Power and Taxes in the USSR

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Power and Taxes in the USSR

Abstract
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Power and Taxes in the USSR

by

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This paper constructs a game theoretical model of the Soviet Union based on Aumann-Kurz tax theory. The Shapley value is computed for the party center, an atom, as well as for an ocean composed of workers and peasants. The equation relating peasant economic power to peasant political power is estimated for the period 1925-29. The power share of the peasants is estimated to be 12%, as opposed to 44% for the party center.
Ever since the pathbreaking work of Bettelheim [5], scholars have taken seriously the notion of class struggle in the U.S.S.R. The power struggle of the 1920s makes this period unique in Soviet history. This paper considers these power struggles from the standpoint of Aumann-Kurz tax theory.

Section 1 of the paper presents the model of a one-party state. The next section discusses Aumann-Kurz tax theory in a one-party state. Section 3 invokes the solution concept for this theory, the Shapley value, and derives the Shapley value allocations for the power and income redistribution games. The final section estimates the distribution of power based on Soviet data for the period 1925-29.
I. The Model

1. General Structure

The model has three types of agents - peasants, workers, and the party - and two different goods, money income and grain. The government, which is run by the party, buys grain from peasants at the domestic market price $p$. The world price of grain is the numeraire: this is the price peasants could get for their grain had they access to the world market. Thus, all money incomes are measured relative to the world market price of grain.

The society $T$ equals $[0,1]$, the unit interval. There is a continuum of agents $(0,1]$ and an atom at zero for the population measure $\mu$. $\mu$ is the Lebesque measure on $(0,1]$. The atom at zero represents the party center; the continuum consists of peasants and workers. The income distribution $y$ is also continuous on $(0,1]$.

2. Peasants

A peasant $dt$ is represented by a utility function $u_t(x(t)) = x(t)$, where $x(t) dt$ is the money value of $dt$'s final allocation, and an endowment $y(t)$ of money income, which represents the world market value of the peasant's grain. The utility function expresses risk-neutrality; the model can be extended to encompass substantial amounts of risk aversion (see [7]).

The distinction between rich, middle, and poor peasants is expressed by differing levels of $y(t)$.

Let $P$ be the set of peasants, $P \subseteq [0,1]$. We assume

$0 < y(P) < 1.

Aggregate endowed peasant income, $y(P)$, satisfies

$0 < y(P) = \int_P y(t) d\mu.$
3. Workers

A worker is represented by the utility function $u_t(x(t)) = x(t)$, and the endowment $y(t)$.

Let $W$ be the entire set of workers. Then $W \cup P = (0,1]$. One has $0 < u(W) < 1$, and $u(W) + u(P) = 1$.

For both peasants and workers, production has already taken place; the remaining economic function is purely distributive.

4. The Party

The party consists of a center (the Central Committee or, more narrowly, the Politburo) and a periphery, the party membership.

The party center is represented by the point 0 and is normalized to have weight $u([0]) = 1$. The party center has income endowment $y([0]) = 0$. The party membership consists of workers and peasants and is represented by the party membership measure $\nu$. The measure $\nu$ is defined as follows for $S$ measurable:

$$\nu(S) = \theta \frac{\nu(S \cap W)}{\mu(W)} + (1-\theta) \frac{\nu(S \cap P)}{\mu(P)}$$

for $\theta \in (0,1)$. In particular, $\nu(W) = \theta$, $\nu(P) = 1-\theta$, and $\nu(W \cup P) = 1$.

Control of the party means control of the state. A coalition which can exercise control of the party is winning. A winning coalition must include the party center, and a proportion $\alpha$ of the membership, $0 < \alpha < 1$.

The extreme values $\alpha = 0$ and $\alpha = 1$ represent dictatorship of the party center and unanimity rule respectively. The complement of a winning coalition is losing. A coalition which is neither winning nor losing is indecisive. Examples of indecisive coalitions are $\{0\}$ and $P \cup W$. 
The party center plays the role of a veto player: it never belongs to a losing coalition.

The state is the chief purchaser of the grain, which it resells to workers and exports to the rest of the world. Peasants pay taxes out of their grain sale receipts; state purchases are financed by the taxes it collects. The determination of the after-tax income distribution and tax functions is the subject of the next two sections.

II. Game Theory and Power Struggle

In the Aumann-Kurz model of distribution [1,2], the major aspect of the state is its tax policy. The state has unlimited tax powers: it can expropriate whom it pleases. On the other hand, those subject to expropriation can destroy their endowments and thus deprive their expropriators of their loot. In a cooperative game, the tax system which emerges has somehow to weigh the threats to expropriate and to escape expropriation in an overall compromise.

