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RISING DEMAND AND UNSTABLE SUPPLY:

The Prospects for Soviet Grain Imports

Summary: Demand for grain in the Soviet Union has increased, but supply has only partially met the need. While average grain yields have increased on unchanged area, they have become increasingly unstable. The result is that the Soviet Union has shifted some of its domestic production instability to international grain markets. This study examines Soviet grain production stability with time series analysis and finds it related to Soviet net grain imports and imports from the United States. It also examines some recent Soviet efforts to reduce grain yield instability.

Affiliation:
Elizabeth Clayton
Professor of Economics
University of Missouri-St. Louis
St. Louis MO 63121

Address:
Soviet Interview Project
325 Coble Hall
801 So. Wright St.
Champaign IL 61820
Tel: (217) 333-7853

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In the search for export markets, American grain traders have turned toward the Soviet Union but have found the market unstable. The instability has come from both partners. On our side, domestic politics, particularly our grain embargo, have reduced marketings in both the short-run and long-run. On their side, instability comes not only from their own domestic politics but also from endogenous sources such as weather and climate. The purpose of this paper is to examine the Soviet sources of endogenous instability and relate them to Soviet grain imports.

Soviet demand for grain has increased significantly in the last decades. There are two major reasons. The first is that population has grown. Between the censuses of 1959 and 1979 the Soviet Union added 54 million people to its population. It estimates that an additional 2-3 million people were added each year since that time [Narodnoe Khoziaistvo SSSR v 1983 g., p.5]. The second reason is that income has increased. During these same years, the average monthly wages more than doubled in the socialized, industrialized sector and collective farm wages grew even faster. [Ibid., pp. 273, 393]. Growing income has expanded the effective demand for meat in particular; and, with highly subsidized meat prices, it has exacerbated a meat shortage of already considerable scale.

Soviet grain supply has grown to meet demand, but only in part. Average annual grain production grew from 129.4 million metric tons in the 1955-1967 period to 188.6 million metric tons in the 1968-1980 period, a 46 percent increase. This was more than sufficient to supply today's population at the consumption level of 1955, but not enough to improve food consumption on a broad scale. To

improve the standard of living has required not only more domestic grain but imports, particularly of feed grains. In any Soviet policy, domestic growth and imports are competing sources of supply. The prospect for imports is governed by the outlook for domestic growth.

The major limit to domestic growth of Soviet grain production is the land base. Pre-revolutionary grain production was centered in the Ukraine near export markets; after the revolution, grain production spread east. The Soviet Union's last expansion of grain area occurred in the mid-1950's when semi-arid parts of Kazakhstan and surrounding republics were ploughed under - the Virgin Lands' Program. Today only one-fourth of Soviet area is farmed, and half of that is in range and pasture. The unused land mass is not only inhospitable to agriculture, but far from population centers.

Half of sown area is in grain, which is located primarily in the Federated Russian republic (RFSFR), the Ukraine, and Kazakhstan. Together, these three republics supplied 91 percent of Soviet grain in 1980. Sown area in grain has been virtually unchanged since the 1950's. Details are shown in Table 1. Wheat continues to be the major grain crop; not shown is a minor shift toward winter wheat, whose yield is higher than spring wheat. Barley, as befits its status as the major feed crop, has grown rapidly in both quantity and sown area.

GRAIN YIELD AND YIELD STABILITY

With grain area stable, the burden of domestic growth has fallen on increasing grain yield. Average annual yield increases between the two time periods are appreciable. For example, the Soviet grain yield increases compare favorably with those shown by Hazell

(1982) for India. But the yield increases are widely believed to have been costly in terms of stability, particularly year-to-year. It is useful to examine the record.

Yield can vary over time from year to year, or for longer periods. In this analysis, average annual yield stability was compared in two time periods: 1955-1967 and 1968-1980. The period 1955-1980 was divided into two parts to reflect first, the major changes in agricultural policy that took place after 1965; and second, the widespread introduction of yield-increasing technology that also pervaded the second period. Unfortunately, the Soviet Union ceased to publish regional grain data after 1980, so the analysis cannot be extended. Departing from custom, severe drouth years were not excluded from the analysis.

Two measures were used to assess variability. The first was the coefficient of variation, or relative variability; it is the standard deviation of yield divided by its mean, and is shown in Table 2. This measure is relative because an increasing variability (the standard deviation) can be offset by a rising average yield (the mean). The second measure was the standard error of the regression, or absolute variability. It is the standard deviation of yield from a trend line. The two measures gave the same results with a few exceptions noted below.

Wheat yield became more stable between these periods except in the minor republics. Although Kazakhstan is deservedly known for the great volatility of its grain yields, it made more gains toward stable wheat yields than other areas. Barley yield became more unstable, except in Kazakhstan, where average yield rose significantly while the

standard deviation fell, and in the minor republics. The yield of other grains became relatively more stable but absolutely less stable, i.e., a rising standard deviation was offset by a rising average yield, but the deviations from a rising trend line increased. In Kazakhstan, the yield of other grains was less stable both relatively and absolutely.

