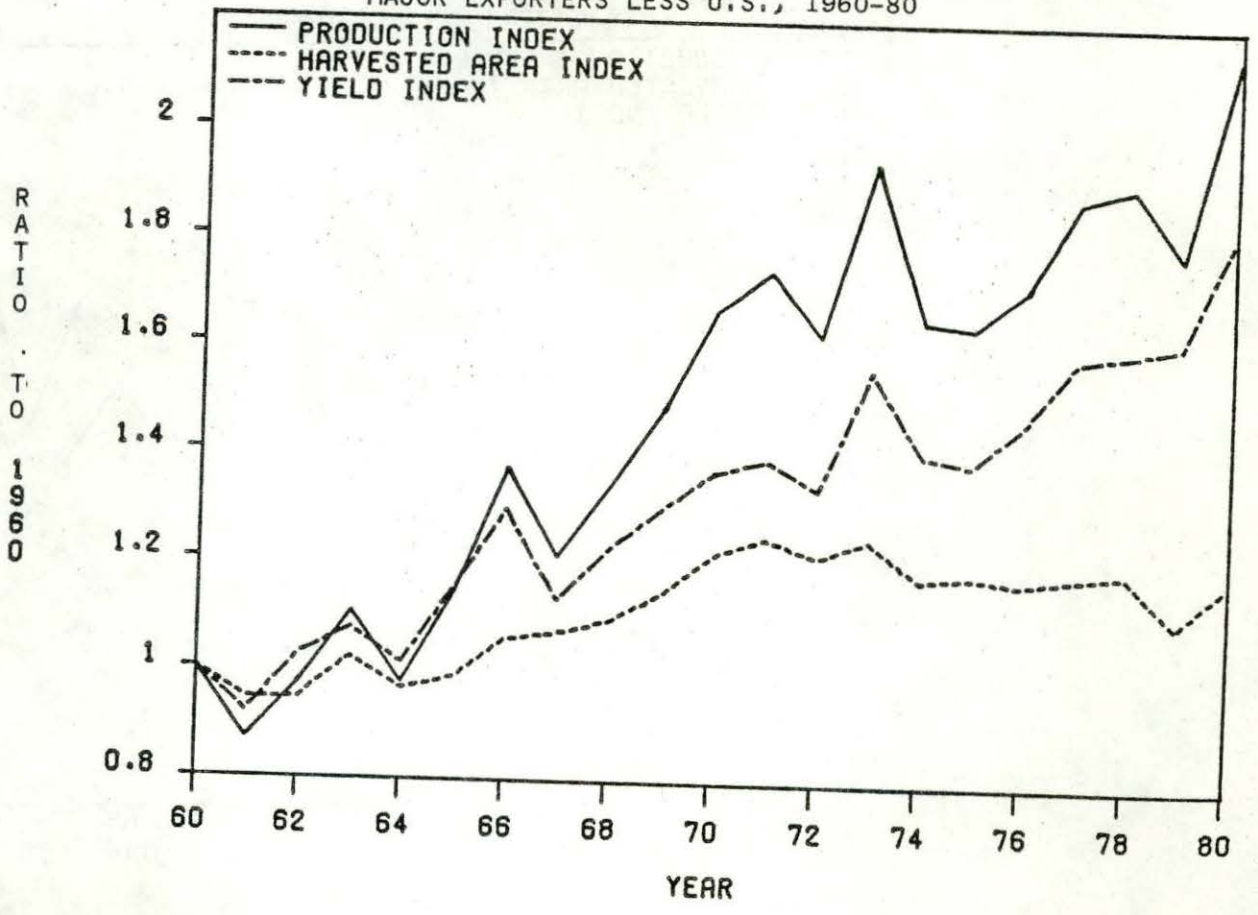


FIGURE 2.24. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS WESTERN EUROPE, 1960-80

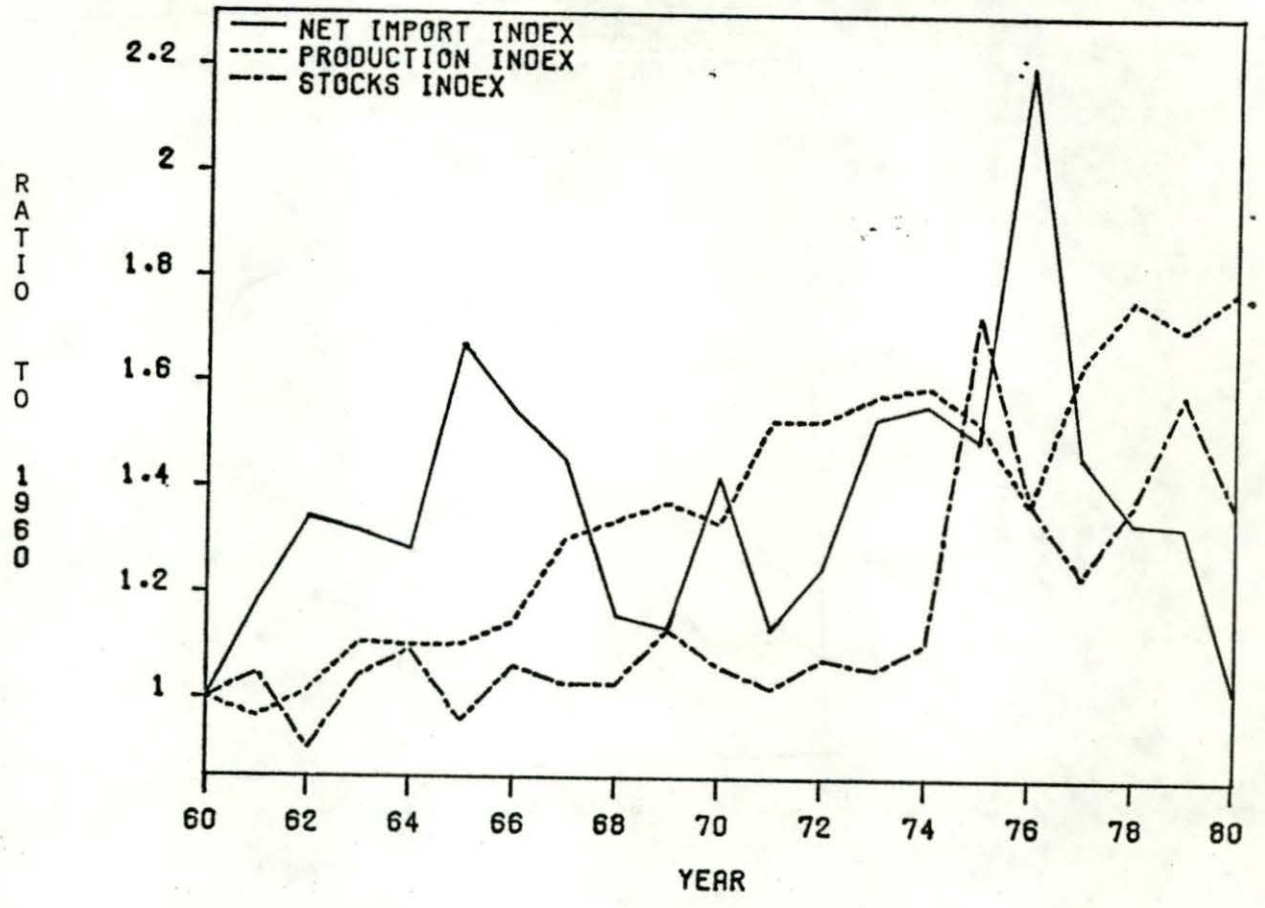


FIGURE 2.25. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA WESTERN EUROPE, 1960-80