A cooperative game \((T,v)\) is a pair consisting of the set of players \(T\) and coalition function \(v\), which measures what each coalition can assure its members. There are cooperative games on two levels in the present model: the purely political struggle for power, and the economic struggle over the distribution of income.

The struggle for power is the easiest to describe. For \(S \subseteq T\), the coalition function \(v_1\) is given by

\[
v_1(S) = \begin{cases} 
1 & \text{if } S \text{ is winning} \\
0 & \text{otherwise}. 
\end{cases}
\]

A coalition has the full state power if it is winning, and not otherwise. This may seem to undervalue an indecisive coalition. One can also consider
the game dual to \( v_1, v_\# \), defined by \( v_\#(S) = v_1(T) - v_1(T/S) \). The dual power struggle game is given by

\[
v_\#(S) = \begin{cases} 
1 & \text{if } S \text{ is not losing} \\
0 & \text{otherwise.}
\end{cases}
\]

Both these representations of the power struggle will prove useful.

The cooperative game concerning the distribution of income \( v_{II} \) is a more complicated affair. Clearly, for the grand coalition \( T \), \( v_{II}(T) = y(T) \). Again, if \( S \) is indecisive, so is its countercoalition \( T/S \). In this case, the members of \( S \) can assure themselves of their own income and \( v_{II}(S) = y(S) \). Now suppose \( S \) is winning and \( T/S \) is losing. If \( S \) and \( T/S \) carry out their strongest threats, then \( S \) expropriates \( T/S \) and \( T/S \) destroys its entire endowment. This yields an outcome to \( S \) and \( T/S \) of \( (y(S), 0) \), respectively. Consider this outcome as the disagreement point of the Nash bargaining problem for dividing \( y(T) \) between \( S \) and \( T/S \). The solution of the Nash bargaining problem is

- for \( S \), \( 1/2 [y(T) + y(S)] \).
- for \( T/S \), \( 1/2 [y(T) - y(S)] \).

These are taken to be the coalition function values for \( S \) and \( T/S \) respectively.

To summarize, for the income redistribution game, the coalition function \( v_{II} \) satisfies

\[
v_{II}(S) = \begin{cases} 
1/2 [y(T) + y(S)] & \text{if } S \text{ is winning} \\
y(S) & \text{if } S \text{ is indecisive} \\
1/2 [y(T) - y(T/S)] & \text{if } S \text{ is losing}
\end{cases}
\]

It is also convenient to introduce a related cooperative game defined by \( q(S) \)
y(S) if S is not losing
q(S) =
       0 otherwise.
The relationship between v and q is that
v(S) = 1/2 [q(S) + qf (S)].
It is important to stress that in the cooperative game, threats to
expropriate or to destroy endowments are not actually carried out in the
final compromise. The situation would degenerate into noncooperative
behavior if such were the case. One reason to opt for a cooperative over a
noncooperative model is the fact that such threats are not carried out.

III. Power Distribution and Income Distribution

A widely accepted measure of political and economic power in a coopera-
tive game is the Shapley value φ. The Shapley value has been given an
axiomatic foundation; in particular, it satisfies axioms of linearity,
symmetry, and Pareto efficiency [3, Appendix A]. The Shapley value also
satisfies the random order interpretation: the Shapley value of a player t
in a game v is the expected marginal product of that player in a random
ordering of all players. Formally,

φv(t) = E[v(S^R_T) - v(S^R_T/\{t\})]

where S^R_T is the set of players up to and including t in a random order R on
the set of players, and E is the expectations operator when all random
orders on T are equally likely.

The Shapley value was originally defined for games with a finite number
of players. For the present situation, which has one large player and a
continuum of small players, Neyman has shown that there is an extension of
the Shapley value which continues to satisfy the symmetry and efficiency axioms, and the random order interpretation [11, Theorem A].

We now turn to the Shapley value for the political power and income distribution games.

