Soviet industrial production, 1928–1950: real growth, hidden inflation, and the 'unchanged prices of 1926/27'

*Mark Harrison**

Department of Economics
University of Warwick
Coventry, England CV4 7AL
+44 1203 523030 (direct)
+44 1203 523032 (fax)
+44 1203 523055 (secretary)
Mark.Harrison@warwick.ac.uk

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> 'It is as if we tried to measure how much a caterpillar grows when it turns into a butterfly' (Nutter (1962), 111).

In this paper I review the traditional thinking of western economists about hidden inflation in Soviet historical growth series in the light of new archival documentation of Soviet statistical practices. In part 1 I show how Soviet hidden inflation in the 'unchanged prices of 1926/27' was identified as an issue for scholarly research. Parts 2 and 3 review existing hypotheses concerning the operation of the 'unchanged prices' before and after the reform of 1935 as a regulatory mechanism in the light of newly available archival documentation. Part 4 reconsiders the fixing of 'unchanged' prices for new products and models as a mechanism of Soviet hidden inflation in the light of index number theory and western statistical practice. Part 5 concludes.

1. The role of hidden inflation

Soviet economic power made an important contribution to the Allied victory in World War II. After the war, evaluating the Soviet Union's economic performance became a major activity for western economists. Of those who contributed to research on the early stages of Soviet industrialisation (for present purposes, the years before 1950), most significant was the group which Abram Bergson gathered in the United States. Prominent among the members of the Bergson group who will feature below were Norman Kaplan, Richard Moorsteen, and Raymond Powell. Others in the United States included Alexander Gerschenkron, Donald R. Hodgman, Naum Jasny, and G. Warren Nutter. From the United Kingdom contributions were made by Colin Clark (who had begun to work in this field even before the war) and Francis Seton. Much more recently Grigorii Khanin in Russia has added new historical research.

According to the official figures of the Soviet era, between 1928 and 1950 Soviet national income had multiplied by more than 8 times, and industrial production by more than 11 times in real terms.[1] The underlying series, expressed in the 'unchanged prices of 1926/27', are shown in table 1. Western economists concurred in the opinion that these high official growth estimates were a product of five main factors: real product growth, the increasing

[1] The official Soviet statistical office was TsSU (the Central Statistical Administration) until 1930 and from 1941 onwards. For almost two years in 1930–1 it had no independent existence. Between 1931 and 1941 it existed under another name, TsUNKhU (the Central Administration for National Economic Accounts), directly subordinate or attached to Gosplan (the State Planning Commission).

comprehensiveness of product coverage, the increasingly roundabout character of production, index number relativity, and hidden inflation.

First of these was the growth of real output reflected in such official indicators as the rise of the grain harvest (110 percent of 1928), potato yields (twice 1928), steel output (6–fold), electric power (18–fold), metal–cutting machine tools (35–fold), mineral fertilizer (40–fold), bicycles (60–fold), synthetic fibres (400–fold), and road vehicles (500–fold).[2] Not every such claim deserves credence; for example, in the case of agriculture, claims for later years were inflated in comparison with earlier years by an unacknowledged switch from measures based on the crop harvested and stored (the 'barn yield') to the crop standing in the field (the 'biological yield'). In industry, on the other hand, the upward trend was undeniable.[3]

Second was an upward bias arising from the changing coverage of official statistics. After 1928 there was a substantial decline in the supply of processed foods, clothing, footwear, and wooden products from small–scale rural household and artisan sources, and a transfer of these activities to large–scale factory industry. As a result, the measured output of consumer products grew by substantially more than the real increase in availability from domestic supply.

Third were biases arising from the application of the officially preferred output concept, based on aggregating the gross value of output (GVO) leaving each farm and enterprise at each stage of production. One result was to give an excessive weight to intermediate products, which were double-counted. Since the output of final products grew more rapidly than that of intermediate products, for a given number of stages of production a downward bias was introduced.[4] On the other hand, as production became more roundabout, the gross value of output could be increased without any change in value added simply by multiplying the number of stages at which output was reported.

Fourth was index–number relativity. The Soviet methodology aggregated a wide range of long data series, some growing with exceptional rapidity, other growing much more slowly or not at all, using early–year weights – the so–called 'unchanged prices of 1926/27'. Since changes in prices and quantities were observed to be negatively correlated over time, the use of early–year weights gave a high reading in volume indexes, and a low reading for price change. To this extent the figures were not wrong or misleading, but they did set an upper bound for real growth and therefore a lower bound for inflation.

Fifth was hidden inflation, which many came to believe accounted for a significant residual. This residual is illustrated in table 2, which compares

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[2] TsSU (1956), passim.

[3] On the 'biological yield', see Wheatcroft and Davies (1994b), 114–16. On the reliability of figures for physical output in Soviet industry see Grossman (1960).

[4] For a survey of such biases see Harrison (1996), 58–66.

independent with Soviet official estimates for national income, industrial production, and machinery production. Three points are important for us, and these emerge clearly despite the divergences among the various independent authorities. First is the strong index number effect revealed whenever estimates based on early years are compared directly with late–year estimates (e.g. Bergson on national income, or Nutter or Moorsteen on machinery production). Second is that, even allowing for the Soviet preference for an early base year, and despite a degree of unevenness in the western attempts to correct for other biases, hardly anyone was able to replicate the very high figures published by TsSU.[5] Third, the table reveals considerable variation among different independently estimated figures, not all of which deserve to be taken equally seriously. The variation is generally attributable to differences of basic data, statistical coverage, choice of weights, and adjustments made for changes in product assortment and quality.

With regard to the latter it is noteworthy that the most important outright disagreements among western studies were concentrated on the machinery sector, where product innovation was most rapid. In table 3 alternative estimates are shown for four selected industry branches (machinery, ferrous metals, food products, and textiles) using weights of the 1920s, 1930s, and 1950s. Hodgman's figures are restricted to large–scale industry and his estimates for food products and textiles are inflated relative to the others by neglect of the decline of small–scale industry in the early 1930s. When this is taken into account, the table shows that machinery was the main source of outright disagreement among the western studies.

Thus part of the gap was attributable to such uncontrolled aspects as the Soviet preference for a material product concept (in the case of national income) or a GVO–based measure (in the case of industrial production), or Soviet secrecy which resulted in a lack of data on military products (in the case of industrial production and especially machinery). Nonetheless, these were clearly insufficient to account fully for the gap which emerged whenever western and Soviet early–year figures were compared directly; the residual, therefore, was to be explained by some mechanism of hidden inflation in the Soviet methodology.

Significantly, none of the western researchers saw deliberate fabrication as sufficient to explain this gap. Before the war Colin Clark had written: 'It is not permissible to accuse the Russian statisticians of deliberate distortion of the figures in order to overstate the productive achievements of their country. If this had been their aim, they would have distorted or suppressed the figures showing the decline in agricultural production between 1929 and 1932, which, as we have

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[5] Among the biases which were difficult to correct were changes in coverage (thus for example Hodgman's study was limited to large–scale industry only) and changes in the gross–output–to–value–added ratio. An exception to the general rule that Soviet official claims could not be replicated was Moorsteen on machinery production at early–year prices, a 'paradox' to which I return below.

seen, they made no attempt to do'.[6] As was revealed after the war by the Soviet 1941 economic plan captured first by the Germans, then the Americans, Soviet economic data were either published, or else subject to different levels of security classification, but the secret and open data were broadly consistent. Thus in 1947 Alexander Gerschenkron could state firmly: 'Serious students of the Russian economy agree that the Russian practice is to withhold certain statistical information rather than to falsify it'.[7] The same observation led Bergson to describe the withholding of information as itself 'something of a testimonial to the reliability of what actually is published'.[8]

Possibly this went too far. As has already been mentioned, the agricultural figures for 1932 had indeed been manipulated in order to exaggerate the availability of foodstuffs in the latter year; the true decline was even greater than was acknowledged. But it is characteristic that the manipulation involved the secret substutition of one methodology for another ('biological yield' for 'barn yield'), not by suppressing true figures in favour of others fabricated solely for publication. The sweeping archival revelations of recent years have confirmed this picture in all but a few exceptional cases.

Instead of searching for lies, therefore, western scholars were right to look instead for mechanisms of distortion, methodologies which would lead to exaggerated real growth estimates without any deliberate intentions or special instructions to lie. They believed they had found one of the most important such methodologies in the 'unchanged (*neizmennye*) prices of 1926/27'.

2. The 'unchanged prices of 1926/27' as a regulatory mechanism

Origins

The product prices used to weight the official growth series were supposedly based on the economic year 1926/27 (until 1931 the Soviet economic year ran from October to September, from one harvest to the next). In the 1920s it was normal to use 1913 prices for the purpose of real product comparisons. By 1928 the prewar base year was perceived as having become obsolete; the period before World War I was increasingly distant, and there was a growing range of industrial products for which '1913' prices had to be invented – a procedure which, as one commentator put it, included having to estimate the cost which would have been incurred in 1913 to make products not yet invented using technological processes which hadn't yet been developed.[9] Hence the switch to a

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[6] Clark (1939), 46.

[7] Gerschenkron (1947), 217.

[8] Bergson (1953), 7–9n.

[9] Rotshtein (1936), 239.

new base year, 1926/27.[10] Within a few years, however, the new system would be afflicted by the same problems as the old one. They were called ‘1926/27 prices’ but, with model changes and new products, it was soon the case that only a small subset of those in use had ever been employed in a realised commodity transaction in the year 1926/27 itself.

As is widely understood, prices play many possible roles in an economic system – signalling, motivational, distributional, accounting, monitoring, and so on. The ‘unchanged prices of 1926/27’ were used for accounting and monitoring, and for these purposes alone, within the Soviet statistical and planning bureaucracy between 1928 and 1950. These were therefore prices of a particular kind. They were the standard of value used to compile many production and supply plans and to report results. This meant they formed important success indicators for most public–sector enterprises and production–branch ministries (other important plans and indicators were given in physical units of output). As such, they also provided the basis for officially published claims with regard to the real growth of industrial production and national income. But the primary motivation behind the ‘unchanged’ prices did not come from disinterested statisticians. It came from the needs of planners struggling to mobilise industry to greater efforts, who required a standard of value in which to denominate the aggregate production quotas of enterprises and ministries producing heterogeneous products. They fixed these quotas in terms of the gross value of output (GVO) measured in ‘unchanged’ prices and distributed both monetary and nonmonetary rewards according to the degree of fulfilment. Such a standard of value was not provided by current prices, since the environment was strongly inflationary and would have provided plenty of scope for self–interested producers to fulfil plans by raising prices rather than quantities, given the asymmetric distribution of information in the command system.

