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AN ANALYSIS OF THE VARIABILITY OF AGRICULTURAL PRODUCTION IN INDEPENDENT AND SOVIET LITHUANIA, 1923-1989*

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INTRODUCTION

With collectivization in the 1930s, the agricultural sector became the “Achilles’ heel” of the Soviet economy. Despite relatively large amounts of agricultural investment over a long period, agricultural productivity declined and labor migrated to the cities. Evidence for the decline led many to support the hypothesis that socialized agriculture is inherently more unstable and thus less productive than private agriculture.¹ Using data on several East European countries before and during the Soviet occupation, Brada (1986) finds that socialized agriculture in Eastern Europe has led to greater instability in crop production with the main cause of the instability being the increased variability of land sown to various crops. However, his study ignores the experience of the former Soviet Union (FSU) because historical comparisons are believed to be difficult to make for the country as a whole.

While pre-1917 data may be difficult to find for much of the FSU, the Baltic region offers a rich source of data that can be used to compare two entirely different economic systems in the same geographic location within the boundaries of the FSU. Such a comparison is more than a historical exercise as many in the Baltics are now turning to the experience of the 1930s independence period for guidance during the present transition period. An explanation of what actually occurred during the interlude between Russian and Soviet occupation has perhaps never been more important. Previous studies of the independence period that do exist (including those done during the period), while valuable, are anecdotal and do not make use of economic theory and/or long time series data.

* The author would like to thank Dr. Vytautas Pranulis (Vilnius University), Vilius Pogozhelskis (United Nations/Geneva), and several anonymous referees for their comments. The Center for International and Comparative Programs at Kent State University provided research support. The views in this paper do not necessarily represent those of USAID.
By looking at the most agrarian of the Baltic republics, Lithuania, this paper re-examines the question of whether socialist agriculture is relatively more unstable than capitalist agriculture using a region of Eastern Europe which was directly under Soviet occupation. Given the destruction of WWII, the delay of collectivization until 1949-50, and the existence of active freedom fighters well into the 1950s in some Lithuanian rural areas, the paper also compares a late postwar period (1966-89) with the prewar period to control for any extraordinary variability introduced during the immediate postwar period.

**SOURCES OF OUTPUT INSTABILITY**

Variability of crop production can be decomposed into the variability of sown area and/or the variability of crop yields (Brada, 1986). Crop yields vary because of environmental, technical, systemic, and policy factors. Environmental factors include the weather, machinery, and fertilizer with the term “environmental” being used in a broad sense to cover the economic as well as natural environment in which the farm is situated. Since the effect of weather is lessened by the long time period covered, the most important environmental factors are such industrial inputs as machinery and fertilizer. Though prices are less variable under socialism, the haphazard nature of the physical material and supply system suggests environmental variability is greater under socialism than capitalism.

Technical factors that increase variability under socialism include the introduction of new higher-yielding varieties that increase variability and the introduction of pesticides that reduce yield variability. Systemic factors include the lower risk for a farmer when agriculture is collectivized and cost considerations. On a collective farm, risk is less because the link between a farmer’s income and yield variability is no longer clearly defined. The relatively larger size of socialist farms further lowers risk because risk is spread among more workers and varieties of crops. Finally, haphazardly supplied off-farm inputs to produce crops are used more intensively on socialist farms with a consequent further reduction in risk. Offsetting the risk dampening factors are various agricultural campaigns that cause confusion among collective and state farm directors who are already subjected to a varying degree of petty
tutelage with basic farm-level decisions as to what, when, and how to plant and harvest the farm’s crops.

Unlike yield variability, Brada (1986) views sown area variability as caused by only systemic and policy factors. Variability of sown area under socialism is believed to be higher because socialist farms are less constrained in switching sown area from one crop to another. Poor decisions about sown area are the central government’s responsibility and not the farmer’s. Also, a collective farm will generally have a wider variety of crops to begin with, making switching easier. Unlike the at times subsidized subsistence wage on a socialist farm, private farmers are interested in maintaining a subsistence amount of production at all times since their very existence depends on this. In summary, a private farm is more constrained in terms of sown area cropping patterns by price signals and the threat of bankruptcy than a socialist farm is with central directives to change sown area cropping patterns.

During the recent transition period in Lithuania (which included an attempt to decollectivize agriculture), many farmers were found to believe that the best way to make the transition to the more risky, private farming is to maintain the larger, formerly collective farm structure within the market system. Given the agricultural development experience of the United States, such a strategy may be effective in creating an agri-business sector.

METHODODOLOGY

The model used is Brada’s (1986) technique of estimating a trend line with account for the absolute size of the dependent variable. Long time series are used to insure that the weather does not strongly influence the results. The time trend of output, yield, and sown area is estimated by:

\[ X_t = AB^t v_t \]

where \( X_t \) is output, yield, or sown area in time \( t \)
\( t = \text{year} \)
\( v_t = \text{stochastic error term with mean } m \text{ and variance } s^2 \)
A and B are regression coefficients to be estimated.
Because the variance increases as output grows for mathematical as well as horticultural reasons, coefficients of variation are used to compare periods. Once the coefficient of variation is computed for each crop (or livestock type) and for each period using the log-log version of equation one, the residual sum of squares (RSS) is estimated for each crop (or livestock type) in each period. The ratio $RSS_i/RSS_j$ then has an F distribution with $T_i-2$, $T_j-2$ degrees of freedom where $T_i$ is the number of years in period “i.” $RSS_i/RSS_j$ is then used to test whether the coefficients of variation are significantly different between periods for a given crop or type of livestock. The data are further described in a data appendix.

RESULTS

The results are presented in Table 1-A (output), Table 1-B (sown area), and Table 1-C (yield). All of the Lithuanian results compare the period of independent Lithuania with some socialist period.\textsuperscript{5}

A. A Comparison of Independent and Soviet Lithuania

For grain, the results are unambiguous in showing the instability of socialized agriculture. Though grain as a percentage of sown area declined from 63 to 56% of total sown area during the independence period, Lithuanian grain exports were 10 times greater in 1937 than in 1928. Under socialism, grain remained just above 60% of total sown area until 1955, with a decline to between 36 and 51% from 1956 on. With all three indices (output, yield, and sown area), socialized agriculture never achieved as low a coefficient of variation as the independence period. In absolute terms, grain yield is almost 5 times more variable under socialism and grain output more than 3 times so. Grain output variation can therefore be attributed to both sown area and yield variation.

Flax-fiber constituted about 3-4% of sown area before the war and declined from 3 to 1% of sown area after the war. Flax-seed constituted from 1 to 2% of sown area before the war and declined from 3-4% right after the war to 2% of sown area every year after 1965.\textsuperscript{6} Though both flax crops exhibit greater yield variances under socialism, sown area coefficients of variation are not significantly different between periods. The greater instability of flax-fiber harvests under socialism can therefore be attributed to more variable
yields, while the stability of flax-seed harvests must be attributed to sown area stability.

Potatoes ranged from 6 to 8% of sown area in independent Lithuania and from 6 to 10% under socialism. While yield is unambiguously more variable under socialism the coefficient of variation for sown area and output is lower. Collectivization appears to have succeeded in creating a more stable harvest for potatoes though potatoes could hardly be called a success given the low profitability and the necessity of mobilizing large cohorts of Lithuanian students each year to complete the harvest.

Under socialism, sugar beets became a technical crop closely linked to sugar refining. The relative importance of sugar beets under socialism is evident in the increase of sugar beet sown area from 0.01% to 0.36% before the war to 1% every year after the war. The small amount of area devoted to sugar beets in itself probably contributed to the high variability in sown area before WWII. Despite a highly significant drop in the variability of sown area under socialism, both yield and output were significantly more unstable under socialism. In other words, even with a crop whose performance has been found to be relatively better in terms of comparisons with private agriculture, yield variability again accounts for harvest variability with very stable amounts of sown area.

B. A Comparison of Independent and “Late Postwar” Soviet Lithuania

The late postwar period yield variability results are similar to the postwar results with the exception of potatoes which have a stability similar to the prewar stability. Grain continues to have a significantly higher coefficient of variation than during the prewar period. Also, a comparison of prewar Lithuanian data on the separate yields of winter-rye, spring-rye, winter-wheat, summer-wheat, barley, and oats with the Soviet era grain yield index (not shown) indicated that in the period 1945-64 there was no year when Soviet Lithuania achieved the same grain yield for any prewar year. Socialist Lithuanian agriculture required a full 20 years after the war to achieve the prewar level of grain yield.

Sown area variability is more mixed in the comparison of the late postwar period with the independence period. Flax-fiber and flax-seed become less variable under socialism than during independence, while sugar beets remain less variable. Fodder and potatoes
now have the same variability as during the independence era, while only grain and vegetables remain more variable under socialism.

Output variability is also similar with flax-fiber, potatoes, and sugar beets now having similar variability between the two periods. Flax-seed now has less variability with only grain continuing to have higher variability under socialism.