**Proposition 1.** The Shapley value of the power distribution game \( v^s \) satisfies

\[
\begin{align*}
\phi_{v^s}(\emptyset) &= 1 - \alpha \\
\phi_{v^s}(P) &= \alpha \theta \\
\phi_{v^s}(W) &= \alpha (1 - \theta)
\end{align*}
\]

**Proof:** By Shapiro and Shapley [14, Theorem 4], the value of the atom in the \( \alpha \)-quota game is \( 1 - \alpha \). By the results of Hart [8, Theorem A] and Neyman [11, Lewin 6], the power of a condition \( S \subseteq W \cup P \) is proportional to its voting size. Since \( v(W \cup P) = 1 \), the proportionality constant is \( \alpha \). Then,

\[
\phi_{v^s}(S) = \alpha v(S), \text{ for } S \subseteq W \cup P.
\]

It then follows that

\[
\phi_{v^s}(W) = \alpha \theta
\]

and

\[
\phi_{v^s}(P) = \alpha (1 - \theta).
\]

Under the assumption of equal likelihood of party membership, these Shapley values are uniformly spread over \( P \) and \( W \) respectively. An increase in \( \alpha \), the quota needed to form a winning coalition, increases the power of both workers and peasants and decreases that of the party center. On the other hand, a decrease in \( \alpha \) centralizes power. Further, an increase in a class's party representation increases its power. Finally, we note that for any game \( v \), \( \phi v = \phi v^\theta \), by reversing random orders. Thus, the power distribution of proposition 1 also holds for the dual power game \( v^\theta \).
We now turn to the income distribution implied by the Shapley value of the income redistribution game. This income distribution is intimately connected with the distribution of power.

**Proposition 2.** The Shapley value \( \phi \) for the income distribution game \( v_{II} \) is given by

\[
\phi_{v_{II}}(\emptyset) = \frac{(1-\alpha)^2}{2} y(T)
\]
\[
\phi_{v_{II}}(W) = \frac{1+\alpha^2}{2} y(W) + \alpha(1-\alpha)\theta y(T)
\]
\[
\phi_{v_{II}}(P) = \frac{1+\alpha^2}{2} y(P) + \alpha(1-\alpha)(1-\theta) y(T).
\]

**Proof.** See Appendix 1.

One can look at the effect of power on the distribution of income by sector in two ways. The first is with respect to price. Peasants realize their Shapley value income by grain sales on the domestic market at price \( P \),

\[
py(P) = \phi_{v_{II}}(P).
\]

Since the world market price of grain is the numeraire, \( p \) represents the relative price of domestically traded grain. This price is quite sensitive to the distribution of power, as shown in the following corollary to Proposition 2:

**Corollary.** If the peasant share in the initial distribution of income exceeds their relative share of power, then \( p < 1 \).

**Proof.** Denote by \( \gamma = \frac{y(T)}{y(P)} \), the reciprocal of the peasant share of income. From proposition 2 and the definition of \( p \),
\[ p = \frac{1 + \alpha^2}{2} + \alpha(1-\alpha)(1-\theta)\gamma \]

By hypothesis
\[(\gamma)^{-1} > (1-\theta),\]
which implies
\[\gamma(1-\theta) < 1.\]

Hence,
\[p < \frac{1 + \alpha^2}{2} + \alpha(1-\alpha) = \frac{1 + 2\alpha - \alpha^2}{2} < 1.\]

One can also predict the effects on price of changes in the parameters of the distribution of power. First,
\[\frac{\partial p}{\partial \gamma} = -\alpha(1-\alpha)\gamma < 0\]

An increase in worker representation in the party decreases the price paid to peasants for grain. The effect of decentralization on price is given by
\[\frac{\partial p}{\partial \alpha} = \alpha + (1-\theta)\gamma(1-2\alpha)\]

If the peasant share in income is less than their relative share in power, then
\[(1-\theta)\gamma < 1, \text{ and} \]
\[\frac{\partial p}{\partial \alpha} > \alpha + (1-2\alpha) = 1-\alpha > 0,\]
decentralization raises the price paid to peasants. However, when peasant share in income is greater than their share in power, decentralization may lower the price paid to them for grain. Finally, an increase in \(\gamma\) raises the price \(p\):
\[\frac{\partial p}{\partial \gamma} = \alpha(1-\alpha)(1-\theta) > 0.\]
If the economy as a whole grows faster than the peasant sector, \( p \) should rise.

Alternatively, one can measure the effect of the parameters of power on the distribution of income through its effect on quantities. Define the collection (subsidy) rate \( e(P) \) to be

\[
e(P) = \frac{y(P) - \psi_{\Pi}(P)}{y(P)}.
\]

This represents the proportion of their grain that peasants give up (or receive from) the redistribution process. The relation between the price and quantity measures is simply

\[
e(P) = 1 - p.
\]

When \( p \) is less than 1, then \( e(P) \) represents a collection rate. The same forces which drive the price down drive the collection rate up. Thus, the collection rate increases when peasant representation in the party diminishes, if the degree of centralization and the income share remain constant.