While the area sown to all grain remained relatively constant between the two periods, the areas sown to individual grains shifted, particularly from wheat to barley. (The correlation coefficient between land sown to wheat and to barley as -.77; between other grains and barley it was -.10.) This means that simultaneously the composition of grain production shifted from a crop whose yield was becoming more stable to a crop whose yield was becoming less stable and its location changed as well.

Hazell (1982, 1984) and Mehra have developed a method to analyze grain yield instability over time when yields, sown area, and location change simultaneously. Their method decomposes the variance of grain production into its constituent parts and separates the effects of each. The constituent variances and covariances are weighted by first-period weights, forming a Laspeyres index of change. The results of applying their method to Soviet data are shown in Table 3. For simplicity of exposition, the change in the residual variance - about 15 percent of the total - is excluded.

The calculations confirm the leading role of barley in accounting for the variance of grain yields. Although the barley's share in total production between 1968 and 1980 was only 24 percent, its share of the change in total production's variance was 39 percent.

However, most of its effect came not from any increase in its own variability but from its growing share in total production and sown area.

The major source of pure yield instability came from wheat. The change in yield variance and covariance in barley and other grains played a relatively minor role in the variability of total grain production. The change in the variance of wheat production was not the largest of the three grain groups - that place was held by barley - but its effect was the largest because of wheat's large share in total production and sown area.

The opportunity cost in terms of production stability of the shift out of wheat and other grains and into barley can be determined from the effect of the interaction between yields and areas. This factor alone contributed most of all to the change in grain variance. The loss was a double one: both the additions and the subtractions contributed to the growth in the variance of total grain production. (Note that the same shift in area alone led to a net reduction in overall variance.)

SOVIET POLICIES TO REDUCE YIELD INSTABILITY

Soviet policy makers have not ignored the problem of unstable grain yields. In a recent speech, the president of the Moldavian Academy of Sciences criticized seed research centers for developing crop varieties whose yield was increasingly variable, and Pravda followed up with an editorial criticism of the scientists. The criticism of seed research centers has some unjustified elements, for new grain varieties may inherently have more unstable yields. When Barker, Gabler, and Winkelman reviewed the research results relevant

to grain yield instability, they found that absolute variability tended to increase in new varieties even when relative variability decreased. The new Soviet varieties have increased average yield, but - particularly in wheat - have not reduced the variance. In addition, of course, plants are bred for goals other than yield stability; Soviet seed scientists have moved the wheat growing north, and emphasized drought resistance.

Yield instability arises from more sources than seed selection. Even where new varieties exhibit more yield stability, they almost always demand complementary technology such as irrigation that brings its own destabilizing effects. In this context, the Soviet Union has emphasized growing more wheat on irrigated land. This policy is particularly important for improving yields in Kazakhstan, where water supplies are limited. For this reason, the Soviet Union recently decided to divert water from Siberia's Ob and Irtysh rivers and to double the irrigated land for grain, the so-called program of "reversing the rivers." This program is expected to double the grain output from irrigated land - from nearly 25 million metric tone to nearly 60 million metric tons per year - and will cost $12 billion. The canal itself is 1,550 miles long. In the past, irrigation programs in the south have foundered on salinization and silting problems; the new program may contribute its own instability.

The Soviet planning system is another source of instability. Using the same Pravda editorial mentioned above, the incentive system at the seed research centers was criticized for emphasizing the number of new varieties, and not their yield stability but only their average

yield. Also criticized was the diversion of seed grain to ordinary use to meet plan targets, leaving the farms to produce their own seed from unimproved varieties. These problems are endemic to Soviet central planning of research and development. They suggest that new and improved varieties founder not only in the field but at their source.

Finally, while grain yield instability is an important problem, it may not have the best claim on resources - the cost of reducing instability may exceed the benefits; or the risk of upside instability may be of little consequence while the risk of downside instability may be offset by imports. Soviet grain imports may be the most economical insurance.

GRAIN YIELD STABILITY AND SOVIET GRAIN IMPORTS

The question addressed in this section is whether Soviet grain imports, particularly from the United States, are at all related to yield instability. The Soviet Union imports grain not only for general domestic use, but for supplying grain-deficit regions that are far from domestic production centers. For this reason, the net imports of grain in some years are less than the total grain imports from the United States alone. The purpose is to reduce the burden on the Soviet domestic transportation system, which is stressed to capacity in ordinary times and over-stressed during harvest. The imports not only supplement domestic supply but smooth out the demand for domestic transport over the year.