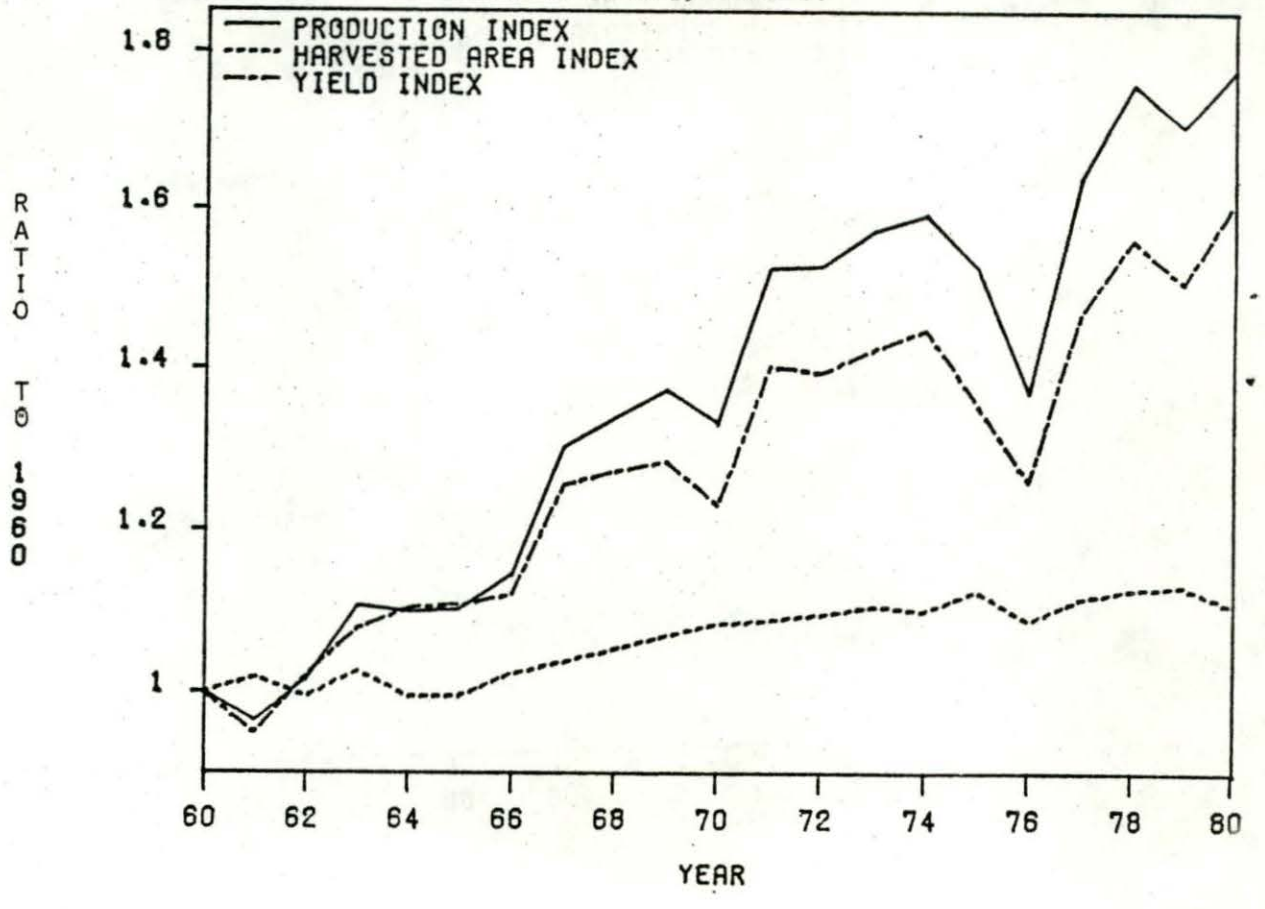


FIGURE 2.26. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS SOVIET UNION, 1960-80

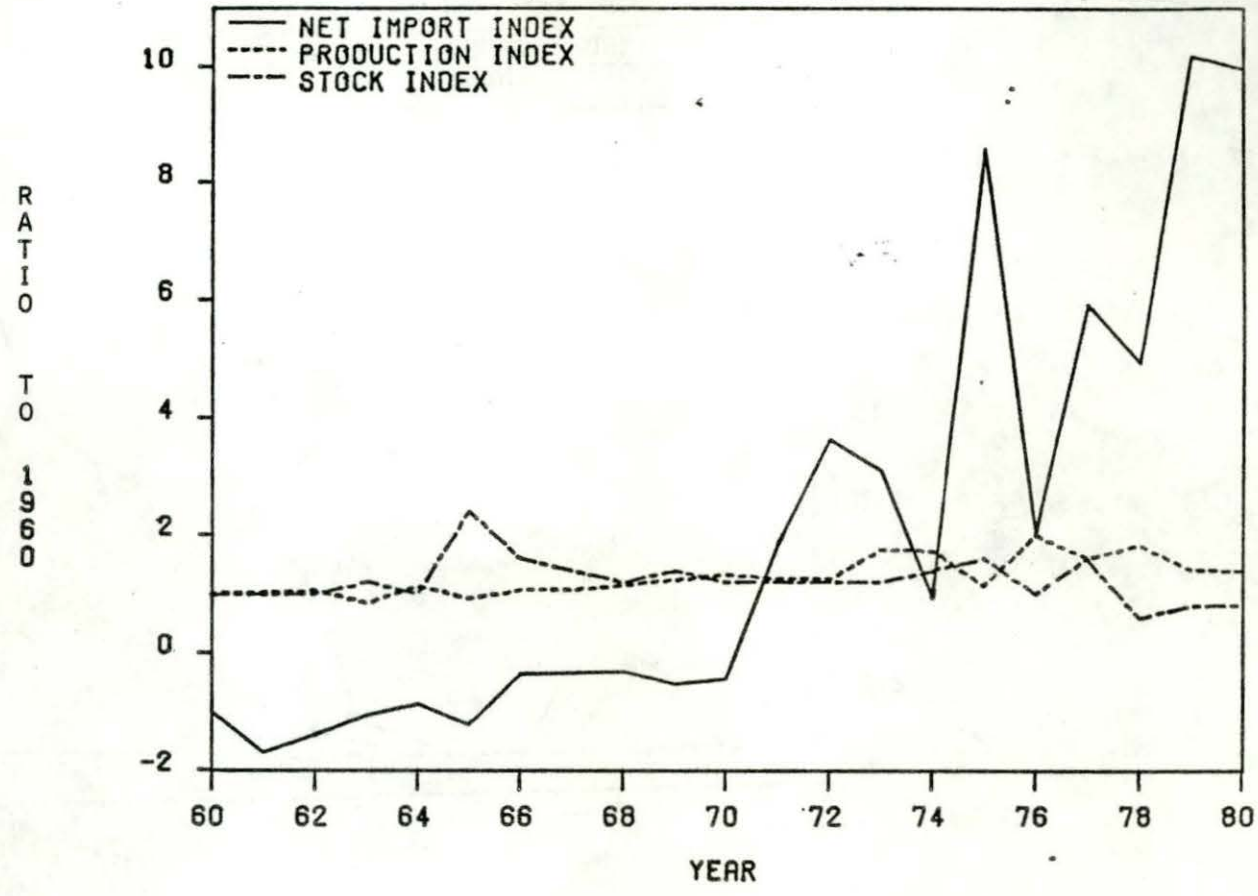


FIGURE 2.27. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA SOVIET UNION, 1960-80.

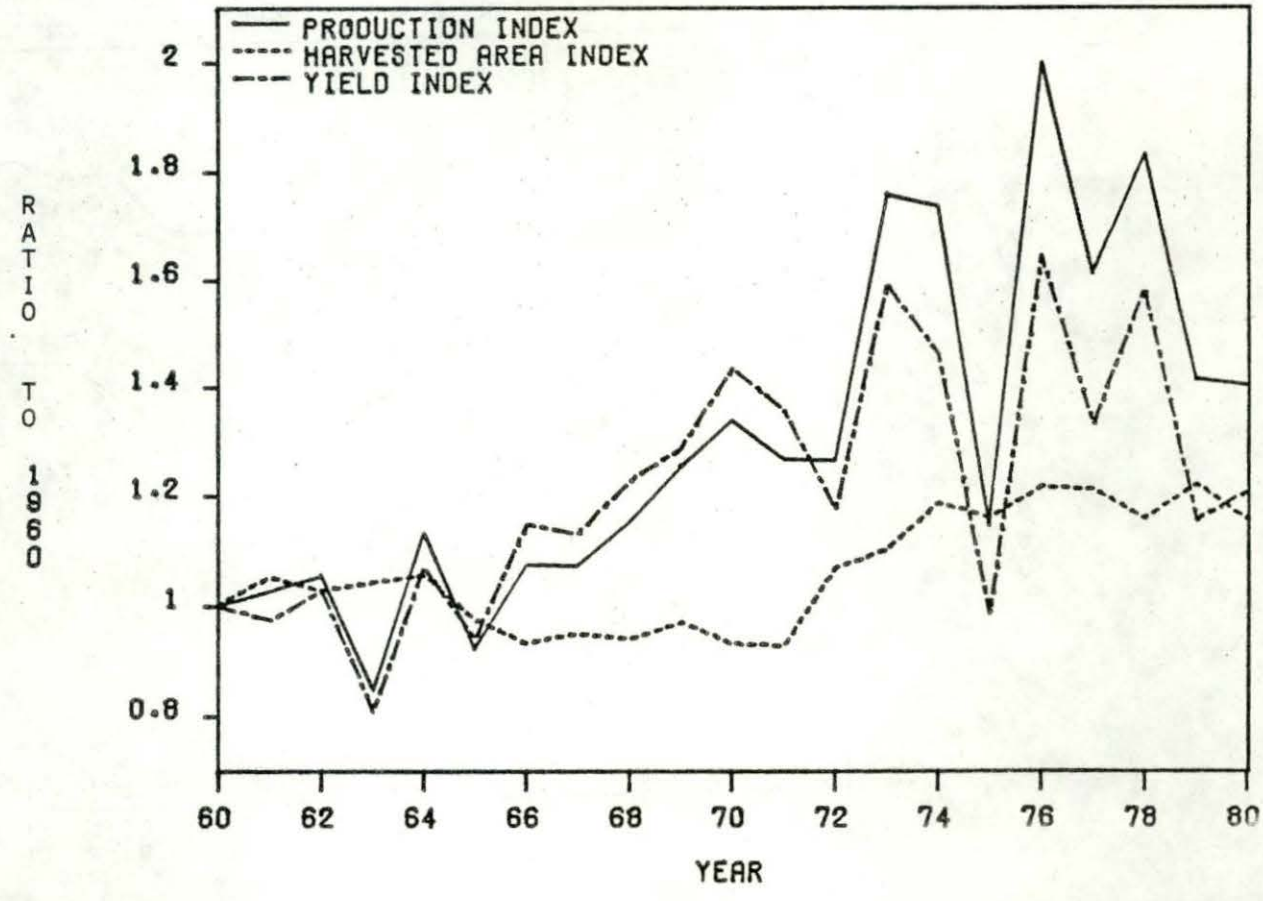


FIGURE 2.28. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS
EASTERN EUROPE, 1960-80