IV. Application to the USSR, 1925-29

This section estimates the \( e(P) \) equation for Soviet data of the period 1925-29. The data and their sources are described in Appendix 2. Before discussing the estimation results, some general discussion of the applicability of the model to this period is in order.

The most crucial issue in any application of Aumann-Kurz taxes is that of strategic fit. The state threat to expropriate grain and the peasant threat to sabotage agricultural production must be clearly present. The Soviet government called a halt to grain requisition without compensation in 1921. Considerable propaganda effort during the 1920s went into convincing
the peasants that such requisitions would not resume. The extent of these efforts shows just how real the state threat remained. Again, the "exceptional measures" of 1928-29, which entailed requisition of grain at the state price $p$, were supposed to be just that, exceptional.

On the peasant side, it is crucial that the peasantry retain control of agricultural production. As late as 1927, 97.3% of the sown area of the USSR was by individual peasants [12, p. 150]. The forced collectivization drive, which began in late 1929, radically changed this strategic feature. By the end of 1933, 64.4% of the crop area was collectivized [12, p. 174]. From the standpoint of cooperative game theory, the collectivization drive marks the end of the compromise between the state and the peasants during the 1920s, and a return to noncooperative relations. The state carried out to a large extent its expropriation threat $(e(P)$ nearly doubled in the period 1930-33 over its 1925-29 average), and peasants carried out their sabotage threat. All of this points to a reasonably good strategic fit for Aumann-Kurz taxes in the period 1925-29.

Another crucial issue is the treatment of the party center as an atom. Interpreting the party center as the Politburo, this is simply not true. The divisions in the Politburo after Lenin's death in 1924, symbolized by the antagonism between Bukharin, Stalin, and Trotsky, are extremely important. Indeed, it is only after the expulsion of the Trotsky and Bukharin factions (the latter at the end of 1929), that the collectivization drive begins. Assuming that $\alpha$ is constant during the period 1925-29 commits one to the proposition that the overall power of the Politburo is independent of these struggles. This last proposition can hardly be confirmed.

A related issue is that of exogeneity. Part of the movement in $\theta$ was due to Party policy; for instance, the Lenin recruitment drives of 1924-25.
To the extent that the party center was able to manipulate $\theta$, estimates of $\alpha$ will not fully capture the power of the party center. The same issue arises with the variable $\gamma$, which the party center was able to influence through its investment policy. Finally, there is a possible feedback relation from $e(P)$ to $\theta$, as the economic squeeze itself forces peasants out of the party. If such were the case, estimates of peasant power would be biased upwards. All this suggests great caution in using the estimates of the $e(P)$ equation.

Estimating the equation

$$e(P) = \frac{(1-\alpha^2)}{2} - \alpha(1-\alpha)(1-\theta)\gamma$$

by the SAS NLIN procedure, one has the following results:

- $\alpha_{est} = .563$
- asymptotic standard error = .035
- asymptotic 95% confidence interval = (.465, .661)
- Regression sum of squares = .128
- Residual sum of squares = .005.

Estimation converged after three iterations; the residual sum of squares are plotted in Figure 1. The minimum sum of squares is quite pronounced at $\alpha = .563$.

On the basis of this result, we estimate the distribution of power at the end of 1929 as the following:

- Party Center = .437
- Workers = .441
- Peasants = .122

Although inferring even a single parameter from five observations is a chancy affair, these results do shed some light on the ideological inter-
Figure 1. Sum of Squared Residuals
pretation of events of this period. First, the estimate of party center power, about 44%, shows just how much was at stake in the struggle between Stalin and his rivals. A single individual taking charge of the party center would be as powerful as the entire working class. Since the estimate of $\alpha$ is if anything biased downwards, it seems hardly a large step from "dictatorship of the proletariat" to "dictator over the proletariat." Again, given that peasants were 80% of the working population, their power share of 12% shows just how little represented they were in the power structure and how vulnerable they were to something like a forced collectivization drive. The workers here appear as a class caught in the middle, not necessarily standing to gain from the collectivization of the peasant class and concomitant state conquest of peasant power. From the standpoint of subsequent Soviet history, the period from 1929 onward appears to have been one of increasing centralization of power in the hands of Stalin himself.
Appendix 1. Proof of Proposition 2

By linearity of the Shapley value,

\[ \phi_{\Sigma} = \frac{1}{2} [\phi_q + \phi_{\bar{q}}]. \]

Since \( \phi_q = \phi_{\bar{q}} \), it suffices to compute \( \phi_q \).