Problems

By 1933 the system of ‘unchanged’ prices had become associated with significant regulatory problems. The product prices in which producers’ performance was measured were ‘unchanged’, but this did not eliminate the scope for producers to behave opportunistically. Producers sought to exploit disparities in the relationship between ‘unchanged’ product prices and prevailing costs to their own advantage. In addition, there was a contest between producers

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[10] For an alternative explanation see Sh. Turetskii (1935), 62: ‘The very transition from unchanged prewar prices to unchanged prices of 1926/27 was a fact of huge political significance. This transition was met with a bayonet–charge by wreckers of every stripe. Separation from the prewar umbilicus in valuing output was perceived by Menshevik planners and statisticians as a blow against their attempts to use planning as a tool for restorationist and counterrevolutionary work’. The serious point which Turetskii went on to make was that 1926/27 was a good base year because it was marked by a normalisation of price relativities after the monetary reform of 1924, including success for government price controls aimed at a relative lowering of industrial product prices and costs.

and regulators for control over the setting of prices. As a result, planners controlled the relationship between producer efforts and rewards with growing difficulty.

One way of classifying these difficulties is in relation to existing products, improved products (when existing products are subject to quality change), and new products. It's helpful to think of product change in terms of attributes or characteristics. Identical products have identical attributes. The quality change involved in incremental product improvement may be defined by the enhancement or combination of existing attributes. A personal computer, for example, is simply a bundle of functions previously performed by a pocket calculator, a typewriter, a file index, and so on, differentiated from these by speed, capacity, and compatibility. There is some point at which the enhancement or new combination of existing attributes creates new attributes. According to Richard Stone, 'A quality change is a change in product which can be accommodated within the base–period system of values [of product attributes]; a new product involves a change which cannot be so accommodated'.[11] Thus new products involve the creation of new attributes which satisfy new wants. The fact that we may be unsure when this point is reached is itself of some importance since it creates a fuzziness in the explanation of price change: is a given price change justified by the utility derived from a new attribute which was previously unavailable at any price, or is it inflationary? Sometimes, only time will tell.

For purposes of identifying historical trends in product quality it may further be useful to distinguish two different kinds of attributes, those of capacity and those of performance. Capacity attributes are evident when the product leaves the factory: for consumer goods, size, weight, colour, finish, uniformity, variety; for machinery, cubic capacity, power–to–weight, volts and watts. Performance attributes such as durability, energy–efficiency, and fitness–for–purpose become evident later, when the product is in use. In a seller's market capacity attributes are more easily controlled than performance attributes. Associated with this, no doubt, was further scope for producer opportunism at the time. Variations in performance attributes were commonly ignored in Soviet product documentation, as in the investigations of western economists. During the 1930s the capacity attributes of machinery products improved more or less continuously, but performance attributes followed a U–shaped path with deterioration under the first five–year plan followed by recovery.[12] The neglect of performance attributes in both documents and literature is a defect which I note, but cannot make good.

Corresponding to the distinction between existing, improved, and new products, the three regulatory problems associated with the early years of the Soviet system of 'unchanged' prices were the issues of multiple pricing of existing products, the adjustment of prices to product improvements, and the pricing of new products.

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[11] Stone (1956), 58.

[12] Davies (1994), 139.

Multiple pricing

'Unchanged' prices were fixed at the enterprise level. For existing products this was supposed to be the historical price of 1926/27.[13] But in the market economy conditions of 1926/27, different prices had been charged for identical commodities by different producers and to consumers in different localities. In some branches, multiple pricing of identical existing products created scope for opportunistic behaviour in the ministry – by forcing output in factories and regions where the ratio of the historic 'unchanged' price to current costs had moved relatively advantageously, ministries could fulfil their plans for less effort.[14]

Product improvements

In some branches, a single average 'unchanged' price was credited to enterprises for several different grades of output. The enterprise's assortment plan specified the mix of grades to be produced, but the gross–value–of–output plan was measured as a sum of rubles in 'unchanged' prices. Enterprises which concentrated on higher–grade products were penalised in terms of a reduced ratio of rewards to efforts.[15] Alternatively, enterprise targets for gross value of output could be met with least effort by biasing the assortment towards lower–grade products.

New products

The years after 1928 saw widespread product innovation in Soviet industry, especially (not exclusively) in machinery. Much of this innovation was associated with the substitution of home machinery products for machinery previously imported. While we lack any comprehensive measure from that period, it was being said by the mid–1930s that the number of commodities being produced which could be matched with the assortment of 1926/27 was already 'comparatively small'.[16] The immediate problem this created was how to price

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[13] '[S]upposed to be', because even for products actually produced in 1926/27, it was said that the 'unchanged' price was often based on some other year (I. Turetskii (1934), 39).

[14] For official recognition of this problem see RGAE, 4372/23/76, 3–4 (Mezhlauk to Sovnarkom, 25 October 1934).

[15] Again see RGAE, 4372/23/76, 14–27 (Mezhlauk to Sovnarkom, 25 October 1934); RGAE, 4372/33/154, 43 (Narkompishcheprom (People's Commissariat of the Food Industry) to Gosplan, 23 February 1935).

[16] Rotshtein (1936), 246. By 1940, according to Sh. Turetskii (1948), 380, only 30 percent of machinery output was directly comparable with the product profile of 1932. According to sources cited respectively by Jasny (1951b), 105, and Nove (1957), 119, the degree of continuity of machinery output from one year to the next was estimated in the late 1940s at only 50–60 percent; in the year 1953, over one quarter of machinery products of the typical machinebuilding enterprise

new products on a ‘1926/27’ basis when compiling the plan quotas and the reports by which plan success and failure were measured.

In the early years of ‘unchanged’ prices, new products would be chained into the system on the basis of either ‘the price relating to the initial moment of mass production of the given type of product, or the average for the first three months of its manufacture’.[17] The significance of this is that new products were usually valued at the high costs characteristic of pilot production in the early phase of the innovation cycle, when volume was low and the markup for overheads was high.[18] Once new–product costs began to fall with mass production, the enterprise could fulfil a given GVO quota made up by new products with much less effort than with old products at ‘unchanged’ prices based on high volume and low unit costs. [19]

One important way for producers to improve the ratio of reward to effort was to concentrate efforts on new products.[20] Another strategy for enterprises and ministries was to press for incorporation of new products into GVO at as high an ‘unchanged’ price as possible.[21] With the setting of ‘unchanged’ prices for new products in the hands of enterprises, surveys revealed great disparities in

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was said not to be comparable with the previous year’s output. In the 1970s, unique products accounted for half the output of the machine–building and metalworking (MBMW) sector; in addition, between 10 and 17% of the MBMW product profile was renewed annually according to CIA (1980), 6–7.

[17] Rotshtein (1936), 241.

[18] I. Turetskii (1934), 39; Sh. Turetskii (1935), 63; Rotshtein (1936), 241–3; Gerschenkron (1947), 219–20; Jasny (1951b), 96–7; Nutter (1962), 111, 154. A countervailing influence in the early 1930s, however, was the subsidy of machinery production and prices. This was a factor which some western economists took more seriously than others. Dobb (1948), 35, argued this in a strenuous defence of the official Soviet practice, and Bergson (1961), 185, was willing to grant it some credence in the light of the relative stability of machinery prices observed in the 1930s.

[19] Sh. Turetskii (1935), 63.

[20] In principle such efforts could also take the form of what Berliner (1976), 375–80, called ‘simulated innovation’: the enterprise relaunches old products with insigificant changes, or changes for the worse, solely in order to shift the enterprise to a new–product regime of higher ‘unchanged’ prices (see also Nutter (1962), 154; CIA (1980), 6–7; Pitzer (1990), 307). There is no direct evidence on this score, however, from the 1928–50 period.

[21] Seton (1952), 352–3; Nove (1957), 119, 121.

procedures and criteria employed, with corresponding scope for arbitrary price–fixing.[22]

Open inflation

Soviet commentators did not mention, but were surely well aware of a further complicating factor. This was the general, unconcealed inflation which was already under way and accelerating in 1928, and which persisted through the 1930s. For illustration consider table 4, which shows a rise in Bergson's implicit GNP deflator between 1928 and 1937 of between 3 times (using 1937 quantity weights) and more than 5 times (using weights of 1928). This table also suggests large relative price effects within the aggregate, with retail product prices multiplying, the prices of basic industrial products merely doubling, and machinery prices rising somewhat or even falling. The trend of machinery prices was particularly significant given the high incidence of product innovation in that sector. But whatever the absolute level of machinery prices after 1928, the significance of the general inflation was to raise the prices of new products above the level at which they would have been introduced had the general price level remained stable. Thus the price level at which new products were chained into the measure of gross output at 'unchanged' prices was inflated relative to the historical 1926/27 level not only by the high relative costs of pilot production, but also by the rising level of all costs.[23]

New–product pricing and hidden inflation

In addition to their real impact on the allocation of resources within the enterprise, we may also think of the statistical influence on hidden inflation arising from producers' opportunistic behaviour with respect to existing, improved, and new products. Their inflationary effect depended strictly on the extent to which producers successfully made use of their opportunities. If the opportunities were realised, the result would be to shift adversely the ratio of real output to output at 'unchanged' prices. Naturally, such behaviour was rarely admitted. Rather, producers complained of the penalties attached to not behaving strategically.[24]

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[22] RGAE, 4372/31/66, 146–145 (memo to Rozovskii (chief of sector for machinebuilding) and Turetskii 'On methods of computation of 1926/27 prices for new products', 7 September 1933).

[23] Gerschenkron (1947), 219–20; Jasny (1951b), 96–7; Nutter (1962), 154.