C. Results for Lithuanian Livestock

Yield data for products from livestock such as meat and wool were not available for the prewar period. Yield indices for the postwar period also could not be calculated because of the lack of disaggregate meat indices. For output (thousands of head), however, the evidence is unambiguous - under socialism the variability of herd size increased (Table 1-A). Only in the late postwar period can some stability be seen in the similar variability of the cattle indices and the lower variability of the size of the pig herd under socialism. As with grain, postwar recovery was very slow with the size of the cattle and pig herds only reaching comparable prewar sizes around 1960—15 years after the end of the war and 10 years after collectivization. The numbers of sheep and horses never reached prewar levels and in 1989 were 8 to 10 times lower than during the prewar period. Lithuanian wool production also remained below the prewar level and is currently 10 times less than 1940.

CONCLUSIONS

A historical analysis of Lithuanian agriculture reveals that unlike other East European countries, the agricultural harvest in Soviet Lithuania was more variable because of both yield and sown area variability. Relative to the 1930s, Lithuanian agriculture experienced higher yield variability under Soviet rule. Though significant differences in yield variability across periods in Lithuania may appear as a negative consequence of socialism in comparison with stable yields in the private agricultural sector of socialist Poland, the differences also can be seen in a positive light in that Lithuanian farmers were able to increase yields despite the Soviet occupation. However, the socialist system protected farmers from the income variability usually caused by yield variability and therefore contributed to the present resistance to agricultural reform in Lithuania. Over the long run, farmers must become accustomed to relatively
greater income variability as without a credible taxation system, the Lithuanian government can only provide variability dampening agricultural subsidies by printing new money. Lithuanians have only to look to Russia to see the consequences of such a "monetarist" strategy.\textsuperscript{11}

EPILOGUE

When this paper was originally written in 1992, prospects for Lithuanian agricultural recovery looked bleak. Though 5000 independent farms were established by the Peasant Law of 1989, Lithuania would not see any economic growth until 1994 as high inflation and changing trade patterns buffeted the economy.\textsuperscript{12} However, land reform begun in 1992 has gradually eased restrictions on private land ownership including the right for foreigners to buy and sell land. Input supplies are also private now though the problem of monopolies still exist. Inflation is down with the restored Lithuanian currency fully convertible. The banking sector has undergone some consolidation and with IMF support is poised to become the strong financial sector needed to support agribusiness. Social sector safety nets now are important to overcome the loss of agricultural employment with the collapse of the collective farms. With the election of a former U.S. Environmental Protection Agency Lithuanian-American to the presidency in early 1998, environmentally prudent use of agricultural land is likely to become a high priority.

DATA APPENDIX\textsuperscript{13}

Ideally, agricultural production data for comparing different economic systems would be highly disaggregate, physical data covering a long period. Disaggregation would eliminate any output heterogeneity noise while physical data would avoid any problems with synthetic prices. Lithuanian data do cover a long period and are in physical terms, but are highly aggregate.\textsuperscript{14} Specifically, the data consist of the three indices output (thousands of metric tons or head of cattle), yield (centners or head per hectare), sown area (thousands of hectares).

Grain, potato, sugar beet, flax-fiber, and flax-seed are the only five crops where data are available for sown area and yield in both the prewar and postwar periods. Incomplete data sets were available
for fodder and vegetable indices (available for sown area only) and livestock (available in thousands of head only). Some prewar Lithuanian data are available from prewar Lithuanian sources and are otherwise supplemented by prewar indices given in Soviet statistical handbooks. Because of the unavailability of data in the earliest years of independence, the independence period covers 17 years only (1923-1939). Data for the single year 1940 is available in many Soviet era handbooks, but such data are not used because they include the Vilnius area. Postwar Lithuanian data are from Soviet statistical handbooks and include all collective and state farm production as well as private plots.

Prewar Lithuanian grain consists of winter and spring rye, winter and summer wheat, barley, and oats. Unfortunately, the unavailability of disaggregated grain data by different types for the postwar period makes specific comparisons with Brada's (1986) East European results difficult. In general, the aggregate index should be less variable than specific types of grain. Prewar fodder consists of the aggregation of prewar Lithuanian indices consisting of vetch for corn, mixture for corn, mixture and vetch for green fodder, unrefined sugar beets, clover and other grass, and other plants.

NOTES


3. Another cause of increased yield variability are summer fallow policies in the former USSR. However, no independent data over the long period covered here could be found to examine this effect. For a discussion of summer fallow policies in the former USSR, see D. Gale Johnson and Karen M. Brooks' book Prospects for Soviet Agriculture in the 1980s (Bloomington: Indiana Univ. Press, 1983).

4. Covariances are also inappropriate here because of their dependence on the units of measurement.

5. The term "variation" is used loosely here and refers to the coefficient of variation in a given period.

6. Though both flax crops are relatively unimportant in terms of the percentage of sown area, both are used because of the existence of prewar flax data series.

7. This point is from Johnson and Brooks, 1983. See note #3.

8. Vegetable and fodder data, though only available in terms of sown area, also suggest increased variability under socialism.