It follows from Neyman [10] that \( q \) has an asymptotic value. Since all limiting values converge to the asymptotic value, it suffices to compute a single limit.

Define \( q \) and \( \bar{q} \) by

\[ q(s) = \gamma(S \cup W) \text{ if } S \text{ is not losing} \]
\[ 0 \text{ otherwise} \]
\[ \bar{q}(S) = \gamma(S \cup P) \text{ if } S \text{ is not losing} \]
\[ 0 \text{ otherwise} \]

Clearly, \( q(S) = \bar{q}(S) + \bar{q}(S) \). We shall compute \( \phi_q \); a similar argument establishes \( \bar{q} \).

Let \( \{ \Pi_k \} \) be a decreasing and separating sequence of partitions of \( W \) and \( P \). In particular, at each stage \( k \),

\[ W = \bigcup_{i=1}^{2^k} W_i. \]
\[ P = \bigcup_{i=1}^{2^k} P_i. \]

with \( \mu(W_i) = 2^{-k} \mu(W) \) for all \( i \) (likewise, \( \mu(P_i) \)). Also, \( E[y(W_i)] = 2^{-k} y(W) \).

Let \( B_1, B_2, \ldots, B_{2^{k+1}+1} \) be a random ordering of the \( W_i, P_i \), and \{0\}.

We compute the expected marginal contribution of \{0\}.

With probability \( (2^{k+1} + 1)^{-1} \), \{0\} is first in a random order, in which case his marginal contribution is 0. With probability \( (2^{k+1} + 1)^{-1} \), \{0\} is
second in a random ordering, in which case his marginal contribution is $E[y(W_i)]$ with conditional probability 1/2 and 0 with conditional probability 1/2. With probability $(2^{k+1} + 1)^{-1}$, $\{0\}$ is third in a random ordering, in which case his marginal contribution is $2E[y(W_i)]$ with conditional probability 1/4, $E[y(W_i)]$ with conditional probability 1/2, and 0 with conditional probability 1/4, and so on.

Let $\lceil x \rceil$ denote the greatest integer less than or equal to $x$. Once $\mu(B_1 \cup B_2 \cup \ldots \cup B_h) - \mu(\{0\}) > \lceil (1-\alpha)2^{k+1} \rceil$, $\{0\}$'s marginal contribution is 0. Then, $\{0\}$'s expected marginal contribution is

$$E \sum_{h=1}^{1} \frac{1}{2^{k+1}+1} \frac{h}{2} E[y(W_i)]$$

$$1 \leq h \leq \lceil (1-\alpha)2^{k+1} \rceil.$$ 

$$= \sum_{h=1}^{1} \frac{1}{2^{k+1}+1} \frac{h}{2} 2^{-k} y(W)$$

$$1 \leq h \leq \lceil (1-\alpha)2^{k+1} \rceil.$$ 

$$= y(W) \left[ \frac{(1-\alpha)^2 2^{2k+2} + (1-\alpha)2^{k+1}}{2^{2k+3} + 2^{k+2}} \right] + o(k).$$

In the limit as $k \to \infty$, one has

$$\phi_q(\{0\}) = \frac{y(W)(1-\alpha)^2}{2}.$$ 

At each stage $k$, one has

$$\nu(W_i) = \frac{\theta u(W_i)}{\mu(W)} = 2^{-k} \theta$$

and

$$\nu(P_i) = \frac{(1-\theta)\mu(P_i)}{\mu(P)} = 2^{-k} (1-\theta).$$

We now seek the expected marginal contribution of $P_i$ in the game at stage $k$. 
The only time \( P_i \) makes a positive marginal contribution is when \( P_i \) is pivotal, that is when \( B_1 \cup B_2 \cup \ldots \cup B_h \cup P_i \) is not losing and \( B_1 \cup B_2 \cup \ldots \cup B_h \) is losing. For \( P_i \) to be pivotal, \( \emptyset \not\subset B_1 \cup B_2 \cup \ldots \cup B_n \) and 
\[
(1-\alpha) - 2^{-k}(1-\theta) \leq \nu(B_1 \cup B_2 \cup \ldots \cup B_n) < (1-\alpha).
\]

From the limiting argument underlying Proposition 1, the probability of such an event is \( \alpha 2^{-k}(1-\theta) + o(k) \), for \( k \) large enough.

From the binomial distribution, the expected value of \( y(B_1 \cup B_2 \ldots \cup B_h) \) is
\[
E(y(B_1 \cup B_2 \cup \ldots \cup B_h)) = \frac{h}{2} y(W_i).
\]

By the central limit theorem, for \( k \) large enough,
\[
h = (1-\alpha)2^{k+1} + o(k).
\]

Hence, the expected marginal contribution of \( P_i \) at stage \( k \) is
\[
\alpha 2^{-k}(1-\theta)y(W)(1-\alpha) + o(k).
\]

Summing over the \( i \), and taking the limit as \( k \to \infty \),
\[
\phi_q(P) = \alpha(1-\theta)(1-\alpha)y(W)
\]

By efficiency
\[
\phi_q(W) = y(W) - \phi_q(\emptyset) - \phi_q(P)
\]

implies
\[
\phi_q(W) = \left[ \frac{1+\alpha^2}{2} + \alpha(1-\alpha) \right] y(W).
\]

A similar argument for \( q \) leads to
\[
\phi_q(\emptyset) = \frac{(1-\alpha)^2}{2} y(P)
\]
\[
\phi_q(P) = \left[ \frac{1+\alpha^2}{2} + \alpha(1-\theta)(1-\alpha) \right] y(P)
\]
\[
\phi_q(W) = \alpha(1-\alpha)y(P).
\]
Finally, by linearity of the Shapley value, \( \phi_q = \phi_{q'} + \phi_{q''} \). Since \( y(W) + y(P) = y(T) \), one has

\[
\begin{align*}
\phi_q(\{O\}) &= \frac{(1-\alpha)^2}{2} y(T) \\
\phi_q(\bar{P}) &= \frac{1+\alpha^2}{2} y(P) + \alpha(1-\theta)(1-\alpha) y(T) \\
\phi_q(W) &= \frac{1+\alpha^2}{2} y(W) + \alpha \theta(1-\alpha) y(T).
\end{align*}
\]
Appendix 2. Data

The following data are used in the estimation of the model:

<table>
<thead>
<tr>
<th>Year</th>
<th>( e(P) )</th>
<th>( \Theta )</th>
<th>( Y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1925</td>
<td>.123</td>
<td>.735</td>
<td>2.73</td>
</tr>
<tr>
<td>1926</td>
<td>.152</td>
<td>.741</td>
<td>2.86</td>
</tr>
<tr>
<td>1927</td>
<td>.153</td>
<td>.727</td>
<td>3.06</td>
</tr>
<tr>
<td>1928</td>
<td>.147</td>
<td>.771</td>
<td>3.03</td>
</tr>
<tr>
<td>1929</td>
<td>.224</td>
<td>.783</td>
<td>3.22</td>
</tr>
</tbody>
</table>

The \( e(P) \) series from Karcz [10, Table 2] and Nove [12, p. 180 and 186], is the ratio of state grain procurement to the total grain harvest. The average for the years 1925-29 is 16.0%. During the collectivization period of 1930-33, \( e(P) \) was .265, .328, .266, and .330 respectively, for an average collection rate of 29.7%. Collectivization nearly doubled the collection rate. In contrast to a rising \( e(P) \) during 1925-29, one observes sharply falling \( p \) [12, p. 157]. The ratio of official to private prices falls from .91 in December 1926 to .44 by June 1929.

The \( \Theta \) series is constructed from Rigby [13, p. 116]. Following Soviet sources, Rigby divides the data into three classes—workers, peasants, and employees. The \( \Theta \) series aggregates the worker and employee figures.

The \( Y \) series is the ratio of GNP to value of agricultural production. This constructed from the Soviet input-output table of 1924, the Johnson-Kahan index of agricultural production [9] and the GNP data in Bergson [4].

All these series rest ultimately on Soviet data. To the extent that the Soviet data is itself unreliable, the precision of these series cannot be vouchsafed. As Rigby says of the \( \Theta \) series, "While the precision of these
percentages should not be exaggerated, being distorted not only by error and misinformation, but also by changes of classification, as we shall see below, they appear to be accurate enough to give a reliable impression of general trends." Indeed, the overall trends of rising e(P), rising θ, and rising γ are generally accepted. The ultimate meaning of any Soviet data is that it is collected for and used by the party leaders.
REFERENCES