[24] For example RGAE, 4372/31/104, 302–301, a circular within Narkomles (the People's Commissariat of the Timber Industry), not dated but 1933, informing of a new schedule of 'unchanged' prices for use in 1934, explaining that the old 'unchanged' prices, differentiated by region but not by product quality, had understated growth both by undervaluing the products of the northern and eastern regions, and by failing to reflect the increase in high–quality products; this claim was repeated in circulating the 1935 handbook (RGAE, 4372/33/156, 360–360ob); likewise, RGAE, 4372/33/154, 43 (Narkompishcheprom (People's Commissariat of the Food Industry) to Gosplan, 23 February 1935).

Western observers identified the procedure for new–product pricing as the most significant opportunity for hidden inflation. They argued that there must be a growing disparity in the measure of industry gross output between old products already in mass production and valued at ‘unchanged’ prices based on low unit costs, and new products valued at the high costs of pilot production.[25] If rapidly growing new products were overweighted relative to slowly growing old products, index numbers of industrial growth must be biased upwards.

Limited published evidence from the early 1930s confirmed that in those sectors most liable to product innovation, such as machinebuilding, ‘unchanged’ prices tended to track prevailing wholesale prices closely, suggesting a breakdown of the distinction between them.[26] This evidence is confirmed from archival sources which show GVO of group ‘A’ (means of production) industry in 1933 at prevailing wholesale prices as 3 percent less than in ‘unchanged’ prices, compared with 16 percent more for group B (means of consumption).[27] More detailed figures from the archives for 1935, the last year of the old ‘unchanged’ prices, showing industry by commissariat, are reported in table 6. This table shows that for heavy industry, where product innovation and real growth were both rapid, ‘unchanged’ and prevailing prices were virtually identical. In the light and food industries, however, where product innovation and real growth were both more sluggish, the change in ‘unchanged’ prices lagged far behind inflation.

It’s appropriate to stress that this was a mechanism of distortion; there was no act of policy or decision to lie about the facts. As Alec Nove pointed out, the mechanism could not have been intended, since the first five–year plan (1928–32) had envisaged a price deflation.[28]

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[25] I. Turetskii (1934), 39; Sh. Turetskii (1935), 63; Rotshtein (1936), 241–3; Gerschenkron (1947), 219–20; Jasny (1951b), 96–7; Nutter (1962), 111, 154. A countervailing influence in the early 1930s, however, was the subsidy of machinery production and prices. This was a factor which some western economists took more seriously than others. Dobb (1948), 35, argued this in a strenuous defence of the official Soviet practice, and Bergson (1961), 185, was willing to grant it some credence.

[26] For a published illustration (an example from Leningrad, evidently of machine–building enterprises) see Rotshtein (1936), 246. The same tendency was later apparent in comparison of industry gross outputs at current and ‘unchanged’ prices in the 1941 plan; see Jasny (1951b), 100, and further Hodgman (1954), 9–10.

[27] Calculated from figures in RGAE, 1562/51/220, 20.

[28] Nove (1957), 118–19.

3. The 1935 reform

A conservative reform

By 1933 there was substantial pressure for change. Some apparently considered that 1926/27 was already obsolete as a base year. The public record shows that the critics of 1926/27 were attacked twice in print in 1934 and 1935, and no soon had they been defeated than criticism resurfaced in 1936.[29] In the main commissariats for large–scale industry the system was a mess. Other branches (local, cooperative, and artisan industry, state farms and farm procurements, river and rail transport, and the consumer goods output of heavy industry) had either already begun to use 1932 as a base year or still did not use 'unchanged' prices at all, requiring their GVO aggregates to be converted from current or 1932 prices to a 1926/27 basis by means of aggregate deflators.[30] In September 1933 a decree of Sovnarkom obliged Gosplan and TsUNKhU to set about a reform. The reform however was to be conservative – to do what was necessary to make the existing system based on 1926/27 work more rationally, not to shift to another base year or a different formula.

The reform was implemented over 18 months, with the main revisions approved by Gosplan in February 1935, ready for the 1936 plan.[31] Each of the three incentive problems was supposedly addressed. The fixing of 'unchanged' prices was centralised, and new–product pricing was to be more tightly regulated. Instead of enterprises authorising their own 'unchanged' prices, which were also therefore variable across enterprises and regions, unified 'unchanged' price schedules (*tsenniki*) for existing products were compiled at a ministerial level and approved by Gosplan and TsUNKhU for use by all enterprises. For a variety of products new price schedules more carefully graded by quality were authorised. For products introduced for the first time in 1935 or a subsequent year, the new rule was that enterprises were to take the 1935 price translated to '1926/27' through multiplication by an adjustment coefficient. The latter was to be derived as the ratio of the 'unchanged' price to the 1935 prevailing price of some other existing product of the enterprise defined as analogous 'in composition and quality' (*po strukture i kachestvu*) to the new product. The result was to be approved annually by TsUNKhU, through a new 'commission for 1926/27 prices'.[32]

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[29] I. Turetskii (1934); Sh. Turetskii (1935); Rotshtein (1936).

[30] RGAE, 4372/23/76, 1–2 (Mezhlauk to Sovnarkom, 25 October 1934).

[31] RGAE, 4372/38/270, 2 (Sobol' (chief of TsUNKhU department of balance of national economy to Iampol'skii (Gosplan), 5 December 1938, 'On planning and accounting for production in unchanged prices of 1926/27').

[32] RGAE, 4372/23/76, 1–26 (Mezhlauk to Sovnarkom, 25 October 1934), 44–5 (draft decree on 1926/27 prices, no date but 1935); RGAE, 4372/31/66. 155–154 (draft 'Methodological instructions', no date); for the published version, see Rotshtein (1936), 248–9.

The conservative inspiration of this reform was expressed not only in clinging to the 1926/27 base year, but also in a determination not to have to revise already published series for GVO aggregates and growth trends of ministries and production branches, as would become inevitable if the base year were shifted nearer to the present. This desire was expressed in both public and private. In public the fact that shifting the base year nearer to the present day would increase the weight of agriculture and light industry relative to heavy industry was cited as a self–evident argument against change.[33] In private, as we shall see below, officials went to great lengths to ensure that no revisions would significantly affect any data already in the public domain.

The reform of 1935 had the potential to affect hidden inflation from two angles. One was its revision of procedures for fixing 'unchanged' prices of new products, and the other was the revision of prices of existing products.

Existing products

Francis Seton and Alec Nove both suggested that the reform might have provided the opportunity for a major upward leap in the 'unchanged' price level. The reason for this was, they thought, that any adjustment to the structure of relative 'unchanged' prices would release pressure from below for upward revision, while both planners and producers would resist price reductions which would lower targets and recorded growth rates.[34] The newly available documentary evidence, however, allows us to reject their hypothesis on several grounds.

The 1–percent rule

First, TsUNKhU officials kept tight control over the process by imposing the rule that, when comparing GVO figures in 'old' and 'new' unchanged prices, ministerial aggregates should not normally vary by more than 1 percent.[35] Thus higher prices for some commodities had to be balanced by reductions for others within the ministerial assortment. Pressure from below may well have been in an upward direction – notably, to introduce higher prices for higher–grade products of the timber and food industries. In practice, however, the 1–percent rule successfully contained it. .

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[33] Sh. Turetskii (1935), 62–4.

[34] Nove (1957), 120. Seton (1952), 353–3 argued: 'It must have been mainly to counteract this tendency that the 'stable–ruble' price structure was revised; the alterations made were therefore presumably in the direction of raising the prices of goods whose weight in the total fulfilment figure had previously been unduly small. The alternative course of reducing the 'stable–ruble' prices of over–valued goods would have had the depressing effect of requiring a general lowering of production targets. It is quite probable, therefore, that the periodic revisions of the stable price base actually reinforced the inflationary bias of the figures'.

[35] RGAE, 4372/23/76, 44–5 (draft decree on 1926/27 prices).

Thus revisions to 'unchanged' prices agreed in 1933–4 resulted in revisions to the 1934 plan GVO of three industrial ministries as follows: light industry +0.14%, the timber industry +0.7%, and heavy industry –0.6%, mainly on account of machinebuilding (–1.3%). For the industry total, the net change was 'insignificant'.[36] In the case of the food industry there had already been enforced an overall net reduction of more than 5%, made up by viticulture (–77%), and other branches (+1.7%).[37] In the same spirit, further revaluations of 'unchanged' prices in light industry resulted in an overall deflation of 1935 plan GVO by 1.0%, with results for different branches varying from –6.9% to +13.1%.[38]

The ratio of wholesale to 'unchanged' prices

A second glance at table 6, which we previously examined only with respect to 1935, appears to confirm the success of the operation. This table allows us to compare the relative trends of ministry GVO from 1935 to 1936 in both 'unchanged' and prevailing wholesale prices. Some noise is induced by ministerial reorganisations for which we cannot easily control (e.g. the transfer of enterprises from local industry to light industry). The important comparisons across the two years are therefore not so much between the value aggregates as between the ratios in the two right–hand columns. New product prices were drifting up with the prevailing price level anyway. If existing product prices were being allowed to drift up as well, because of permissive revisions associated with the reform, then these ratios could be expected to show little change. In fact they show a substantial increase. In 1935–6 prevailing prices rose faster than 'unchanged' prices. For industry as a whole the ratio of wholesale to 'unchanged' prices rose from 1.48 to 1.74. An increase was similarly recorded by every important branch except local industry the behaviour of which was disturbed exogenously. Thus the 'unchanged' price level does not appear to have exploded in an uncontrolled way.

Price comparisons for identical products

The third grounds for rejecting the hypothesis that the reform provided an opportunity for hidden inflation with respect to existing products are obtained from 3 samples of products matched in different years before and after the reform. Each sample is drawn up for a different purpose, but none shows any upward drift that could be termed remotely significant.

The samples are not large, consisting of 32, either 36 or 32, and 31 observations respectively. By way of context consider that there were more than 39,000 'unchanged' prices approved by Gosplan or TsUNKhU for the single year 1934, of which machinery alone accounted for some 17,000, and the heavy, light,

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[36] RGAE, 4372/23/76, 22–3; see also ibid., 5.

[37] RGAE, 4372/23/76, 42–3.

[38] RGAE, 4372/33/154, 103.

and timber industries together for more than 28,500.[39] Thus the 3 samples may be considered convincing only when taken in conjunction with the other evidence already cited.

Results of *t*–tests for differences in means of paired samples are shown in table 7. In all cases variables are transformed into their natural logarithms. Sample 1 consists of 'unchanged' prices for 32 basic products which can be matched from price schedules of 1928 and 1935. In this case a decline in the sample mean between the two years is just significant at 5 percent.

Sample 2 is drawn from a document of October 1934, which specified the transition from multiple to unified 'unchanged' prices in the heavy and timber industries; 31 separate basic products were covered, and, additionally, the old single price for plywood was replaced by 5 separate product prices graded by quality. The 'new unchanged' prices of the first 32 products are compared with the arithmetic means of the corresponding 'old' maxima and minima for each product. For the 5 plywood products each paired observation links the single 'old' price with a different 'new' quality–graded price. Sample 2(A) includes, and sample 2(B) excludes plywood products, where price revisions appear to have been mildly inflationary. In neither case, however, is the increase in the sample mean statistically significant.

Sample 3 is drawn from a document of the People's Commissariat of the Food Industry, again from September 1934, detailing revisions to 'unchanged' prices. Among the revisions reported are 32 commodities where a direct comparison is allowed between the old and new 'unchanged' prices. The mean of natural logs of the new prices is less than for the old prices, and the reduction is just significant on a one–tailed test at 10 percent.

New products

In principle, the reform was intended to rationalise the position with regard to new product prices. Here one might think of the problem in two phases – *ex ante* and *ex post*. Both proved intractable, although for different reasons.

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[39] RGAE, 4372/23/76, 48–50, 'List of 1926/27 price schedules registered by Gosplan and TsUNKhu', appendix to draft Sovnarkom decree of September 1934 'Ob oformlenii tsennikov neizmennykh tsen 1926/27 g.'). By way of self–exculpation I note that the recomputation of postwar United States price indexes for durable goods by Gordon (1990), which covered more than 25,000 price quotations drawn from trade catalogues and periodicals, required a generation of research assistants and 15 years' work (ibid., 7). Note, in addition, that under Soviet seller's–market conditions goods were specified in less detail than in the United States buyer's market since there was no need for the producer to win over the buyer. Therefore, the price and product information available to modern researchers from Soviet historical documentation is both greater in quantity and inferior in detail compared with US sources.

New product prices: ex post

In 1934–5, many examples came to light of products recently innovated the 'unchanged' prices of which now appeared unreasonably high in the light of cost reductions attributable to scale economies, learning, and so on. Branches commonly mentioned in this connection included machinebuilding, nonferrous metals, and chemicals, while products specifically highlighted included machinery products, furniture, and leather footwear.[40]

In one document of 1934 we find a number of illuminating comparison involving new products and foreign prices. Thus it was estimated that for metal products generally, the ratio of Soviet 'unchanged' 1926/27 prices to US prices of 1926/27 stood at 1.54 or 1.66 if comparators were the UK and Germany), but for new products Soviet 'unchanged' prices exceeded import prices by 4–5 times or more. In the case of individual mining machinery products the ratio to import prices varied between 1.5 to 12, and for textile machinery from from 4 to 6, but in the case of farm machinery, described as more fully assimilated to mass production, not more than 1.2–1.3.[41]

In practice, however, it was impossible for the regulators to affect substantially the level of new product prices after the event. They were trapped by their own 1–percent rule. A significant deflation would lower results already published and plans already promulgated. 'Unchanged' prices for furniture could be cut, for example, only because an increase was being sanctioned simultaneously for sawn timber and plywood products on average, leaving the ministerial aggregate roughly constant.[42] Cases therefore also arose where reductions were pronounced desirable but left unenforced, in order to maintain continuity with the price regime of the past.[43]

The conclusion of an internal Gosplan review of subsequent practice was that the regulators had been able to interfere only where relative prices of particular commodities were clearly wrong, and had made no attempt to revise the general level of 'unchanged' prices, since this would result in 'distortion of of the evaluation of plan fulfilment and the necessity of revising published time series for industrial output and the proportions of different branches'.[44]

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[40] RGAE, 4372/23/76, 3–4; RGAE, 4372/23/76, 14–27; RGAE, 4372/23/76, 19; RGAE, 4372/35/58, 20–1

[41] RGAE, 4372/23/76, 19 (Mezhlauk to Sovnarkom). However, some part of this spread might be understood as a Gerschenkron effect, with relative prices of more highly fabricated goods negatively influenced by relative development level in cross–country comparison.

[42] RGAE, 4372/23/76, 5.

[43] RGAE, 4372/23/76, 19; RGAE, 4372/35/58, 20–1;

[44] RGAE, 4372/38/270, 3 (Sobol' to Iampol'skii, 5 December 1938).

New product prices: ex ante

Here it is clear, again, that the reformers aimed to have a substantial impact through the imposition of adjustment coefficients (mentioned above) to translate the introduction prices of new products to a '1926/27' basis; the coefficients were to be derived as the ratio of the 'unchanged' price to the 1935 prevailing price of some other analogous commodity already in production.

The problem, in the opinion of the forthright Rotshtein, was that what was analogous 'in composition and quality' remained undefined, leaving scope for opportunism at the enterprise level in choosing favourable new–product comparators among existing products of the enterprise.[45] To each new product there might correspond a population of potential comparators, each with a different adjustment multiplier (ratio of the 'unchanged' price to the 1935 prevailing price). Favourable comparators could be defined as those with high adjustment multipliers. The size of the multiplier would be influenced not only by significant random variation, but also and especially by the comparator product's year of introduction – before or after 1926/27 – determining the level at which its 'unchanged' price had been fixed initially (in other words there was no obligation to find a comparator which had been produced and priced in 1926/27 itself). Thus, the reform of 1935 appeared to have made little or no essential difference to producers' scope for discretionary behaviour, and therefore to the mechanism of hidden inflation.

A further problem about new products which fed back into other aspects of the 'unchanged' prices nightmare is that new products soon became old products. As 'unchanged' prices of new products were introduced first in the enterprise, and only subsequently offered up for high level rubber–stamping, it became virtually impossible for the TsUNKhU commission to keep track of them all, verify them, and unify them. As product innovation proceeded and industry's assortment profile widened, complaints about multiple pricing, prices based on excessively aggregated product classes, and huge disparities between 'unchanged' prices and prevailing costs continued to be voiced.[46]

<u>'Unchanged' prices after the reform</u>

The commission for 1926/27 prices, with tens of thousands of prices to regulate, was inadequately staffed and funded. It continued to chide producers for

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[45] Dobb (1948), 35, and (1949), 21–2, alone among western observers, found the 1934–5 reforms a convincing solution, arguing that the new procedures 'removed criticism on this particular score'. This was clearly overoptimistic; the chaining of new products into gross output indexes at high prices based on temporarily inflated costs, and the regrading of existing products as new in order to reprice them at a higher level, persisted even under the new arrangements of the post–1950 era according to CIA (1980), 6–7.

[46] RGAE, 4372/92/82, 53–4 (1937); RGAE, 4372/38/270, 3 (1938); RGAE, 1562/3/553, 80–1 (1938).

following incorrect procedures and to remind them of the obligation to maintain a link with the increasingly remote 1926/27 base.[47] The 1–percent rule still frustrated attempts to bring down new–product prices once they had been fixed.[48] In 1938 the commission chairman (Sobol') and secretary (Liubimov) wrote to Sautin, then chief of TsUNKhU:

> In the opinion of many the system of unchanged prices of 1926/27 is becoming obsolete. Thus for example the planning department of Narkommash [The People's Commissariat for Machinebuilding] considers that the historically established 'so–called unchanged prices of 1926/27 give a false impression of changes in the volume of output, plan fulfilment, etc.'.[49]

However, there was to be no further reform. Purges, war mobilisation, and postwar reconstruction would come first. Through this period, the patterns already noted in table 6 become even more strongly marked. The figures in table 8, although with some imprecision, show that through this period 'unchanged' prices of producer goods (the civilian production of group 'A') began to lag somewhat behind prevailing prices, but in defence industry where product innovation was exceptionally rapid there continued to be no real difference between the two. Meanwhile, prevailing prices of consumer goods (group 'B') rose to four or five times the 'unchanged' price level.

Under these circumstances the pressure for change in the system of 'unchanged' prices could not be expected to disappear with completion of the reform. Indeed Rotshtein's significant critique appeared almost immediately afterwards. Rotshtein's case was the perfectly sensible argument that with product innovation any fixed base year rapidly becomes obsolete.[50] The scope for both statistical distortion and resource misallocation arising from producers' opportunistic behaviour was generally recognised in official documents. Rotshtein's argument was ignored, however; the final abolition of the 'unchanged prices of 1926/27' had to wait until 1950, a quarter of a century having elapsed since the base year.

Even a decade later Starovskii, the conservative head of the Soviet Union's statistical organs since 1938, would speak out nostalgically in defence of the

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[47] RGAE, 4372/35/58, 11 (Protocol no. 48 of the commission on 1926/27 prices, 4 April 1937).

[48] RGAE, 4372/35/58, 20–1. In its decree no. 53, 15 June 1937, the commission on 1926/27 prices acceded to a ministerial reversal of an order to lower 'unchanged' prices for leather footwear on the grounds that otherwise the ministerial GVO would be excessively deflated.

[49] RGAE, 1562/3/553; this document is not dated, but cites a letter from Narkommash to TsUNKhU of 28 January 1938.

[50] Rotshtein (1936), 242.

system of ‘unchanged prices of 1926/27’ as if the 1935 reform had essentially solved its problems.[51] And the growth rates themselves remained sacrosanct until the now–celebrated attack on them by Khanin and Seliunin in 1987.[52]

Summary

The evidence is that Soviet producers sought continuously to widen the scope for discretionary behaviour vis à vis the controls imposed on them by centralised plans. Whatever the pressures they exerted on the ‘unchanged’ prices of existing products, the countervailing pressure of the planning and statistical agencies was more than sufficient, and these prices were controlled increasingly tightly from the beginning of the system in 1928 through the 1935 reform. Products already in production in 1926/27, however, formed a diminishing proportion of the total. Through the introduction of new products, producers exerted a continuous upward pressure on the overall level of ‘unchanged’ prices which the authorities were powerless to check.

4. New products in index number theory and practice

By what standard should the Soviet methodology be judged?

The evidence is that the weighting of new products was the central unsolved problem of the system of ‘unchanged’ prices. But this is not sufficient, strictly speaking, for us to define the outcome as intrinsically inflationary or as an intrinsic overstatement of real growth.

Why not? At its simplest, the reason is that the weighting of new products is arguably the central unsolved problem of all index number computations. Even in countries with excellent basic data and professional experience, compiling index numbers in the presence of product innovation is a process which continues to invite controversy. And it is worth remembering that, far from starting with today’s knowledge and experience, Soviet practitioners were working on the frontier in the dawn of index number practice. Each of these points requires further explanation.

First, contrary to appearance and implication, modern practice does not supply any perfect solutions to the problem of accounting for new products,

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[51] Starovskii (1960), 111. Starovskii’s conclusion flew in the face of the evidence now made available from his own archive: ‘It is perfectly obvious that any potential inaccuracies of previous years when exceptions were made [to the proper way of doing things] are not expressed in subsequent indexes. The absolute level of output in 1948, say, was compared directly with the level of output of 1928, for example, and how the level of output in 1930, say, was calculated had no bearing on this’.

[52] Khanin and Seliunin (1987).

called the ‘house–to–house combat of price measurement’.[53] For example, economic theory tells us that in principle new products may often be accounted for as new combinations of characteristics already embodied in existing products. What is relevant is not the price per product unit, but the price per unit of each characteristic, which can be established by observing how product unit prices vary with specifications.[54] This theory, however, does not help us in the presence of new characteristics, or (to put it in other words) when existing characteristics are enhanced to such a degree or bundled in such a way that a want is satisfied for the first time. In practice, even with good data and modern facilities a characteristics approach remains very difficult to implement, and is little practiced even within official statistical agencies in advanced market economies. Thus, according to Robert Gordon, even in the 1980s the United States did not have a price index for machinery which adequately accounted for product innovation.[55]

Gordon’s evidence is that conventional western practice resulted in a overstatement of postwar durable goods inflation and understatement of output in the United States. There was hidden deflation in the official series, which insufficiently captured long–run improvements in product specifications and performance. Interestingly, an identical criticism of CIA measures of postwar Soviet industrial prices and production was made a few years ago by Michael Boretsky. He similarly charged CIA analysts with failure to account for the growth of Soviet new and unique industrial products, and for smallscale quality improvements in industrial products not reflected in growth of physical units produced. He argued as a corollary that there was hidden deflation in the associated CIA measures of price change.[56]

At the time Boretsky’s case met with a stiff rebuttal, and it is not my intention to place these two arguments (his and Gordon’s) on the same level.[57] Nonetheless it is surely significant that experts find it hard even today to agree on appropriate measures of price and quantity change for industrial products in the presence of product innovation in either the United States or the Soviet Union;

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[53] Boskin et al. (1996), section V.

[54] This approach was drawn to the attention of western researchers on Soviet prices and production with the publication of Griliches (1961).

[55] Gordon (1990), 28–32 (on some of the difficulties of implementing a hedonic regression approach to changing product characteristics in the presence of innovation, including multicollinearity of measured characteristics, and missed characteristics, see ibid., 92–9); also on United States consumer price measurement Boskin et al. (1996)

[56] Boretsky (1987), 529–31.

[57] For the rebuttal see Pitzer (1990), and Boretsky (1990) in reply. A partial rebuttal of the Boskin Report is supplied by the United States Department of Labor, Bureau of Labor Statistics (1997).

some at least find it possible to argue that official measures in both countries have overstated inflation and understated real growth.

Interwar Soviet statisticians operated on the basis of far less practical experience. The USSR was only the third country in the world to place national accounts on an official footing in 1925.[58] Accounting for real growth just of industrial production was in its infancy in the United States and Germany as well as in the Soviet Union. Kondrat'ev's index of Russian prerevolutionary industrial growth was published only in 1926.[59] Thus it would be astonishing if Gosplan or TsUNKhU had not made mistakes. What was lamentable was not the mistakes, but their entrenchment in the Soviet statistical record without correction for over 60 years.

Thus fixing weights for new products presents an exceptionally difficult problem in index number theory. Past discussion of the flawed methodology behind Soviet 'unchanged' prices usually implied that the proper solution was self–evident. Yet the critics had more than one ideal model of index number practice in mind, implying divergent theoretical criteria against which Soviet practice was being judged. Below I represent these criteria as the direct– and chain–Laspeyres indexes.

Theoretical standards

The direct–Laspeyres index

The record of western discussion reveals considerable uncertainty as to the theoretical standard to which Soviet statistics should have aspired. Loosely speaking, the Soviet concept of 'unchanged' prices was closest of all to a direct–Laspeyres index. By a direct–Laspeyres index I mean one which makes a direct comparison between the current year and the base year (in this case 1926/27) without any intervening link year. But the Soviet practice of pricing new products was nearer to the spirit of a chain–Laspeyres index in which the weights are updated each time the product assortment is revised, creating one or more links in a chain connecting the base and current years. The difference between these two helps us to understand the biases at work in the Soviet hybrid variety.

Peter Wiles can be represented as one who evaluated Soviet practice from a direct–Laspeyres standpoint. Wiles was also one of the few to be aware of the implications of early work on hedonic regression techniques. He understood that, with a direct–Laspeyres index as the standard of comparison, and on a very strict interpretation of utility theory, a production index based on the TsUNKhU

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[58] The Soviet Union came after Australia (1886) and Canada (also 1925), but before all other countries including Germany (1929), the United States (1934), and the UK (1939). See Studenski (1958), vol. 1, 151–2.

[59] Kondrat'ev (1926).. For other index numbers of industrial production in other countries at the end of the nineteenth and in the early twentieth centuries see Wagenführ (1932) on Germany and Fabricant (1940) on the United States.

methodology in the presence of product innovation could not be shown necessarily to overstate real growth.

The reason is that an increase in variety is itself an increase in output, or in other words product innovation is itself deflationary.[60] What is the appropriate weight for a product introduced after the base year? The problem is that its relative price at the moment of introduction is not too high, as most asserted, but too low. Here Wiles essentially reinterpreted a proposition of Hicks: if a good is unavailable in the base year, the appropriate price by which it should be weighted once it is in production should be the 'choke' level where the demand curve intersects the price axis and no units are demanded.[61] Axiomatically this must be higher, not lower, than the relative price at which the new product enters production.

In the Soviet case the argument is complicated, and in this case offset, by the inflation of the 1930s. If Soviet statisticians were intending to compile a direct–Laspeyres index of production based on 1926/27, then weighting new products by their introduction prices undervalued them on the Hicks–Wiles criterion, which refers to relative prices. But this downward bias in the TsUNKhU measure was offset by the inflation after 1926/27 which lifted the price level at which new products were introduced relative to the base year. In Wiles's words, '... when Soviet statisticians before the war gave grossly exaggerated weights to new goods, because they chained them in at inflated current prices, they did better than they knew. In a haphazard way they may have given a truer picture of the hedonic reality than by any orthodox procedure!'.[62]

In other words, on a direct–Laspeyres standard, the Soviet methodology incorporated not one but two biases. The upward bias arose from inflation, and can be measured. But there was also a downward bias arising from weighting new products by their introduction prices, instead of their higher choke prices. The downward bias cannot be measured since the choke prices were unobserved. All that can be concluded from a direct–Laspeyres standpoint is that the Soviet methodology exaggerated real output growth if measured inflation exceeded the (unmeasured) deflationary impact of product innovation, and not otherwise, and we cannot know which was the case (for a more formal discussion see proposition 1, appendix A).

The chain–Laspeyres index

There is a sense, however, in which Wiles (and indeed all those who treated the Soviet figures as a defective attempt at a direct–Laspeyres index) addressed the wrong standard. For one thing, the direct–Laspeyres index is no better as a

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[60] What Wiles (1962), 250, actually wrote is that 'to reduce variety is to reduce output'.

[61] Hicks (1940), 114; see further Diewart (1987).

[62] Wiles (1962), 250n.

measure of utility than other, more practicable concepts. It does not claim to measure utility directly, but only sets a bound – in an economy where prices and quantities are negatively correlated, an upper bound – on the change in utility; if the correlation of price change and quantity change is persistent, then the Laspeyres index is presumed to drift increasingly above 'true' real growth. For another thing, modern statistical agencies do not construct direct–Laspeyres index numbers of production in which the base year is fixed once and remains fixed. Instead, it's normal to shift the base year at least every 10 years, very often every 5, and in some cases more frequently still. Instead of a continuous run with a single base year, Laspeyres index numbers with different bases are chained together to form a series. If the weights are revised annually, we have a moving–weight index which approximates to a Törnqvist or Divisia–type integral index.[63]

The theoretical properties of the chain–Laspeyres index are not straightforward, since the utility standard is no longer invariant with respect to time. If the direct–Laspeyres index tends to run high, the chain–Laspeyres index will drift below it, and we can no longer be sure exactly where it lies in relation to 'true' real growth. [64] Still, it is at least practicable. New products can be chained in each time the base is changed; there is only a relatively small compromise involved in forgetting the deflationary impact of the increase in variety between the new base year and the old one, as long as the gap between base years and therefore also the unrecorded increase in variety between them are kept small.

A contest between the Soviet methodology and a chain–Laspeyres index with frequent links has a very clear outcome. First, it enables us to redefine what was wrong with Soviet 'unchanged' prices. The problem is not that new products were chained in at their introduction prices, which was more or less inevitable and done by everyone in practice; the problem is that old products were never reweighted upwards with inflation, and expensive new products were not reweighted downwards as they became cheap old products.[65]

Second, whereas we cannot be sure that Soviet 'unchanged' prices exaggerated real growth compared with a direct–Laspeyres index, we can be much more certain when the comparator is a chain–Laspeyres index. When prices and quantities are negatively correlated, all it takes is a general inflation to

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[63] Practical examples of the latter are rare and do not usually involve updating prices of individual products every year; however, they do exist, and one such case is the UK Retail Price Index. Gordon (1990) compiled new indexes of postwar price change for 22 classes of durable goods in the United States; he used a Törnqvist formula only for the last stage of aggregating the 22 into one.

[64] Allen (1975), 186.

[65] This was exactly the spirit of those who stressed the disparity arising when old products established in production were valued cheaply relative to new products with temporarily high prices at the bottom of the learning curve. Remarkably, a chain index with annual links was the solution proposed by Rotshtein (1936), 249–51.

ensure this result. The reasons in the Soviet methodology are that, first, the failure to take into account inflation of existing–product prices subsequent to the base period resulted in a growing underweighting of existing, slow–growing products relative to rapidly growing new products; second, the failure to take into account the relative deflation of new product prices after their introduction resulted in the overweighting of new products once they had ceased to be new (again, for formal discussion see proposition 2, appendix A).

A strict interpretation of the foregoing argument suggests that Bergson and Wiles were mistaken in an implication which they sought to draw from the relative stability of machinery prices in the 1930s. According to Moorsteen (table 4), machinery prices rose between 1928 and 1937 only using 1928 weights in which existing products were naturally predominant. At 1937 weights the index falls. The main reason is the more than 50 percent decline in the prices of tractors and automotive vehicles, combined with the enormous increase in their weight from 1 percent of total machinery production by value in 1928 to 37 percent in 1937 (table 5). Bergson and Wiles both believed that this undermined the hypothesis of overvaluation of new products in the official growth measure.[66] Their argument contained some truth from a direct–Laspeyres standpoint: any deflationary tendency (whether or new or existing products) would reduce upward drift of the official output measure relative to a direct–Laspeyres index. But since a direct–Laspeyres index cannot strictly be implemented, we ought to set the problem instead in a chain–Laspeyres context. From here we see that Bergson and Wiles were wrong. It was the failure to raise the weight of non–machinery products as their prices rose (while machinery prices in aggregate remained stable), and the failure to cut the weight of new machinery products after the introduction period as outputs rose and costs and prices fell, which drove the official volume index far above a chain–Laspeyres equivalent.

Practical standards

When western economists criticised the Soviet methodology, they commonly had in mind its failure to replicate a direct–Laspeyres index. In their own practice, however, they did not themselves incorporate new products in the way which a direct–Laspeyres standard would have required, and instead they tended to work to various other standards. These western standards are significant because it was against the results of their application (as in table 2) that Soviet index numbers were judged to be inflated.

Below I review the western standards briefly in terms of their efforts to eliminate substitution biases at the upper and lower levels of aggregation.[67] At the lower level, representative commodities are selected. Western observers

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[66] Bergson (1961), 186; Wiles (1962), 238n. Bergson connected this with Dobb's argument that the subsidy of machinery prices had mitigated the overpricing of new products.

[67] I take the terms 'upper–level substitution bias' and 'lower–level substitution bias' from the Boskin Report (Boskin et al. (1996), section IV).

could not incorporate tens of thousands of individual products into their measures, as Soviet measures did. They did not and could not have base–year weights for products not yet available, or current–year weights for products no longer produced. To cover breaks in continuity when one product is phased out and another is phased in, series for individual commodities are chained together beneath the surface so that continuous price and quantity relatives representing broader product groups and production branches. At the upper level, the price and quantity relatives are combined using expenditure weights (for final products) or value–added weights (for final and intermediate products).

In Soviet statistical practice the distinction between levels of aggregation did not arise since every single product was counted using gross–output weights. Soviet statisticians were proud of this fact and considered the western reliance on sampling and representative commodities to be a grave defect.[68] In a purely formal sense there were upper and lower levels of aggregation in Soviet practice in that each product entered a subministerial, then a ministerial subtotal before the ministerial subtotals were summed for the gross value of output of industry as a whole, but there was no methodological break between the different levels.

Typically, upper–level and lower–level substitution biases worked in opposite directions. At the upper level, at least when price and quantity changes are negatively correlated, the substitution bias arising from a Laspeyres–type formula is towards overstatement of real growth because early–year weights exaggerate its welfare impact. As production expands, more rapidly growing lines of output are being substituted for those growing more slowly, but the switch is towards products of which both price and marginal utility are falling relatively. There are several possible remedies, including the chain–Laspeyres index in which the weights are updated annually, the Fisher Ideal index (the geometric mean of the Laspeyres and Paasche indexes), and a moving–weight index.

At the lower level, on the other hand, substitution bias may result in overstated inflation and understated real growth. The representative product must be defined with a degree of imprecision. A product definition might refer to cement or steel in only in homogeneous tons or metal–cutting machine tools in only in units produced. The advantage of a broader definition is that it gives continuity over long time intervals since at least products classifiable under these broad headings were produced in every year. There is a disadvantage, however. In real life, within the product class one set of attributes gives way to another. Change may not always represent improvement, but in the long run it may be assumed that improvement was typical. New commodities are chained in as if identical with the old commodities which they replaced. The deflationary impact of new or improved product attributes is unmeasured; price changes associated with changes in attributes remained unexplained except as inflation. Remedies include the finer definition of products, the measurement of change in attributes and of price per unit of the attribute, and the early recognition of new products and new attributes.

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[68] Starovskii (1960), 105.

The independent studies of western economists may therefore be classified according to the steps taken to offset the biases at the upper and lower levels.

Upper–level substitution bias

Upper–level substitution bias may be dealt with briefly. All the studies just mentioned used a Laspeyres–type formula at the upper level of aggregation, and all were vulnerable to substitution bias. The main scope for substitution bias, however, was concentrated in the 1928–37 period because that is when most change in the structure of both prices and quantities took place.

The weights used in the different studies by Hodgman (1934 wage costs), Nutter (1928 and 1955 prices) and Moorsteen (1928, 1937, and 1955 prices) are listed in table 2. In addition Nutter reported results based on 'moving' weights – 1928 weights through 1937, and 1955 weights thereafter. The crucial distinction, though, was between estimates for the 1928–37 period based on weights of 1928 compared with those based on any other year. This was because the inversely correlated change in the structure of prices and output was largely compressed within the 1928-37 period. For example, over the long period Nutter's 'moving–weight' index for civilian industry (a 3.9–fold increase, 1928-50) tracked his similar index based on 1928 weights throughout (a 4.2–fold increase) much more closely than the one based on 1955 weights (a 3.1–fold increase). By 1937 the phase of most intensive structural change was over. Therefore the scope for substitution bias is greater in the period up to 1937, while the choice of weights is much less critical for any period beginning in 1937 or a later year.

All the western studies were vulnerable to upper–level substitution bias, but the best of them reported index numbers using a variety of weighting schemes which allow recomputation on an ideal index number basis. From this point of view one can say that upper–level substitution bias therefore presents less of a problem than substitution bias at the lower level.

Lower–level substitution bias

Most biased at the lower level were probably the calculations based on quantity relatives which were already more highly aggregated. For example, Hodgman's quantity relatives for machinery relied on series for just 23 broadly defined products, some based on units produced (e.g. wheeled tractors, series 'E' freight locomotives), some on measures of capacity (e.g. steam boilers in square metres, power transformers in kilowatts).[69] Nutter used a somewhat larger number of quantity series for 'machinery and equipment' (38 products) and 'miscellaneous machinery' (50 products), all in physical units.[70] Thus he incurred the same risks as Hodgman, but to a lesser extent because his product

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[69] Hodgman (1954), 163–4 and table A.

[70] Nutter (1962), table D–10. Nutter described any machinery index as 'largely arbitrary and unreliable', and described his own results for Soviet machinery as merely 'illustrative (ibid., 144).

definitions were somewhat narrower so that shifts among them captured a somewhat higher proportion of quality change.

Jasny and Moorsteen shared a representative–product approach defined at the level of the individual commodity. Probably, therefore, they had a better chance of accounting explicitly for model changes and new products. Their common difficulty, however, arose when the individual commodities available at the start of the period went out of production or were replaced or supplemented by entirely new commodities. This created the need for an explicit method for chaining products with dissimilar attributes. At this point their two studies diverged sharply in character and sophistication. Jasny declared himself unable to generalise at all except from price observations for identical models.[71] Characteristically this did not stop him from generalising. Whether by accident or design, his results were quite close to Moorsteen's provided they were sufficiently interpreted for the effects of index number relativity.[72]

Moorsteen's work was more elaborate, and included computing price and quantity relatives for 191 product categories representive of broader machinery classes between 1928 and 1958. Although the new–product problem could not be escaped, Moorsteen considered that it was mitigated by technological conservatism in Soviet industry ('in order to economize costs', he wrote, 'models once established in production are often manufactured without significant change over long periods'). He aimed to deal with product innovation by direct matching of old models with the new ones which replaced them. In two–thirds of cases when product innovation did occur, he was able to identify a new product as a close or even exact substitute for an old one, which meant chaining the new price onto the old one on a one–for–one basis. When nonidentical models had to be compared, he looked for a new product which was substitutable in use for the old one, based on a minimum of 3 or 4 technological parameters. Where direct equivalence could not be established, he applied a compensating factor linked to measurable attributes, e.g. in the case of wheeled tractors, when the Fordson–Putilovets was replaced by the International, twice as heavy and powerful, he assumed the user benefit of the latter to be worth twice that of a Fordson.[73]

Moorsteen regarded this procedure as a compromise which imparted some bias to his results. In the case just given, he presumed that he had still overstated inflation and understated the change in quality. Nonetheless, it is clear that the Moorsteen bias was much less than that arising when new–for–old

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[71] Jasny (1952), 130.

[72] The problem lay at the upper level of aggregation. Jasny constructed various Laspeyres price index numbers using fixed 1926/27 weights, but did not understand that a value index deflated by a *Laspeyres* price index makes a *Paasche* volume index. He referred to his volume measures as if they were based on 'real' 1926/27 prices, when in fact they were current–weighted. The effect is visible in table 2. See further Wheatcroft, Davies (1994a), 35.

[73] For full detail see Moorsteen (1962), 51–6.

product substitutions and model changes were entirely ignored, as in Hodgman's and Nutter's estimates. Therefore it's not surprising that at an intermediate level of disaggregation such as for civilian machinery Moorsteen's real growth estimates were higher. In tables 2 and 3 comparison was made between Moorsteen at 1937 prices with Hodgman at 1934 weights, and Moorsteen at 1927/28 and 1955 weights with Nutter; table 3 showed that machinery was the main source of disagreement among the western studies). A more surprising outcome of table 2, considered separately below as the 'Moorsteen paradox', was the fact that Moorsteen's machinery index at 1927/28 weights outperformed the official TsUNKhU index at 'unchanged' 1926/27 prices. The main point, however, is that with a finer product classification, and more numerous product attributes entering into Moorsteen's explanation of price change, the smaller was the element of change in machinery prices remaining unexplained by product innovation and therefore attributable by him to inflation.

The Moorsteen paradox

A natural conclusion is that we should regard Moorsteen's machinery index numbers (and the associated Kaplan–Moorsteen indexes for industry as a whole) as relatively transparent from the point of view of upper–level substitution bias, as relatively reliable from the point of view of lower–level substitution bias, and therefore as nearly definitive comparators for calculating the extent of hidden inflation in the Soviet official figures. In that case, however, it becomes urgent to solve the 'Moorsteen paradox' proposed by R.W. Davies.[74] The paradox can be summed up as follows:

1. The mechanism of hidden inflation in Soviet 'unchanged' prices was the weighting of new products.

2. Product innovation was concentrated in the machinery sector.

3. The real growth of machinery output over the period 1928–37 proposed by Moorsteen's machinery index based on 1927/28 weights (table 2) exceeds that proposed by the official Soviet index for machinery and metalworking based on 'unchanged prices of 1926/27'. In short, there was no hidden inflation, and perhaps even hidden deflation, in the official machinery index

4. If anything, the greatest hidden inflation, when official index numbers are compared with western estimates, was in light and food industry products, where product innovation was less intense.

The solution to the paradox comes in two parts. First, the paradox may be interpreted in light of my proposition above that a general inflation of prevailing prices is a sufficient condition for hidden inflation in the Soviet index when prices and quantities are negatively correlated and when the comparator is a chain–Laspeyres index. This proposition is just as valid for subindexes (e.g. for machinery or consumer goods) as it is for industry as a whole. Thus, according to

[74] Davies (1994), 140; see also Davies (1978), 40–3.

Moorsteen's estimates reported in tables 3 and 4, prevailing machinery prices measured on a Paasche basis fell between 1928 and 1937. If machinery prices were stable or falling, we should not anticipate hidden inflation in the official index of machinery products. If the fall in prevailing prices of machinery products was sufficiently rapid, there may have been hidden deflation (for a formal demonstration, see proposition 3, appendix A). By the same token, hidden inflation in official index numbers of consumer industry products was ensured by rising prevailing prices, even if the pace of product innovation was less hectic. Thus the presence of hidden inflation in index numbers of consumer industry products, but not of machinery products, is explained. However, this is not sufficient to explain hidden inflation in the official index numbers covering industry as a whole since, even with hidden inflation, official index numbers of consumer industry products grew less rapidly than those pertaining to machinery.

The second part of the solution is that, as a result of the weighting of new products by their prevailing prices at the moment of introduction, the machinery sector became increasingly overweighted relative to consumer industry. From the stand point of the procedures required for a proper chain–Laspeyres index, Soviet statisticians failed to reweight existing products regularly. Existing products were concentrated in consumer industry, where product innovation was slower. Thus the weight of the consumer industry at 'unchanged' prices fell further and further behind its weight at prevailing prices. Exactly this point is illustrated in table 9, where the weight of products of the heavy, defence, and machinebuilding industries in Soviet industry GVO of 1937 is shown as 50 percent in 'unchanged' prices, but only 37 percent at current direct cost, and 35 percent at prevailing wholesale prices net of indirect taxes. (Similar computations may be made from tables 6 and 8). Therefore hidden inflation in the overall official index of industrial production was the logical result of combining a machinery index which reflected rapid real growth of machinery output reasonably accurately (or even understated it at times), but was increasingly overweighted, with a consumer goods index which overstated real growth but was increasingly underweighted.

Wartime hidden deflation

Military machinery in the war years provides a clearer case of hidden deflation.[75] Between 1941 and 1943, with the wartime transition to mass production prevailing prices of existing weapons fell by more than 50 per cent on average.[76] The 'unchanged' prices of existing weapons, however, reflected their higher introduction prices based on peacetime craft production costs. New weapons and improved models, however, went immediately into mass production. Many new and improved weapons were introduced during the war, especially in 1943 and 1944. Their introduction prices reflected the lower costs of wartime. If they were chained into the official index at or near their introduction prices, then they did not

[75] This idea was first proposed by Harrison (1990), 573–4.

[76] According to regression coefficients reported by Harrison (1996), 219 (table E.1, row 2).

receive their due weight relative to the prewar models they were replacing. The result was to undervalue the most rapidly growing lines of output.

Thus, at the 1944 peak the official measure of Soviet industry's defence production, in 'unchanged' prices of 1926/27, stood at 3.1 times the 1940 level, but this was substantially below the 3.9 times estimated by Harrison at prewar prices.[77] It appears, therefore, that in wartime price and quantity change in military machinebuilding satisfied the conditions for hidden deflation to affect official measures of real output. No change in statistical policy or system was required to bring this about. It happened automatically as a result of applying the normal statistical methodology in abnormal circumstances.

Summary

In this section I have argued that the appropriate standard of comparison for Soviet production indexes was the chain–Laspeyres index formula. By this standard, given that prices and quantities were negatively correlated, a sufficient condition for hidden inflation in the Soviet index was a general inflation of prevailing prices. In their own research Western researchers strove to eliminate hidden inflation more or less well, but I identify Moorsteen's as probably the best estimates under the circumstances.

The elimination of all bias from index numbers may be an impossible goal. An important lesson is perhaps to be found in Edgeworth's famous 1925 definition: an index number is 'a number adapted by its variations to indicate the increase or decrease or a magnitude not susceptible of accurate measurement'.[78] All index numbers involve practical compromise. Edgeworth put it this way not because of any merely practical difficulties but because index numbers are ultimately no more than indirect statements about utility which is unobservable in itself, and can only be proxied at best.

Soviet index numbers were not conceived as statements about utility, of course; their practitioners adhered to a labour–cost theory of value which led them to think of Soviet 'unchanged' prices more as a standard of constant costs of production.[79] One might think 'cost' is a more unambiguous notion than utility, but perhaps not too much should be made of this because even Marxian political economy required the expenditure of labour, living or embodied, to be justified by society's wants in the long run, whether the latter are defined by a market or a plan. Whichever way you look at it, those who build index numbers are always in

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[77] Harrison (1996), 72. Even this figure may be an underestimate since it contains little compensation for lower–level substitution bias.

[78] Edgeworth (1925), 379 (emphasis added).

[79] Thus Rotshtein (1936), 229: 'the unit of value selected from this point of view' (the author having referred previously to the purpose of measuring 'the scale of output as an indicator of the outcome of the production process') 'should be as close as possible to production' (emphasis added).

pursuit of one theoretical ideal or another, and must compromise with reality in that pursuit; but some practical compromises are better than others, and the compromise embodied in Soviet ‘unchanged’ prices was worse than most.

5. Conclusions

This study has given rise to a number of clear–cut conclusions:

1. The Soviet ‘unchanged prices of 1926/27’ were originally developed as a monitoring device to facilitate regulation of production enterprises and ministries by central planners from above. In this they reflected the role of statistics as the handmaiden of policy, not as an independent, critical activity.

2. The system of ‘unchanged’ prices was intended to limit the scope for producer opportunism under hierarchical regulation, but contained intrinsic weaknesses which producers soon learnt to exploit.

3. There was continuous pressure for below for increases in ‘unchanged’ prices. The authorities were able to contain this pressure with regard to the weights of existing products, but were relatively powerless with regard to the weighting of new products.

4. The 1935 reform rationalised and centralised the system of ‘unchanged’ prices administratively, but made no essential difference to the effectiveness of controls on ‘unchanged’ prices of either new of existing products.

5. There were strong arguments for an early reform of the system, but a combination of statistical conservatism with adverse circumstances delayed reform until 1950.

6. The statistical consequences of the way in which the system operated must be defined in relation to one or another specific comparative index–number formulation. The presence of hidden inflation in Soviet measures of real growth based on the ‘unchanged prices of 1926/27’ is best defined in relation to a chain–Laspeyres index.

7. It is when a chain–Laspeyres index is taken as the comparator that we find hidden inflation to be unambiguously present in the Soviet index numbers for aggregate output. This finding is consistent with the presence of hidden deflation and understated real growth in some official subindexes such as for machinery and weapons in particular periods.

Tables

Table 1. Soviet industrial production and national income, 1928–50, selected years: official figures (billion rubles at 'unchanged prices of 1926/27')

	Industrial production	National income
1928	21.8	25.0
1937	95.5	96.3
1940	137.5	125.5
1948	163.0	144.0
1950 (prelim.)	235.0	205.0

Source: Jasny (1951a), 7. Industrial production is gross output (including double–counted intermediate products); national income is gross output *less* 'productive [intermediate] consumption'.

Table 2. Soviet national income and industrial production, 1932, 1937, 1940, and 1950: alternative estimates (percent of 1928)

	Weights	1932	1937	1940	1950
National income					
TsSU (1956)[a]	1926/27 prices	182	386	513	843
Clark (1957)[b]	international prices		133	161	(212)
Jasny (1961)[c]	1926/27 prices	..	171	189	244
Bergson (1961)[d]	1928 factor costs	..	275	..	..
	1937 factor costs	..	162	197	243
	1950 factor costs	..	160	188	232
Moorsteen–Powell (1966)[e]	1937 factor costs	110	172	203	246
Khanin (1988)[f]	mixed weights	..	..	(150)	173
Industrial production					
(A) Industry as a whole					
TsSU (1956)[a]	1926/27 prices	202	446	646	1119
Jasny (1955)[g]	1926/27 prices	165	287	350	470
Nutter (1962)[g]	moving weights	140	279	312	385
Moorsteen–Powell (1966)[e]	1937 factor costs	153	267	318	415
Khanin (1991)[h]	mixed weights	..	..	346	..
(B) Civilian industry					
Clark (1951)[g]	international prices	128	310	339	..
Hodgman (1954)[g]	1934 wage costs	172	371	430	646
Seton (1957)[g]	international regression weights	181	380	462	733
Kaplan–Moorsteen (1960)[g]	1950 prices	154	249	263	369
Nutter (1962)[g]	1928 weights	140	261	283	419
	1955 weights	136	222	216	313
	'moving' weights	140	261	267	387
Machinery production					
(A) Industry as a whole					
TsSU (1956)[a]	1926/27 prices	400	1100	2000	4300
(B) Civilian industry					
Gerschenkron (1951)[g]	1939 dollar prices	264	525	..	..
Hodgman (1954)[g]	1934 wage costs	258	626	..	..
Kaplan–Moorsteen (1960)[g]	1950 prices	287	601	504	1470
Nutter (1962)[g]	1928 prices	364	1067	828	2316
	1955 prices	212	436	326	779
Moorsteen (1962)[i]	1927/28 prices	..	1792	1532	..
	1937 prices	378	889	794	2244
	1955 prices	..	550	477	..

Note: all figures are recomputed (if not so given in the source) as percentages of 1928.

Sources: see next page.

Sources to table 2:

[a] TsSU (1956), 36, 46, 75. National income is net material product; industrial production is gross output.

[b] Clark (1957), 247. National income is net national product; the figure in parentheses is for 1951.

[c] Jasny (1961), 444. National income is net national product.

[d] Bergson (1961), 128, 149, 153. National income is GNP at factor cost.

[e] Moorsteen and Powell (1966), 622–3. National income is GNP at factor cost.

[f] Khanin (1988), 85. National income is net material product; the figure in parentheses is for 1941.

[g] Given or cited by Nutter (1962), 113, 146, 155, 158. Nutter's 'moving' weights were 1928 weights through 1937, and 1955 weights thereafter. The Kaplan–Moorsteen machinery index was based on Moorsteen (1962).

[h] Khanin (1991), 146.

[i] Moorsteen (1962), 106–7. Moorsteen's initial year is 1927/28 (October–September), not 1928.

Table 3. Index numbers of Soviet industrial production, selected branches, 1937: alternative estimates (percent of 1928)

		Weights	Machinery	Ferrous metals	Food products	Textiles
(A)	Nutter	1928	1067	416	181	134
	Moorsteen	1927/28	1792	..	..	..
(B)	Hodgman	1934	625	399	259	198
	Moorsteen	1937	889	..	..	..
(C)	Nutter	1955	436	418	169	138
	Kaplan-Moorsteen	1950	..	421	156	153
	Moorsteen	1955	550	..	..	..

Sources: Hodgman (1954), 190–4 (large–scale industry only); Nutter (1962); 524–8; Moorsteen (1962), 106–7; Kaplan and Moorsteen (1960), vol. 2, 220, 224.

Table 4. Indexes of Soviet prevailing prices for GNP and selected product groups, 1937: western estimates (percent of 1928)

	Weights	1937
GNP	1928	563
	1937	328
Retail products	1928	870
	1937	595
Basic industrial products	1937	222
Machinery	1927/28	143
	1937	71

Note: all figures are computed or recomputed as percentages of 1928.

Source: the GNP deflators are calculated from figures of GNP at current and constant prevailing prices given by Bergson (1961), 46, 48, 130; other figures from ibid., 186.

Table 5. Prices and weights of Soviet machinery, 1927/28–1955

	1927/28	1937	1955
Weights (percent)			
All machinery	100.0	100.0	100.0
Tractors	0.5	6.5	8.7
Automotive vehicles	0.7	30.3	24.2
Other machinery	98.8	63.2	67.1
Prices (percent of 1937)			
All machinery			
1927/28 weights	70	100	291
1937 weights	141	100	197
1955 weights	137	100	153
Tractors	225	100	247
Automotive vehicles	236	100	179
Other machinery			
1927/28 weights	68	100	237
1937 weights	85	100	153
1955 weights	86	100	130

Source: Moorsteen (1962), 68, 72, 73, 75.

Table 6. Gross value of output of Soviet industry at wholesale and 'unchanged' prices, 1935–6 (million rubles)

People's commissariat	At 'unchanged' prices		At prevailing wholesale prices		Ratio, wholesale to 'unchanged' price level	
	'old' prices	'new' prices				
	1935	1936	1935	1936	1935	1936
Heavy industry	25107	33504	25614	40196	1.02	1.20
Light industry	5910	12939	12707	28991	2.15	2.24
Food industry	6591	10600	16522	32419	2.51	3.06
Timber industry	1306	3523	1918	5853	1.47	1.66
Local industry	7189	3030	11156	3564	1.55	1.18
Procurements	1673	1859	2598	2797	1.55	1.50
Cinematography	144	190	188	279	1.31	1.47
Total	47919	65645	70703	114099	1.48	1.74

Source: RGAE, 1562/51/220, 10 (1935), 1 (1936)

Table 7. Mean differences in natural logarithms of 'unchanged' prices between samples of matched commodities, various years

Sample 6.1 (1928–35)	$ln(p_{28})$	$ln(p_{35})$
Mean	5.912	5.725
Variance	5.675	5.550
Observations	32	32
Pearson correlation	0.966	
Hypothesized mean difference	0	
Degrees of freedom	31	
t–statistic	1.719	
$P(T \leq t)$ one–tail	0.048	
t critical one–tail	1.696	
$P(T \leq t)$ two–tail	0.096	
t critical two–tail	2.040	

Data sources: 1928 from TsSU (1928); 1935 from RGAE, 1562/33/154, 175–53.

Table 7 (cont.)

Sample 6.2 (1934)	(A)		(B)	
	ln(mean)	*ln(new)*	*ln(mean)*	*ln(new)*
Mean	3.838	3.934	3.699	3.697
Variance	2.639	3.164	2.935	3.132
Observations	36	36	31	31
Pearson correlation	0.968		0.995	
Hypothesized mean difference	0		0	
Degrees of freedom	35		30	
t–statistic	–1.259		0.060	
P(T≤t) one–tail	0.108		0.476	
t critical one–tail	1.690		1.697	
P(T≤t) two–tail	0.216		0.953	
t critical two–tail	2.030		2.042	

Data source: RGAE, 4372/23/76, 9–13 (Spravka ‘O vazhneishikh popravkakh, vnosimykh v deistvuiushchie tseny 1926/27 g. po promyshlennym narkomatam’, not dated, but apparently September or October 1934)

Table 7 (cont.)

Sample 6.3 (1934)	*ln(old)*	*ln(new)*
Mean	5.157	5.046
Variance	9.892	9.070
Observations	32	32
Pearson correlation	0.989	
Hypothesized mean difference	0	
Degrees of freedom	31	
t–statistic	1.294	
P(T≤t) one–tail	0.103	
t critical one–tail	1.696	
P(T≤t) two–tail	0.205	
t critical two–tail	2.040	

Data source: RGAE, 4372/31/105, 173–168.

Table 8. Wholesale and 'unchanged' prices in Soviet industry, 1940–1950 (selected years)

	Industry, total	Group 'A'			Group 'B', total
		total	military products	civilian products	
(i) Commodity output at prevailing wholesale prices (billion rubles)					
1940	390	147	27	120	243
1945	284	129	51	78	155
1950	716	315	21	294	391
(ii) Gross output at 'unchanged prices of 1926/27' (billion rubles)					
1940	138	84	24	60	54
1945	132	103	53	50	29
1950	240	162	20	142	78
(iii) Ratio, wholesale to 'unchanged' price level					
1940	(2.98)	1.75	1.12	2.00	4.50
1945	2.15	1.25	0.96	1.56	5.34
1950	2.98	1.96	(0.96)	(2.14)	5.00

Source: RGAE, 4372/94/945, 7. Group 'A' products are means of production (civilian products) or destruction (military products); group 'B' products are means of consumption. In principle, part (iii) of the table is part (i) divided by part (ii). The original gives a figure for civilian production of group 'A' in 1950 of 394 billion rubles where 294 billion was clearly intended. Even with this correction, figures in parenthesis in part (iii) still appear to be subject to minor error, but it is not clear whether the errors originated in the numerator, denominator, or solution.

Table 9. The composition of industry GVO by commissariat, 1937 (percent of total)

People's commissariat	At 'unchanged' prices of 1926/27	At 1937 production costs	At 1937 factory prices	
			excluding turnover tax	including turnover tax
Heavy industry, defence industry, and machinebuilding	50	37	35	27
Timber industry	4	5	4	3
Light industry	20	25	24	20
Food industry	18	28	31	33
Local industry	5	3	3	4
Procurement	3	2	3	13
Industry, total	100	100	100	100

Source: RGAE, 4372/38/270, 7.

Appendix A

The purpose of what follows is to compare the Soviet methodology for introducing new products into a Laspeyres volume index with alternative schemes.

A simple two–product, four–period model suffices. Commodity A is an 'old' product, supplied throughout at an unvarying rate. Commodity B is produced not at all in the base period $t = 0$, innovated as a 'new' product in period i, mass–produced in period m, and produced at a still higher rate in period n.

For simplicity I tabulate the price and quantity vectors as follows:

$t =$	0	i	m	n
Quantities				
A	1	1	1	1
B	0	x_i	x_m	x_n
Prices				
A	1	p_i	p_m	p_n
B	π_0	$p_i \cdot \pi_i$	$p_m \cdot \pi_m$	$p_n \cdot \pi_n$

The ratio of outputs of new to old products from the innovation period onward is given by x_t . There is some sort of underlying cost–inflationary process at work, reflected fully in the price of old products, so $p_t > p_{t-1}$. