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Drift in Producer Price Indices for the Former Soviet Union Countries

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This paper shows that, under the price fluctuations that characterize most transition economies, the commonly used chain index derived from the published month-to-month price change of the producer price index (PPI) in most cases dramatically overstates the rate of price inflation. This drift, which is due to the use of a nonstandard formula, could affect any price index compiled with the same nonstandard formula. The drift declines with slower rates of inflation but is still important for countries in which monthly inflation continues to run at nearly 10 percent. [JEL C43, C82, E31]

ECONOMISTS who have worked with former Soviet Union (FSU) price data have noted the striking difference between the cumulative price increase derived by chaining the reported monthly producer price index (PPI)[1] and the reported change of this index over 12 months.[2]

The purpose of this paper is to show that, in the context of the price fluctuations characterizing most transition economies, a chain index derived from the month-to-month price change of the PPI dramatically overstates the rate of price inflation in most cases. The analysis is based in part on a seminal paper by Szulc,[3] who studied the problem of drift for

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[1] The PPI is often referred to as the Wholesale Price Index (WPI) or, in Russian, as *optoviy*. This nomenclature is misleading as the observed prices are, in fact, producer prices (ex-factory gate) and not wholesale prices.

[2] See Koen and Phillips (1992, 1993).

[3] See Szulc (1983).

a wide class of index formulas, and in part on observations made by the IMF's technical assistance missions on price statistics of detailed price movements in the FSU countries. Greatest during the year 1992, the drift declines with slower rates of inflation (and possibly with changing patterns of price increases) but remains important for countries in which monthly inflation continues to run at nearly 10 percent.[4]

Consequently, the current version of the PPI should not be used as a deflator of the value of production to obtain a volume indicator. Indices of industrial production so derived would largely underestimate the growth (or overestimate the decline) in output. As the bias under discussion is measured in relation to the Laspeyres standard, the overestimation of price change would be effectively eliminated if the basis for calculation of the PPI were changed to a Laspeyres formula.

The paper also provides an explanation for the difference between the chained monthly index and the $t/t - 12$ version of the PPI and guidance on which of these indices should be used.

I. A Nonstandard Formula

Probably because producer price indicators were used to monitor a central economic plan, a time series with a fixed reference base was of less interest to users of the data than a set of indicators comparing prices in the current month with those of the previous month, and those of the current month with those of the same month in the previous year. These specialized comparisons were formed by averaging the price relatives appropriate for the time period under consideration with a set of weights from a fixed reference period. To form a fixed reference base series from the monthly data compiled in this fashion, it was necessary to chain the monthly indices together. If the index formula implied by this practice is examined, it can be seen as a slight generalization of the Sauerbeck index studied by Szulc (1983), and it might therefore be called "the generalized Sauerbeck index."[5]

[4]The problem with the producer price index formula that is the subject of this paper would also exist with any other price index, including the consumer price index (CPI), if this index was using the same nonstandard formula. Correction of this problem should therefore be undertaken wherever it is encountered. Fortunately, most of the FSU countries have introduced a new CPI using standard Laspeyres formulas with the assistance of the IMF's Statistics Department. In fact, the problem may not be limited to transition economies. An interesting instance of similar linking problems seems to have occurred at low levels of aggregation in the U.S. CPI, although with less serious consequences (see Moulton (1993)).

[5]Szulc refers to a chain of unweighted averages of price relatives for adjacent

II. The Generalized Sauerbeck Index versus the Laspeyres Index

The generalized Sauerbeck (GS) index formula used in the producer price indices of a number of FSU countries is

$$P_{GS}^{0,t} \equiv \prod_{\tau=1}^{t} \sum_{i=1}^{n} w_i^0 \frac{p_i^\tau}{p_i^{\tau-1}}. \tag{1}$$

In this formula, the i subscript indexes item, the t superscript indexes time period (month), the 0 superscript represents the base period, p represents price, and w represents the item weight from the base period. From the formula, it can be seen that this is a chain of fixed-weighted averages of short-term price relatives.

The Laspeyres index formula (L) is

$$P_L^{0,t} \equiv \prod_{\tau=1}^{t} \sum_{i=1}^{n} \left[\frac{w_i^0 \dfrac{p_i^{\tau-1}}{p_i^0}}{\sum_{i=1}^{n} w_i^0 \dfrac{p_i^{\tau-1}}{p_i^0}} \right] \frac{p_i^\tau}{p_i^{\tau-1}}, \tag{2}$$

which, as shown, can also be expressed as a chain of averages of short-term price relatives, but in contrast with equation (1), with weights that vary from period to period. The formulas in equations (1) and (2) look deceptively similar and, by inspection, are in fact identical for the first time period after the base period, when $t=1$.

However, Szulc (1983) shows that negative serial correlation, under which the relatives assume higher than average values that are followed by lower than average values and vice versa, induces an upward bias in the Sauerbeck formula when compared with the Laspeyres formula. Positive correlation, which is characterized by more uniform price changes across commodities, results in a downward drift in the Sauerbeck index.

III. Szulc's Argument

To specialize Szulc's notation somewhat for the purpose of this paper, let

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pairs of time periods as "the Sauerbeck formula." The formula used in FSU countries is a chain of weighted averages of price relatives in which the weights remain constant from period to period—hence the term "generalized Sauerbeck."

$$r_i^t \equiv \frac{p_i^t}{p_i^{t-1}}$$

$$y_i^t \equiv \frac{q_i^{t-1}}{q_i^0}$$

$$c_i^t \equiv w_i^0 \frac{p_i^{t-1}}{p_i^0}. \tag{3}$$

In the language of practitioners, the first item is the "short-term price relative," the second is the "long-term quantity relative," and the last is the "cost weight."

The chain form of the Laspeyres index in equation (2) can then be expressed as

$$P_L^{0,t} = \prod_{\tau=1}^{t} \frac{\sum_{i=1}^{n} c_i^\tau r_i^\tau}{\sum_{i=1}^{n} c_i^\tau}. \tag{4}$$

For comparative purposes, one may select any chain index (including the generalized Sauerbeck) with period-to-period links that can be expressed as an average of short-term price relatives and assume that the weights are revised and a new link is introduced every period. In this case (if several minor algebraic steps are omitted) the chain index can be expressed in terms of the cost weights of the Laspeyres index as

$$P_C^{0,t} = \prod_{\tau=1}^{t} \frac{\sum_{i=1}^{n} c_i^\tau r_i^\tau y_i^\tau}{\sum_{i=1}^{n} c_i^\tau y_i^\tau}. \tag{5}$$

Szulc defines the cumulative drift of the chain series in relation to its "direct" Laspeyres counterpart as the ratio of (5) to (4) and applies a theorem of Bortkiewicz to show that the drift can be written as

$$\prod_{\tau=1}^{t} (1 + corr(r^\tau, y^\tau) cv(r^\tau) cv(y^\tau)). \tag{6}$$

In equation (6), $corr(r, y)$ refers to the correlation between r and y, and $cv(r)$ and $cv(y)$ refer to the coefficients of variation of r and y. (The cv is the ratio of the standard deviation to the mean.) In each period, both the direction and magnitude of drift critically depend on the (cost-weighted) correlation across items between the short-term price relatives (r) and the long-term quantity relatives (y), $corr(r, y)$. The terms in equation (6) that depend on (cost-weighted) coefficients of variation

($cv(r)$ and $cv(y)$) can increase the magnitude of drift, but do not affect its direction.

Szulc then proves that, in the Sauerbeck index case, $corr(r, y)$ is positive if prices tend to bounce, leading to an upward drift in the index.[6]

The potential for bias resulting from use of the Sauerbeck formula is dramatically illustrated by Szulc's "bouncing" price relatives example.[7]

Period:	0	1	2	3	4
Price of A:	1	2	1	2	1
Price of B:	2	1	2	1	2

In this case, the direct index (which directly compares period 4 to period 1) is equal to 1 in period 4, while the chained index is equal to 2.44—a drift factor of 2.44 over an interval of five periods.

IV. Relevance to the Context of FSU Countries

Strong negative serial correlation in the relatives and high variability in rates of price change across items is typical of both market economies encountering unanticipated sectoral shocks and transition economies. In the latter case, price movements are characterized by price "liberalization" in fits and starts, sector by sector, as the government resets prices according to evolving notions of their equilibrium levels and political feasibility. Under these conditions, monthly price relatives for selected classes of goods typically follow a pattern of assuming a value of unity, then a value substantially greater than unity, then unity again. Since higher than average values succeed lower than average values, this form of price adjustment produces bouncing in relative prices, that is, negative serial correlations in the monthly relatives.

Therefore there is a strong case that the generalized Sauerbeck PPI will show a significant upward drift when compared with the direct index, which is the "corresponding month of the previous year"—or "$t/t - 12$"—version of the PPI.

[6] The opposite holds true when the same tendency of relative price change persists during the entire period, from the base time, 0, to the target time, t. Szulc's demonstration on the Sauerbeck index is applicable to the generalized Sauerbeck index.

[7] The example uses the Sauerbeck formula and thus equally weights the price relatives in constructing each chain link.

Table 1. *Producer Price Indices in Selected FSU Countries*
(Percent change from December 1991 to December 1992)

	Russia	Kyrgyz Republic	Estonia	Kazakhstan
GS index	+6,097	+4,131	+2,125	+12,490
t/t − 12 index	+3,275	+2,002	+1,261	+3,816
Drift	1.84	2.01	1.63	3.22
	Latvia	**Turkmenistan**	**Ukraine**	**Armenia**
GS index	+1,920	+8,808	+9,668	+765
t/t − 12 index	+1,324	+1,515	+4,128	+1,106
Drift	1.42	5.52	2.31	0.72

Note: The drift is expressed as the inflation measured by the GS index divided by the inflation measured by the (*t/t* − 12) index. It is therefore equal to [GS index + 100] / [*t/t* − 12 index + 100]. For example, in the case of Russia, it is equal to 6197/3375.

V. Evidence

The available evidence strongly supports the proposition that the pattern of price changes in FSU countries in 1992 approximated conditions leading to an upward drift of the generalized Sauerbeck month-to-month chained index in most republics.[8] This evidence also indicates that the drift can be large. As shown in Table 1, the GS index produces estimates overshooting of actual annual inflation from a factor of 1.42 in the case of Latvia to a factor of 5.52 in the case of Turkmenistan, for the period December 1991–December 1992. For the Russian Federation, the factor was 1.84 for the same period. Armenia is the only country in which the measured drift was downward in 1992.

More recent results for the Russian Federation and Kazakhstan show that, although the annual drift has diminished from the peak of December 1992,[9] it has still been quite significant in 1993 (see Table 2).

VI. Conclusions

The generalized Sauerbeck index clearly should not be used as a measure of producer price change—particularly under conditions of high inflation and negative serial correlation in short-term rates of price

[8] The data needed to calculate drift are not available in all republics of the former Soviet Union.

[9] December 1992 registers the highest yearly drift. The year 1992 began with a large price shock in January, making it the most inflationary annual period in these countries in recent years.

Table 2. *Annual Drift in the Producer Price Index*

	Russian Federation	Kazakhstan
December 1992	1.84	3.21
January 1993	1.58	1.62
February 1993	1.40	1.40
March 1993	1.34	1.11
April 1993	1.36	1.90
May 1993	1.32	1.96
June 1993	1.32	1.52
July 1993	1.32	1.39

change. To use it under these conditions as a deflator for the value of output leads to underestimated growth (or, more precisely in the case of FSU countries, to overestimated decline) in industrial production. Although it has certain conceptual shortcomings,[10] the $t/t-12$ version of the PPI is definitely a better measure of inflation for a specified one-year period.

There are, therefore, three possibilities for an economist desiring monthly constant price indicators for the FSU countries: (1) use other deflators than the current PPI, (2) use other figures based directly on quantities or volume of production if available, or (3) wait for the national compilers to implement a Laspeyres PPI. This has been achieved in some countries in cooperation with IMF Statistics Department technical assistance missions on price statistics.

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[10] For example, the base period, 0 in w_{i0}, is in general not the same as the $t-12$ period for the price relative, p_{it}/p_{it-12}, as would be required by the Laspeyres formula.