9. However, the substitution of machinery for horsepower undoubtedly contributed to the decline of the number of horses.
10. The decline in the wool industry reflects the comparative advantage of wool production in other republics within the former Soviet Union. It is not clear if this advantage is real or was administratively imposed by the Soviet occupation.

11. This conclusion is not meant to recommend against any government intervention. For example, during the disastrous 1992 agricultural season, government support was clearly warranted.

12. For a full discussion of the transition era in Lithuanian agriculture see the work of Natalija Kazlauksiene and William H. Meyers such as “Beyond Privatization: Developing a Market Economy for Lithuanian Agriculture,” Baltic Report 95-BR 20, August 1995. Funding and preparation of the paper were provided by the International Trade Development Unit, Ministry of Agriculture, Vilnius, Lithuania; Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa; and Midwest Agribusiness Trade Research and Information Center (MATRIC) also at Iowa State University.

13. Data are taken from the following sources:

14. With independence, the opportunity to collect detailed data at the farm level now exists. However, the collection of such data over a long period was beyond the scope of this study. For an example of the level of detail now becoming available, see Brooks, Karen. 1991. “Price Adjustment and Land Valuation in the Soviet Agricultural Reform: A View Using Lithuanian Farm Data,” European Review of Agricultural Economics, 18, pp. 19-36.

15. Agricultural specialists in Vilnius assured the author that the omission of the Vilnius area from the prewar estimates would not influence these results significantly because a wide variety of crops are grown in this region.

<table>
<thead>
<tr>
<th>TABLE 1-A</th>
<th>Output Coefficients of Variation (in %) for the Main Agricultural Products in Independent and Soviet Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flax-fiber</td>
<td>23.16</td>
</tr>
<tr>
<td>Flax-seed</td>
<td>24.37</td>
</tr>
<tr>
<td>Grain</td>
<td>15.50</td>
</tr>
<tr>
<td>Potatoes</td>
<td>23.70</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>34.91</td>
</tr>
<tr>
<td>Cattle</td>
<td>7.30</td>
</tr>
<tr>
<td>Horses</td>
<td>7.08</td>
</tr>
<tr>
<td>Pigs</td>
<td>16.62</td>
</tr>
<tr>
<td>Sheep</td>
<td>10.19</td>
</tr>
</tbody>
</table>
TABLE 1-B
Sown Area Coefficients of Variation (in %) for the
Main Agricultural Products in Independent and Soviet Lithuania

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flax-fiber</td>
<td>17.32</td>
<td>31.63</td>
<td>14.29**</td>
</tr>
<tr>
<td>Flax-seed</td>
<td>19.97</td>
<td>24.21</td>
<td>5.75**</td>
</tr>
<tr>
<td>Grain</td>
<td>11.70</td>
<td>18.09**</td>
<td>10.94*</td>
</tr>
<tr>
<td>Potatoes</td>
<td>21.28</td>
<td>20.04**</td>
<td>16.88</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>90.55</td>
<td>16.53**</td>
<td>9.30**</td>
</tr>
<tr>
<td>Fodder</td>
<td>21.32</td>
<td>28.72**</td>
<td>7.42</td>
</tr>
<tr>
<td>Vegetables</td>
<td>4.21</td>
<td>15.32**</td>
<td>7.79**</td>
</tr>
<tr>
<td>Total hect.</td>
<td>11.47</td>
<td>3.95**</td>
<td>1.61</td>
</tr>
</tbody>
</table>

TABLE 1-C
Yield Coefficients of Variation (in %) for the
Main Agricultural Products in Independent and Soviet Lithuania

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flax-fiber</td>
<td>19.31</td>
<td>35.63**</td>
<td>26.94**</td>
</tr>
<tr>
<td>Flax-seed</td>
<td>16.75</td>
<td>29.77**</td>
<td>24.91</td>
</tr>
<tr>
<td>Grain</td>
<td>11.20</td>
<td>50.90**</td>
<td>19.61**</td>
</tr>
<tr>
<td>Potatoes</td>
<td>15.28</td>
<td>19.15**</td>
<td>13.74</td>
</tr>
<tr>
<td>Sugar Beets</td>
<td>18.64</td>
<td>40.48**</td>
<td>20.51</td>
</tr>
</tbody>
</table>

Note A:  * — significantly different at the 5% level  
** — significantly different at the 1% level

Note B:  Output: Prewar sugar beets 1933-39 only. 
         Postwar flax-seed 1945-75 only. 
         Sown Area: Prewar sugar beets 1925-39 only. 
         Yield: Prewar sugar beets 1933-39 only. 
         Postwar flax-seed 1945-85 only.