The hypothesis that grain imports depend on domestic production instability was tested by regressing the residual from a time trend on imports. Barley yield was more closely related to

imports than either wheat or total yields, as expected. For net imports, the results were quite robust: the R^2 was .90 and the F ratio was 51. In order to reduce a severe problem of serially correlated errors, the specification also included imports lagged by one year, an autoregressive form.

For imports from the United States, the results were not so powerful. three differences can be noted. First, the imports depended more on grain yield than on barley yield. This finding is unlikely because Soviet grain imports from the United States include more corn, which is a feed that substitutes for barley, than wheat. Second, the significance statistics are drastically reduced: the R^2 is .36 and the F ratio is only 3. Finally, the autoregressive form was not noticeably better than the simpler form. The latter two findings may simply reflect the effects of the embargo's market disruption. In any event, that issue deserves more study in depth.

CONCLUSIONS

Grain yield instability in the Soviet Union increased between the periods of 1955-67 and 1968-80. Coupled with the desire to improve the population's standard of food and nutrition, the Soviet Union has supplemented its own domestic supplies, particularly of animal feed, during lean years. It has used the international market as an insuror of its production risk, and in effect has passed on that risk to international grain traders.

While the Soviet efforts to stabilize yields have not been negligible, and indeed the scheme to divert northern rivers to the south reflects a strong commitment and willingness-to-pay for stabilization, the stabilization policies that have been used so far

have been counter-productive: grain yield has increased but so has variance. The United States' grain embargo added another element of instability not only to the Soviet Union but to the international grain market, and its effects are only now diminishing.

The evidence presented here suggests that the Soviet Union will continue to be a major trader in the international grain markets for much of the next decade. Surely they will continue to buy in the market during lean years. But, with rising average yields, the two-sided nature of instability suggests that they might even enter as a seller.

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Table 1: Average production, area, and yield of grain crops, 1955-1967, 1968-1980

Crop	1955-1967	1968-1980	Change
	Average production (1,000 metric tons)		(percent)
Wheat	67,823	93,542	37.9
Barley	17,307	45,521	163.0
Other grains	44,236	49,526	12.0
Total grain	129,367	188,589	45.8
	Average area (1,000 hectares)		(percent)
Wheat	65,511	62,368	-4.8
Barley	14,796	28,849	94.9
Other grains	43,674	33,622	-23.0
Total grain	123,982	124,839	0.7
	Average yield (metric tons/hectare)		(percent)
Wheat	1.03	1.50	45.6
Barley	1.16	1.58	36.2
Other grains	1.02	1.47	44.1
Total grain	1.04	1.51	45.2

Other grains include rye, millet, buckwheat, oats, corn and miscellaneous grains.
Sources: (1) 1955-1974: USDA, USSR Grain Statistics: National and Regional, 1955-1975, Statistical Bulletin No. 564, January 1977; (2) 1975-1980: Narodnoe Khoziaistvo, USSR and republics, various years.

Table 2: Coefficient of Variation, Soviet Union and selected republics, 1955-1967 and 1968-1980

Republic and Crop	1955-1967	1968-1980	Change (%)
RFSFR:			
Wheat	.18	.15	-16.7
Barley	.17	.21	23.5
Other grains	.13	.12	- 7.7
Total grain	.16	.15	- 6.2
Ukraine:			
Wheat	.18	.16	-11.2
Barley	.13	.18	38.5
Other grains	.18	.14	-22.2
Total grain	.17	.15	-11.8
Kazakhstan:			
Wheat	.40	.26	-35.0
Barley	.41	.26	-36.6
Other grains	.32	2.58	706.7
Total grain	.39	.26	-33.4
Other republics:			
Wheat	.15	.33	220.0
Barley	.22	.15	-31.9
Other grains	.20	.23	15.0
Total grain	.18	.16	-11.1
USSR:			
Wheat	.18	.14	-22.2
Barley	.15	.17	13.3
Other grains	.14	.11	-21.4
Total grain	.15	.13	-13.3

Sources: Same as Table 1.

Table 3: Disaggregated Components of Change in the Variance of Grain Production, Soviet Union, 1955-1967 to 1968-1980

Change in:	Wheat	Barley	Other Grains	Total Grains
		%		
(1) Mean yields	7.4	9.5	3.7	20.6
(2) Mean areas	- 4.3	8.4	-8.5	-4.4
(3) Yield variances and covariances	17.1	3.3	5.0	25.4
(4) Area variances and covariances	.2	.7	-1.2	-0.3
(5) Area-yield covariances	- .1	.8	1.5	2.2
(6) Interaction between (1) and (2)	10.0	2.9	14.9	27.8
(7) Interaction between (2) and (3)	1.6	9.4	2.0	13.0
(8) Interaction between (1) and (4)	1.2	3.9	9.4	14.5
(9) Interaction between (1),(2), and (5)	1.7	0.4	-0.9	1.2
(10) Sum (1)-(9)	34.8	39.3	25.9	100.0

Sources: Same as Table 1.