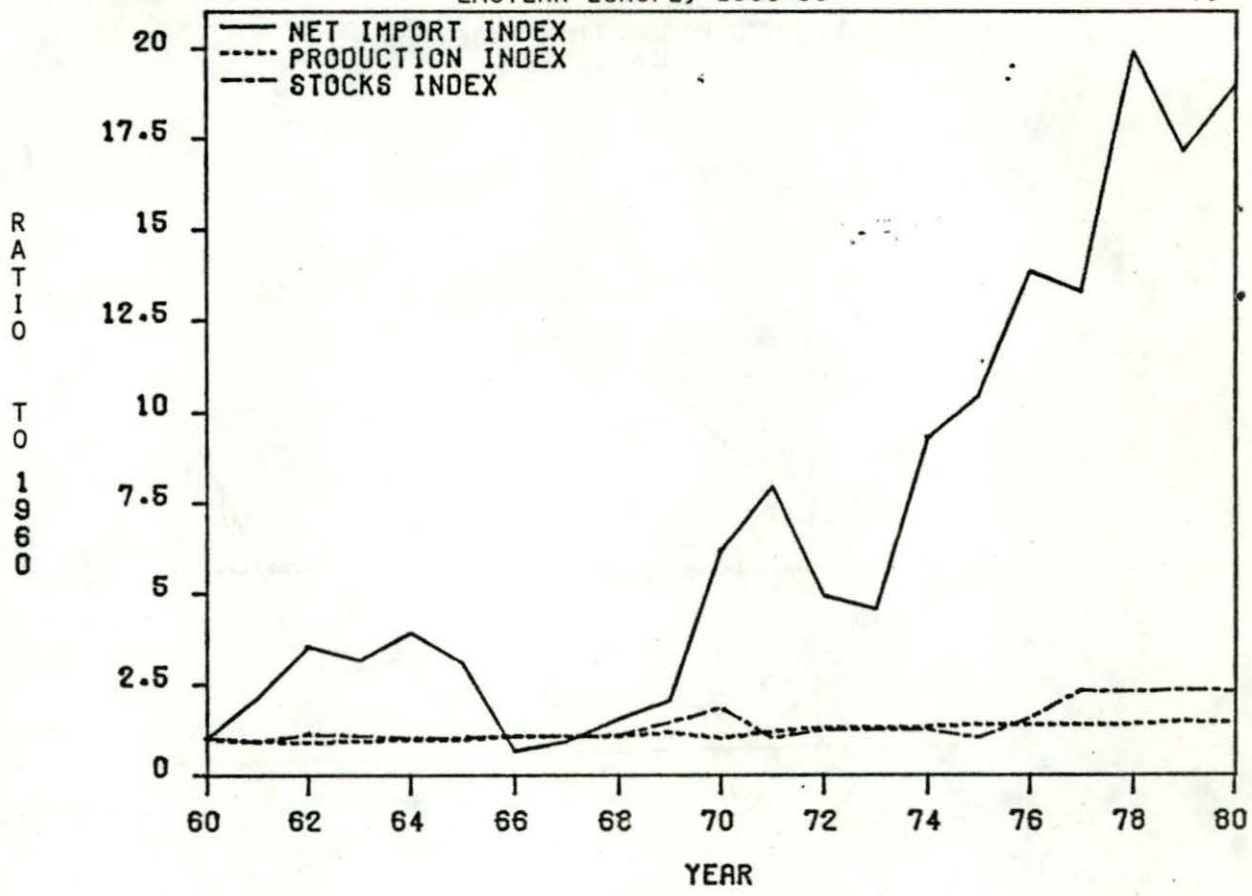


FIGURE 2.29. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED ARE
EASTERN EUROPE, 1960-80

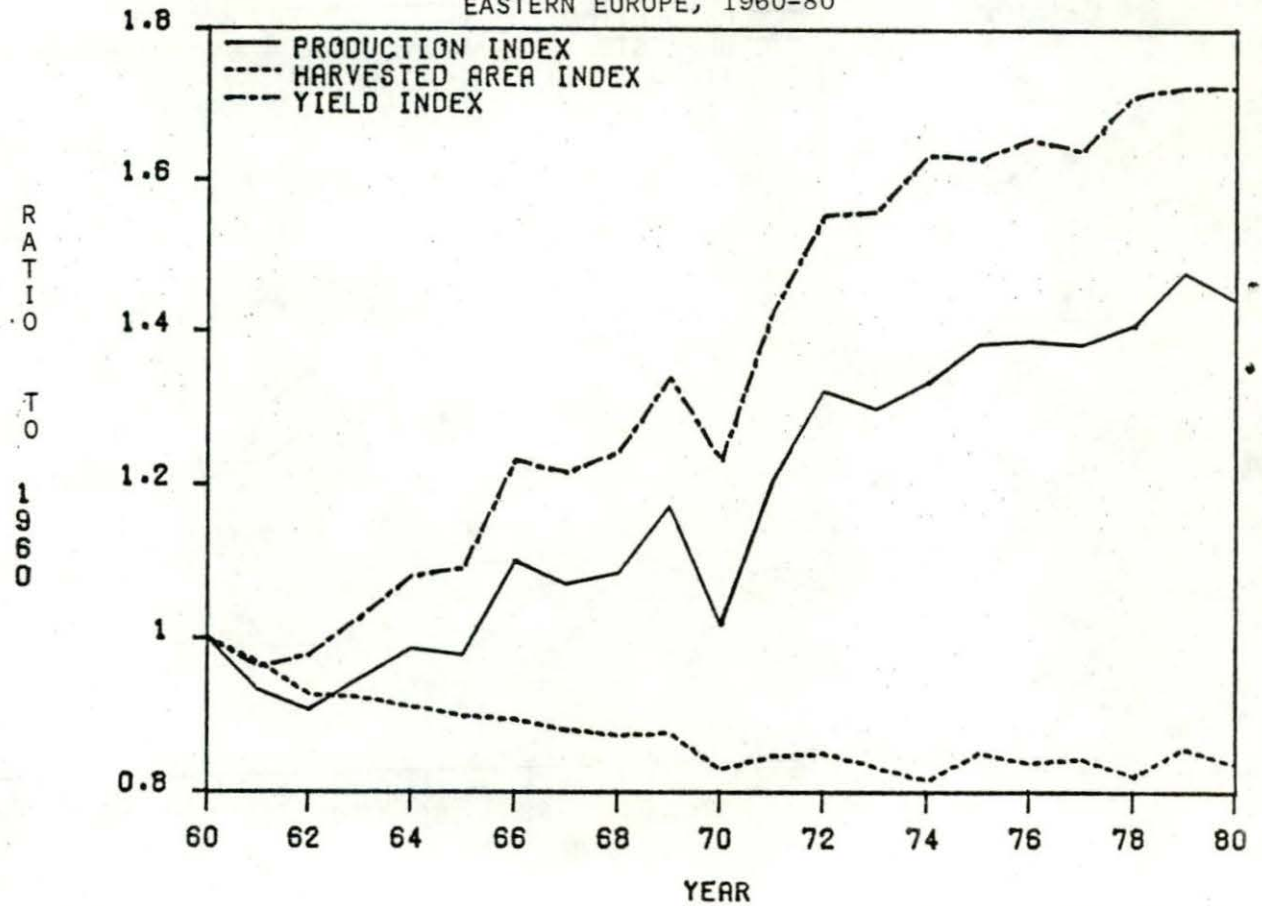


FIGURE 2.30. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS SOVIET BLOCK, 1960-80

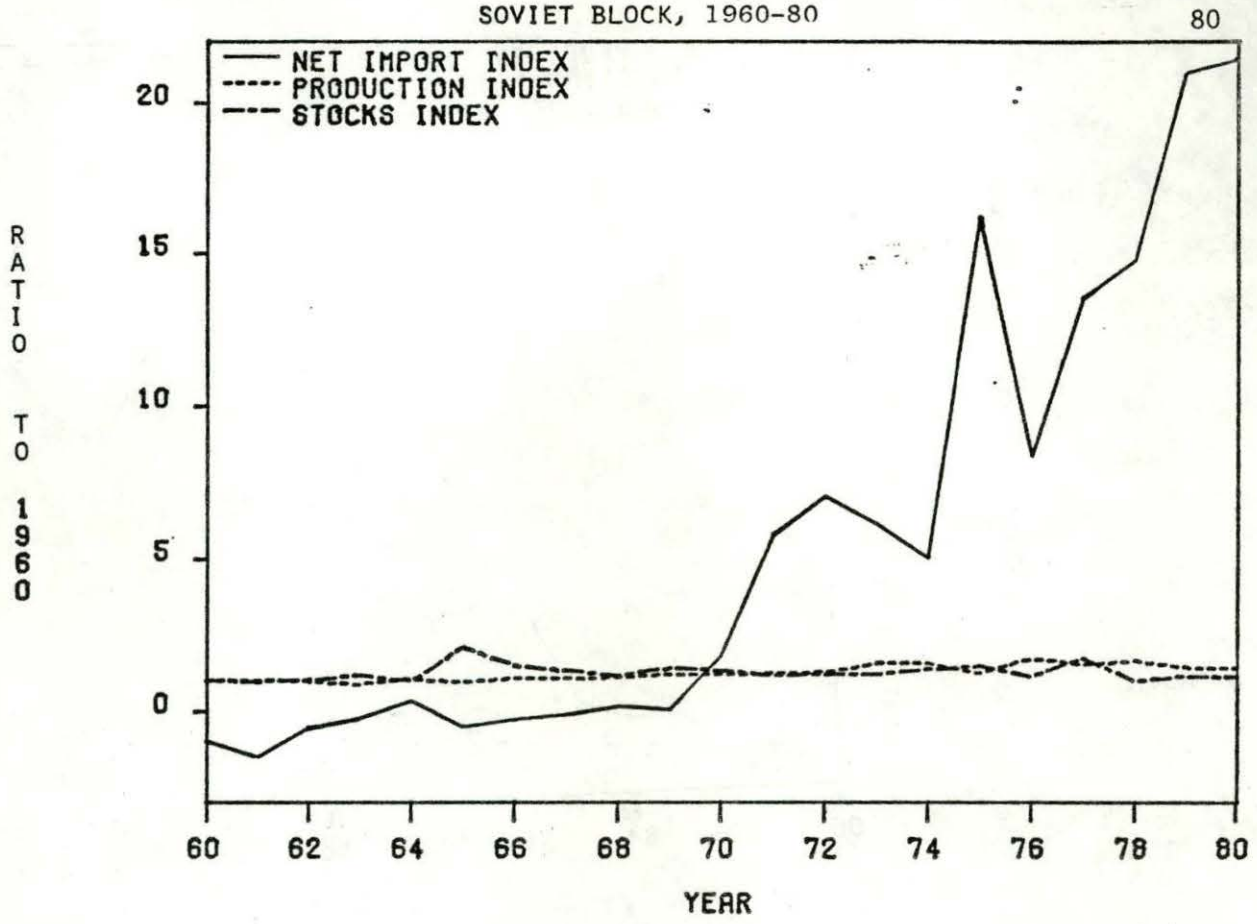


FIGURE 2.31. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA SOVIET BLOCK, 1960-80

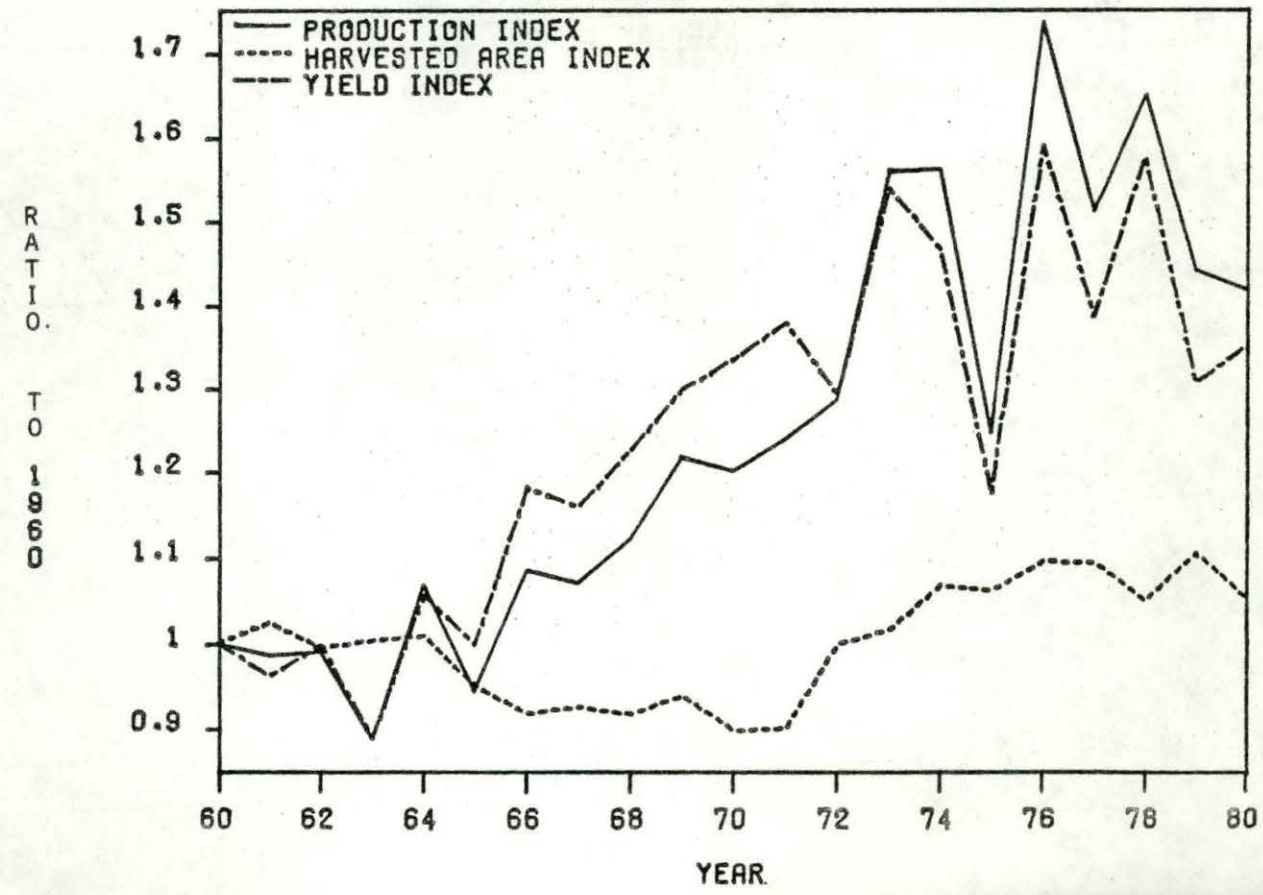


FIGURE 2.32. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS ASIA, 1960-80

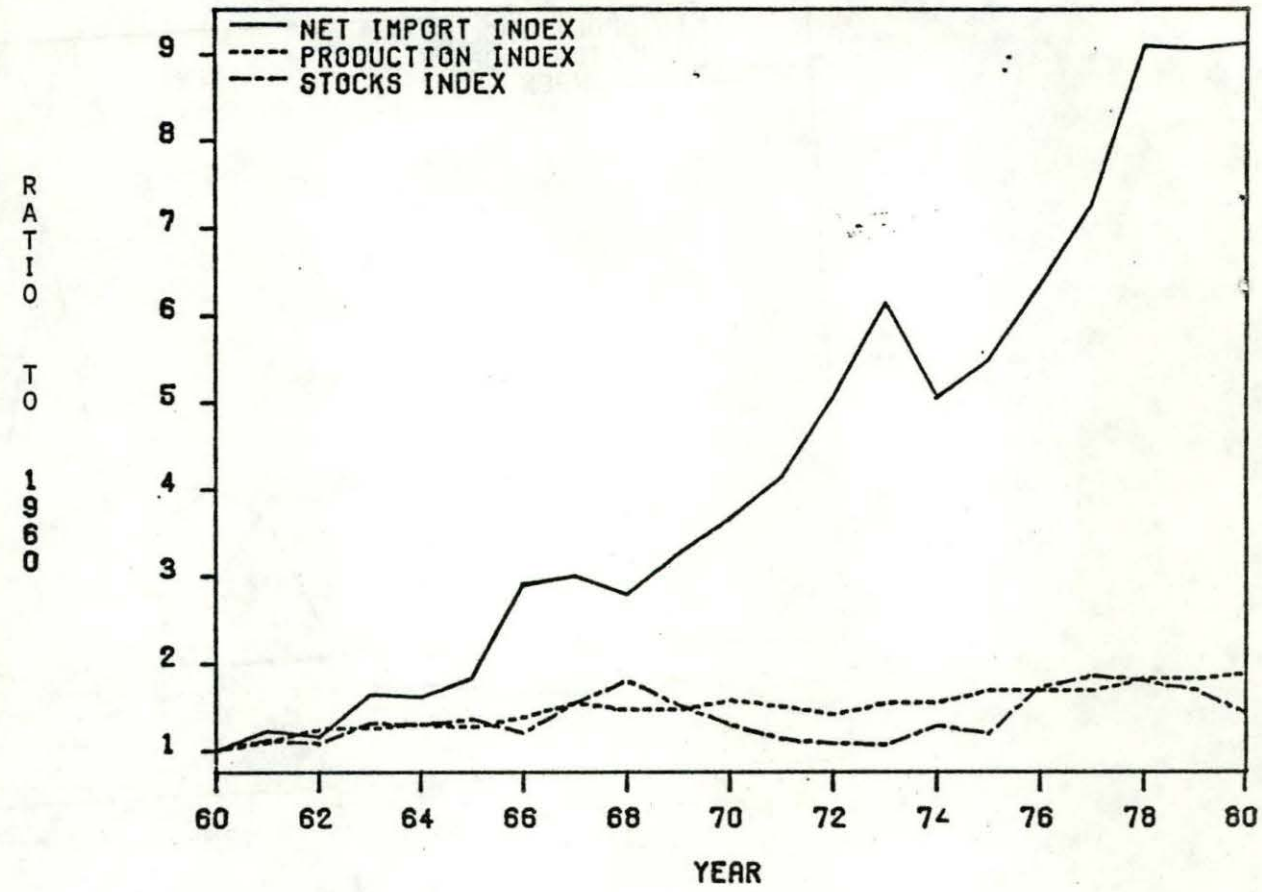


FIGURE 2.33. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA ASIA, 1960-80

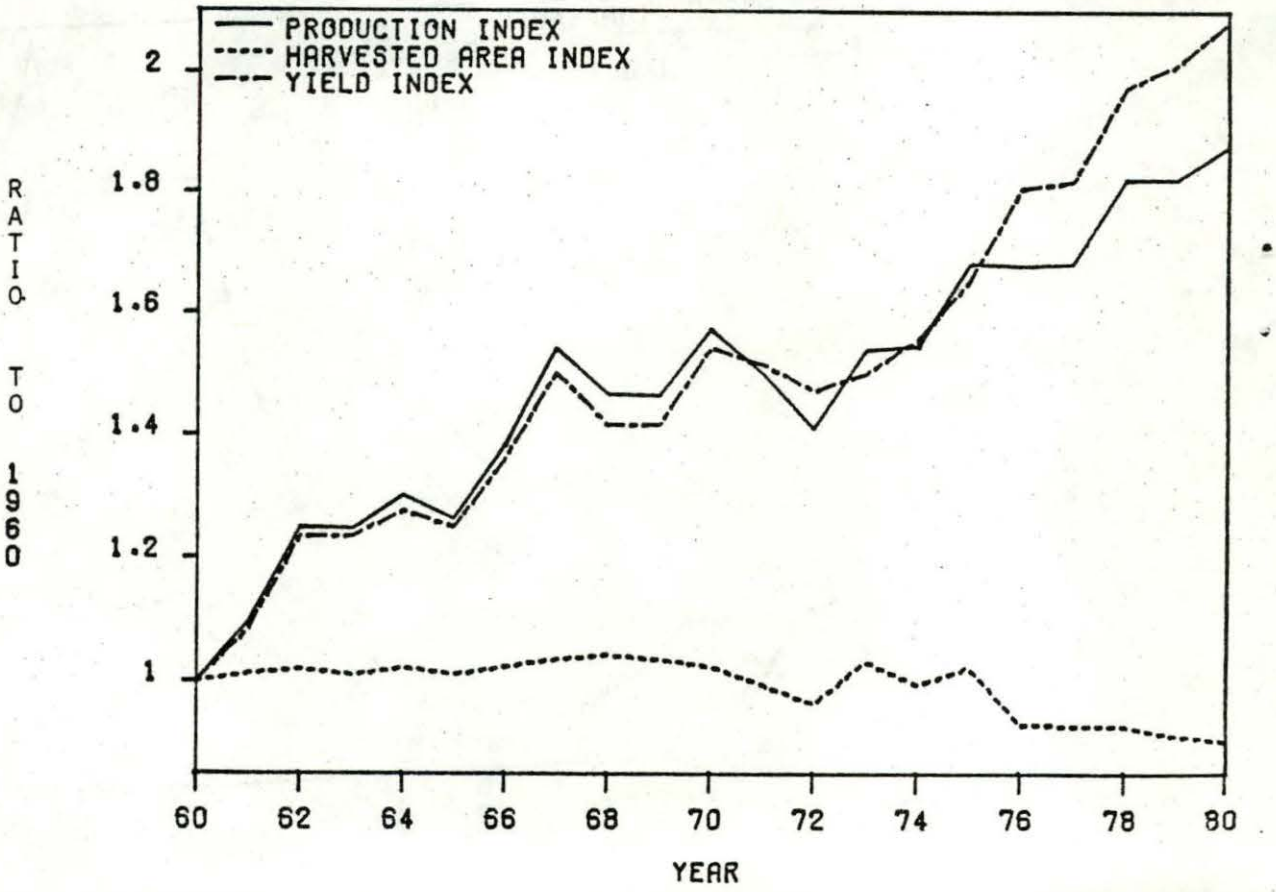


FIGURE 2.34. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS AFRICA, 1960-80

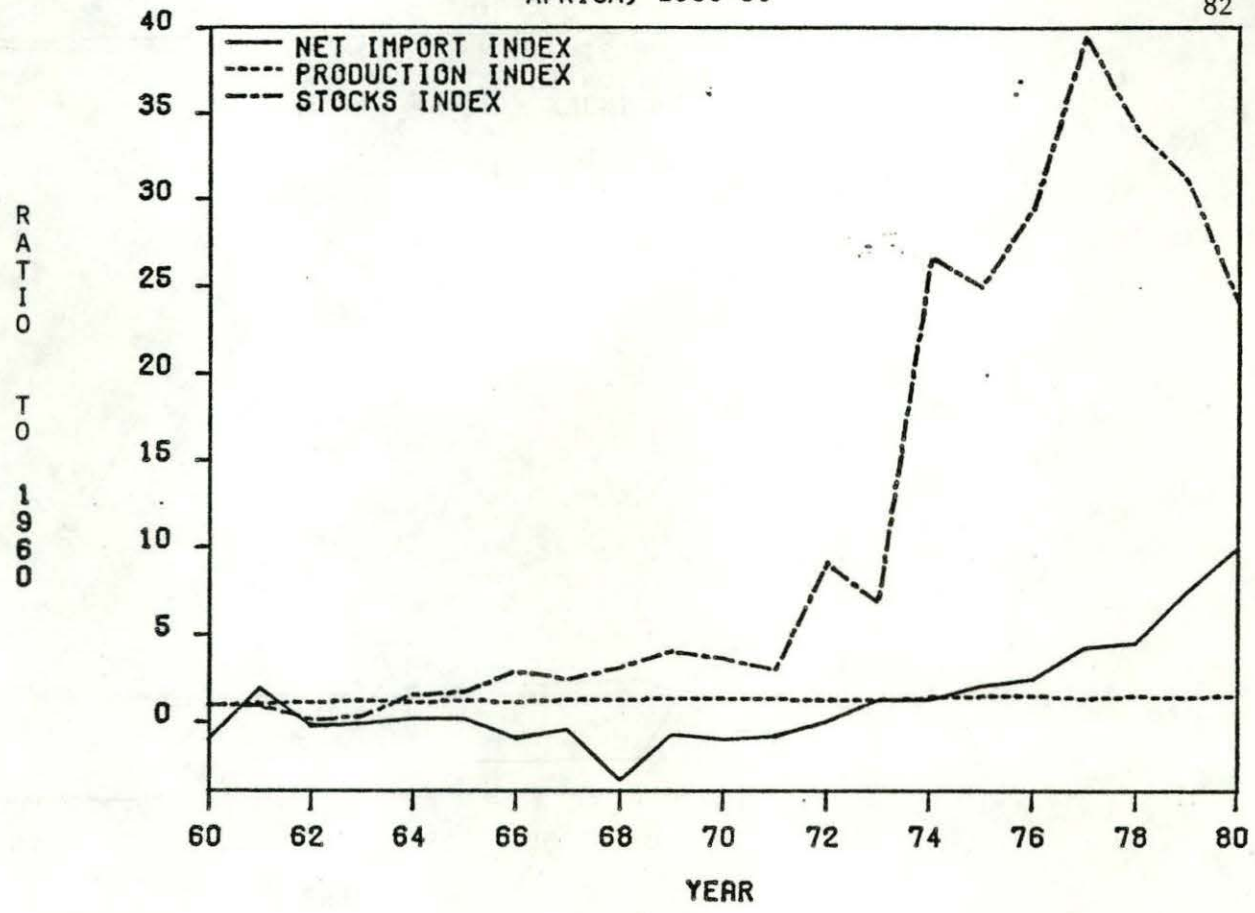


FIGURE 2.35. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA AFRICA, 1960-80

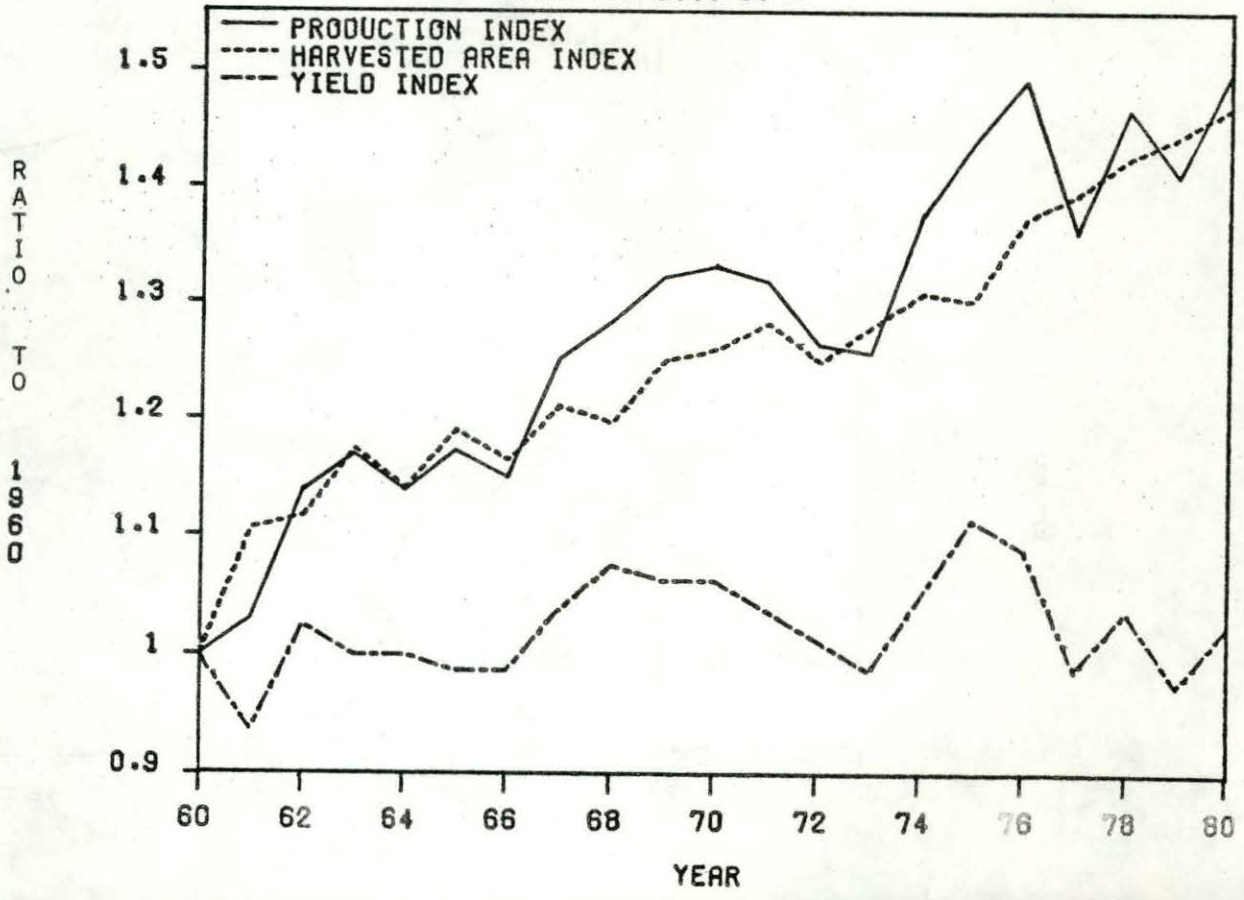


FIGURE 2.36. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS
CENTRAL AMERICA, 1960-80

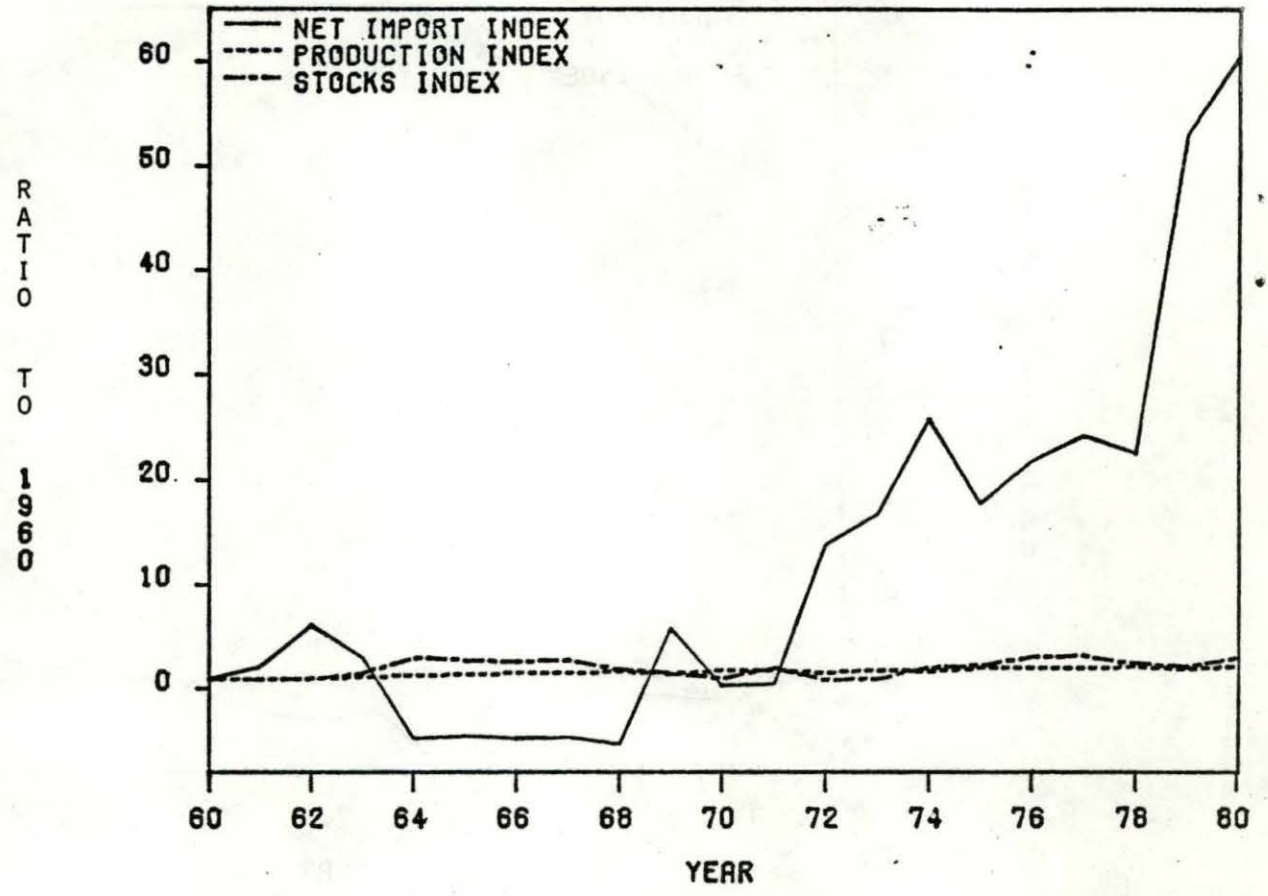


FIGURE 2.37. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA
CENTRAL AMERICA, 1960-80

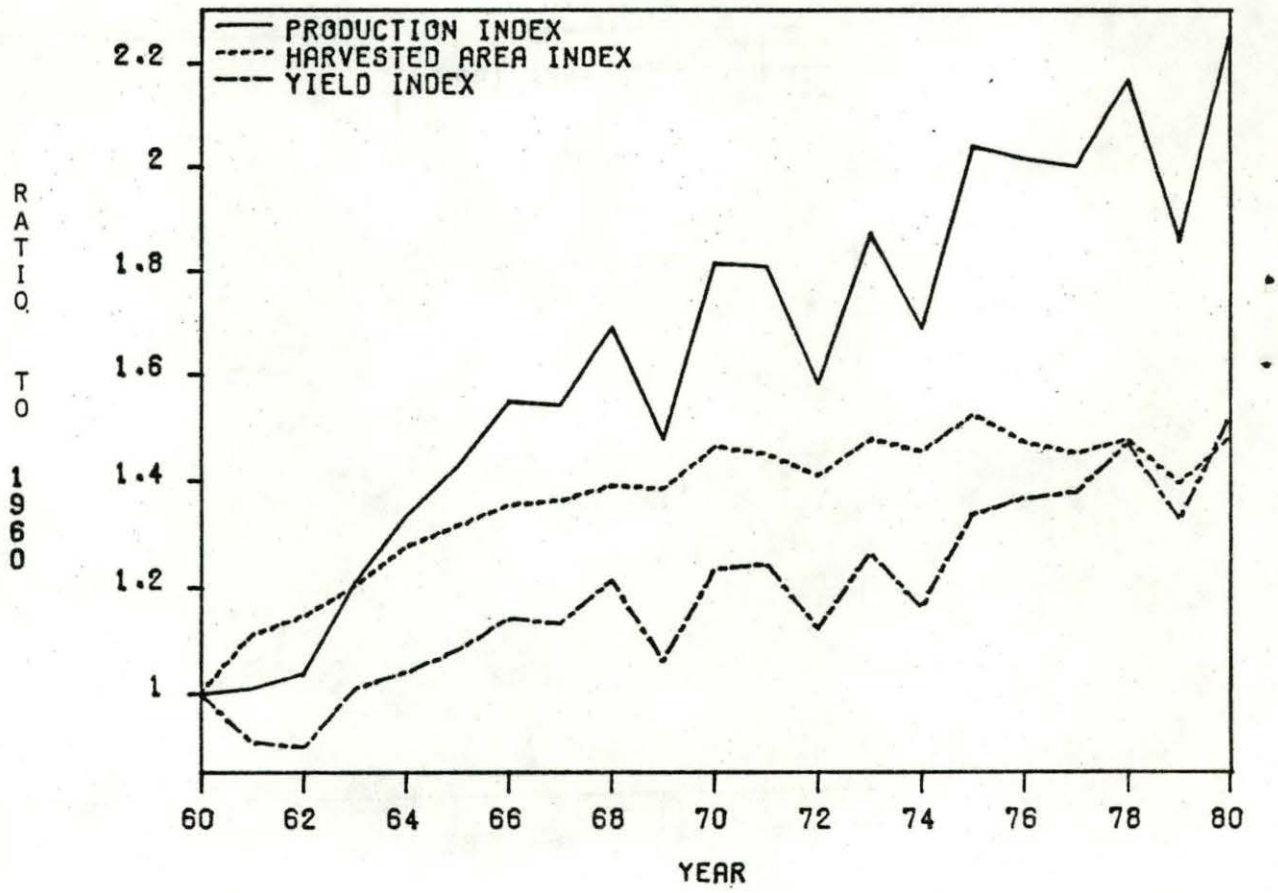


FIGURE 2.38. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS SOUTH AMERICA, 1960-80

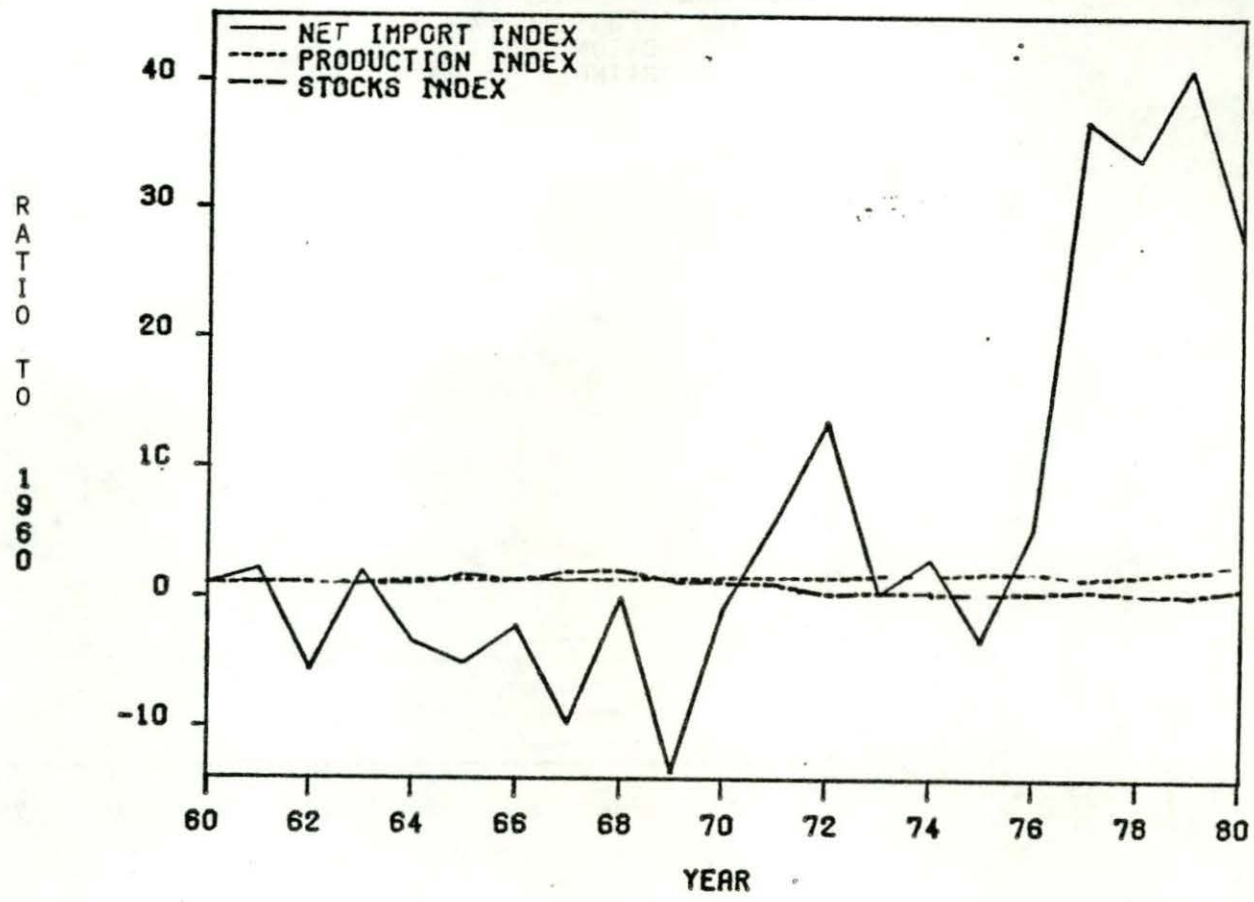


FIGURE 2.39. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA SOUTH AMERICA, 1960-80

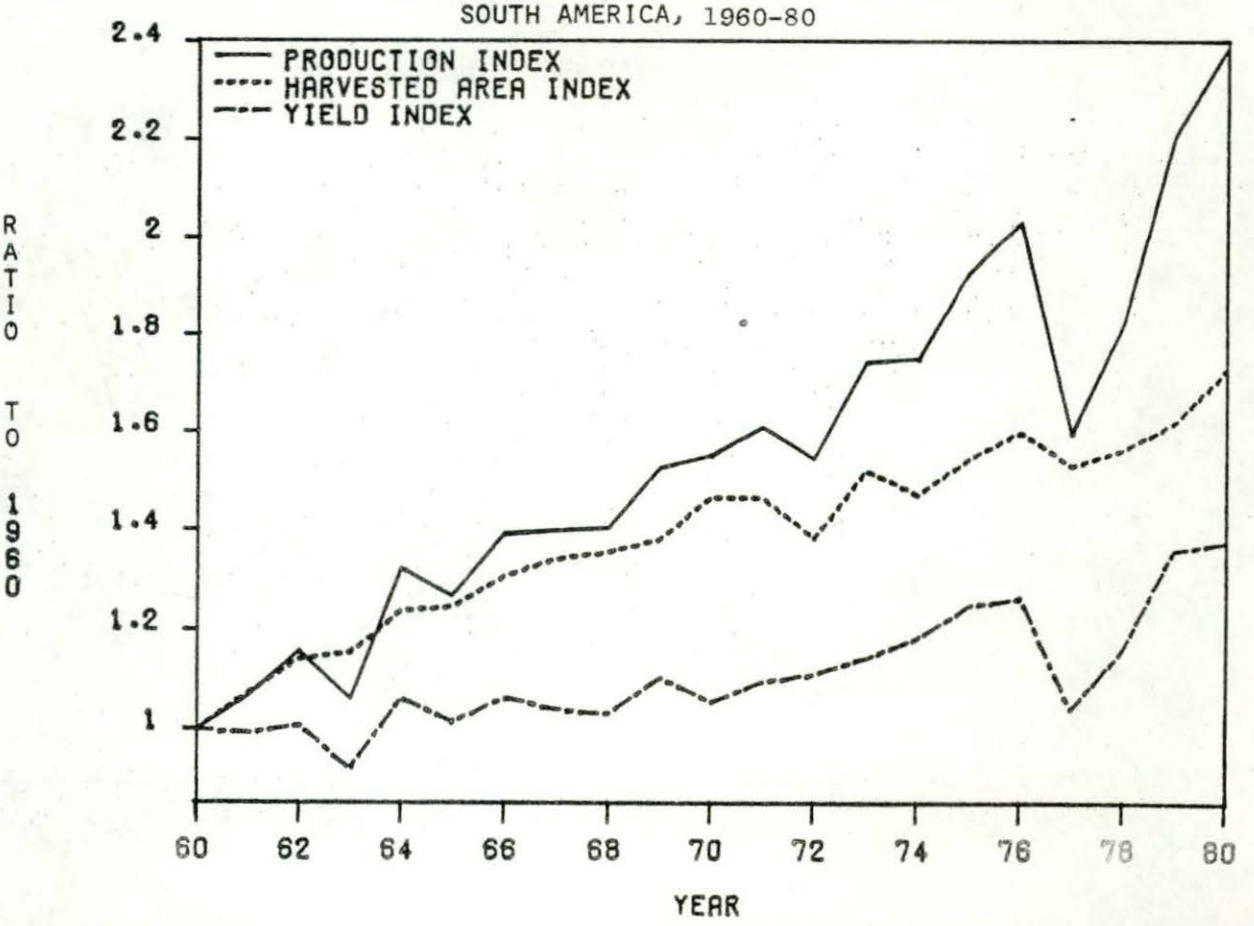


FIGURE 2.40. COARSE GRAIN: NET IMPORTS, PRODUCTION AND STOCKS OIL EXPORTING LDC'S, 1960-80

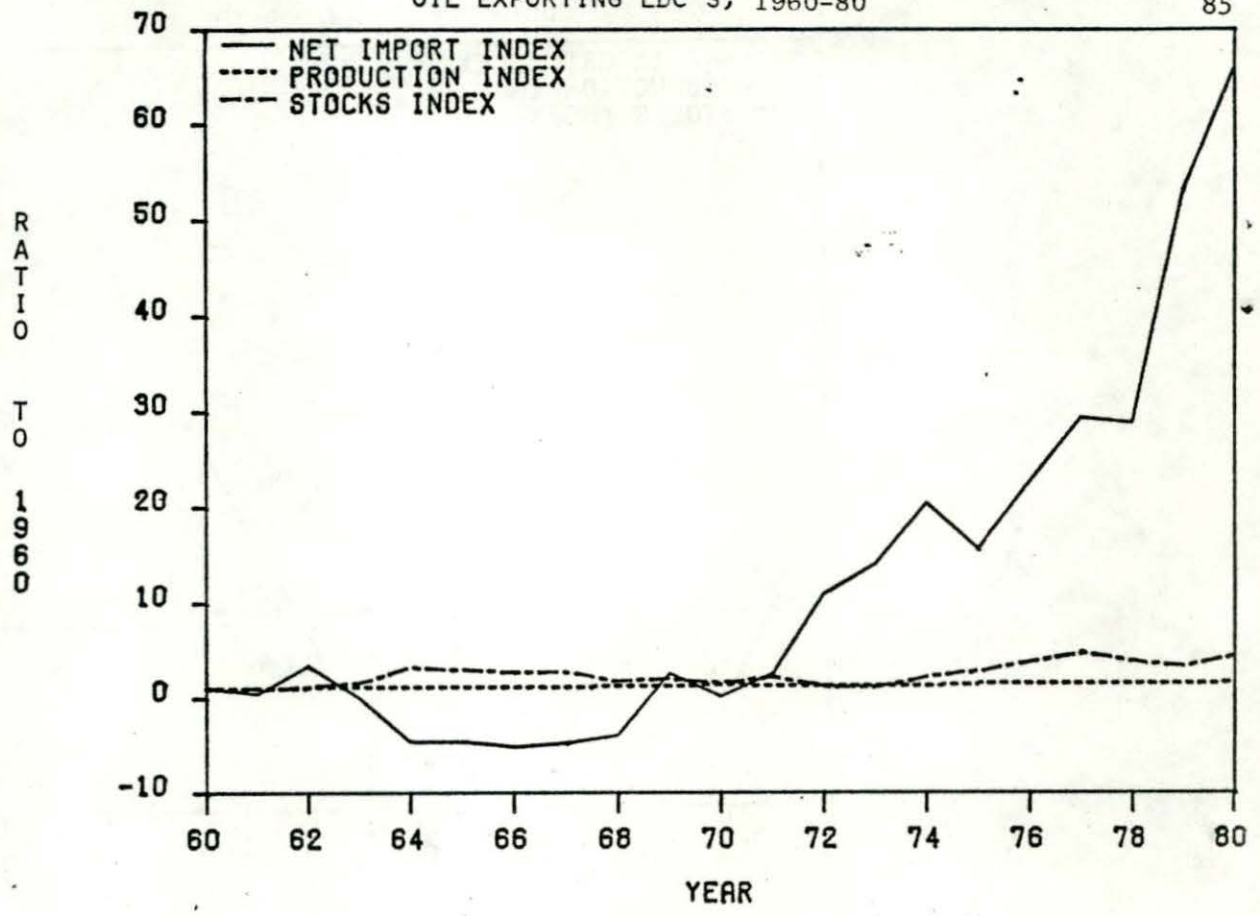
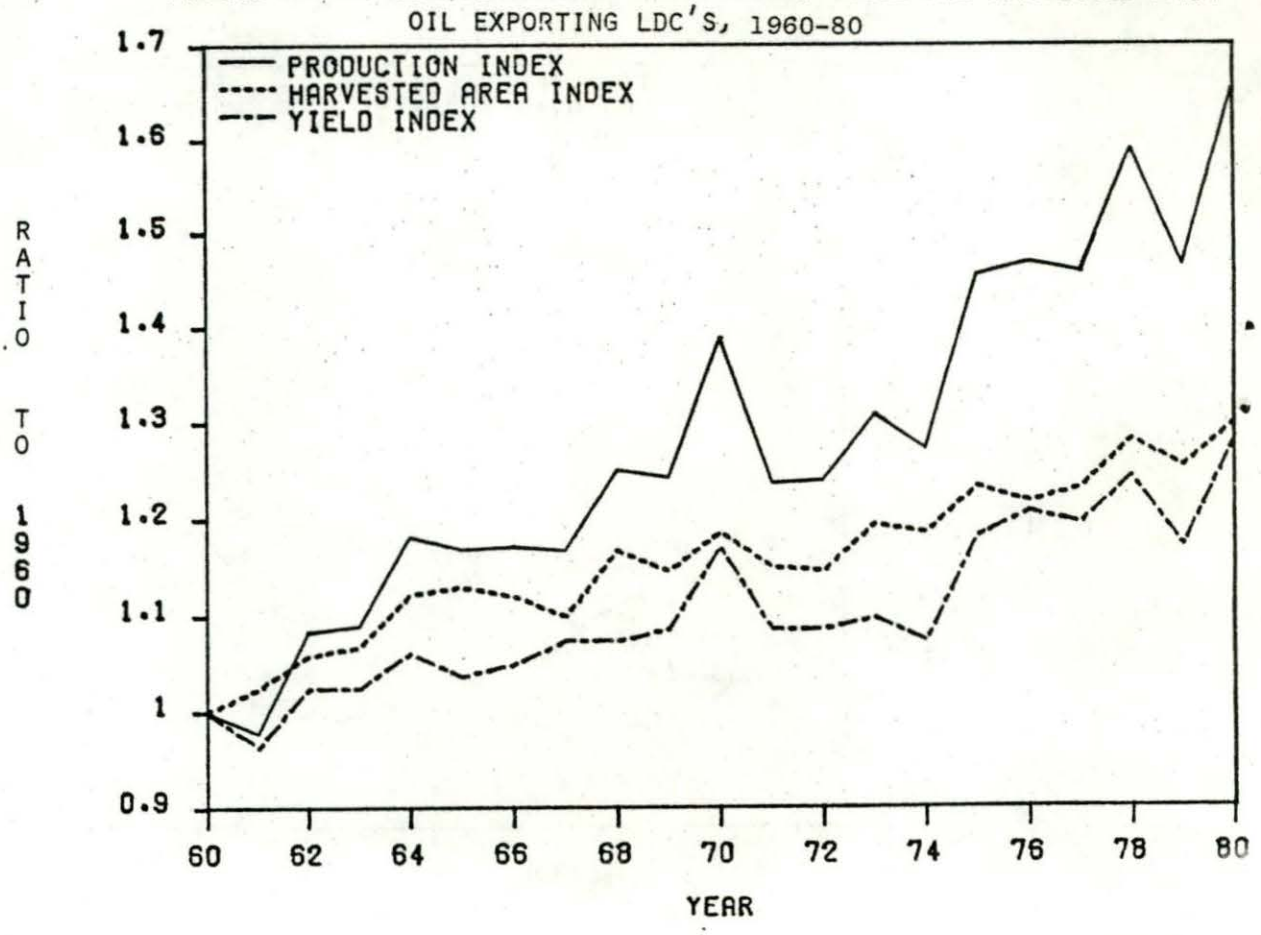


FIGURE 2.41. COARSE GRAIN: PRODUCTION, YIELD AND HARVESTED AREA OIL EXPORTING LDC'S, 1960-80



APPENDIX: INTSTAB DATA BASE

INTSTABDATABASE has been developed for use in the analysis of the sources of instability in the world grain markets. This database contains information on production, consumption, stocks, and trade for wheat, coarse grains, soybeans and soymeal. A description of the country/regions for wheat and coarse grains is included here. Coarse grains consist of corn, barley, sorghum, oats, rye, millet, and mixed grains.

WHEAT REGIONS--RESEARCH DATA BASE

REGION	NAME	COUNTRIES
Exporters		
1	U.S.	U.S.
2	Canada	Canada
3	Australia	Australia
4	Argentina	Argentina
5	Turkey	Turkey
6	South Africa	South Africa
7	France	France
8	All Exporters Exc. U.S.	Canada, Australia, Argentina, Turkey, South Africa
Importers		
Europe		
9	EC-6	Belgium, France, Italy, Luxumbourg, Netherlands, W.Germany
10	EC-9	EC-6 plus U.K., Ireland, Denmark
11	Other Western Europe	Austria, Finland, Greece, Iceland, Malta, Norway, Portugal, Spain, Sweden, Switzerland
12	Western Europe	EC-9 + OWE
13	USSR	USSR
14	Eastern Europe	Albania, Bulgaria, Czechoslovakia, E.Germany, Hungary, Poland, Yugoslavia
15	USSR+E.Europe	sum of 13,14
16	Total Europe	W.E. + E.Europe + USSR
Asia		
17	Middle East Oil Exporters	Iran, Iraq, Saudi Arabia
18	Middle East Non Oil	Jordan, Lebanon, Yeman A.R., Yeman D.M., Israel
19	East Asia Middle Income	Korea, Taiwan, Singapore

20	Japan	Japan
21	China	China
22	S. Asia Major Importers	Bangladesh, Pakistan, Philippines, Malaysia, Sri Lanka, India, Indonesia, Thailand
23	Other Asia Exc. Exporters	Afganistan, Burma, Cambodia, Cyprus, Fiji, Hong Kong, Nepal, New Zealand, N.Korea, S. Vietnam, Syrian Arab. Rep., Turkey
24	Total Asia	Sum of 17,18,19,20,21,22,23
Africa		
25	Oil Exporting	Algeria, Lybia, Nigeria
26	Other Major Importers	Angola, Egypt, Morocco, Mozambique, Tunisia, Zaire, Zambia
27	Other Africa Exc. Exporters	Botswana, Burundi, Camaroon, Chad, Dahomey, Ethiopia, Ghana, Guinea, Ivory Coast, Kenya, Lesotho, Mali, Malagasy Rep., Malawi, Niger, Rhodesia, Rwanda, Senegal, Sierra Leone, Somali Rep., Sudan, Tanzania, Togo, Uganda, Upper Volta
28	Total Africa	Sum of 25,26,27
Central America		
29	Mexico	Mexico
30	CA Other Major Importers	Cuba, Dominican Rep., Jamaica, Trinidad and Tobago
31	Other CA Exc. Exporters	Honduras, Nicaragua, Panama, Costa Rica, El Salvador, Guatamala, Haiti
32	Total CA	Sum of 29,30,31
South America		
33	Total S.A.	Bolivia, Brazil, Chile, Columbia, Ecuador, Guyana, Paraguay, Peru, Surinam, Uruguay, Venezuela
Miscellaneous		
34	LDC Oil Exp.	Algeria, Ecuador, Indonesia, Iran, Iraq, Nigeria, Lybia, Saudi Arabia, Venezuela,

35	World Total	Mexico Does not include Undesignated
36	Undesignated	

COARSE GRAIN REGIONS--RESEARCH DATA BASE

REGION	NAME	COUNTRIES
Exporters		
1	U.S.	U.S.
2	Canada	Canada
3	Australia	Australia
4	Argentina	Argentina
5	Thailand	Thailand
6	South Africa	South Africa
7	France	France
8	All Exporters Ex. U.S.	Canada, Australia, Argentina, Thailand, South Africa
Importers		
Europe		
9	EC-6	Belgium, France, Italy, Luxumbourg, Netherlands, W.Germany
10	EC-9	EC-6 plus U.K., Ireland, Denmark
11	Other Western Europe	Austria, Finland, Greece, Iceland, Malta, Norway, Portugal, Spain, Sweden, Switzerland
12	Western Europe	EC-9 + OWE
13	USSR	USSR
14	Eastern Europe	Albania, Bulgaria, Czechoslovakia, E.Germany Hungary, Poland, Yugoslavia
15	USSR+E.Europe	sum of 13,14
16	Total Europe	W.E. + E.Europe + USSR
Asia		
17	Middle East Oil Exporters	Iran, Iraq, Saudi Arabia
18	Middle East Non Oil	Jordan, Lebanon, Yeman A.R., Yeman D.M., Israel
19	East Asia Middle Income	Korea, Taiwan, Singapore
20	Japan	Japan

21	China	China
22	S. Asia Major Importers	Bangladesh, Pakistan, Philippines, Malaysia, Sri Lanka, India, Indonesia
23	Other Asia Exc. Exporters	Afganistan, Burma, Cambodia, Cyprus, Hong Kong, Nepal, New Zealand, N.Korea, S. Vietnam, Syrian Arab. Rep., Turkey
24	Total Asia	Sum of 17,18,19,20,21,22,23
Africa		
25	Oil Exporting	Algeria, Lybia, Nigeria
26	Other Major Importers	Angola, Egypt, Morocco, Mozambique, Tunisia, Zaire, Zambia
27	Other Africa Exc. Exporters	Botswana, Burundi, Camaroon, Chad, Dahomey, Ethiopia, Ghana, Guinea, Ivory Coast, Kenya, Lesotho, Mali, Malagasy Rep., Malawi, Niger, Rhodesia, Rwanda, Senegal, Sierra Leone, Somali Rep., Sudan, Tanzania, Togo, Uganda, Upper Volta
28	Total Africa	Sum of 25,26,27
Central America		
29	Mexico	Mexico
30	CA Other Major Importers	Cuba, Dominican Rep., Jamaica, Trinidad and Tobago
31	Other CA Exc. Exporters	Honduras, Nicaragua, Panama, Costa Rica, El Salvador, Guatamala, Haiti
32	Total CA	Sum of 29,30,31
South America		
33	Total S.A.	Bolivia, Brazil, Chile, Columbia, Ecuador, Guyana, Paraguay, Peru, Surinam, Uruguay, Venezuela
Miscellaneous		
34	LDC Oil Exp.	Algeria, Ecuador, Indonesia, Iran, Iraq, Nigeria, Lybia, Saudi Arabia, Venezuela, Mexico
35	World Total	Does not include Undesignated
36	Undesignated	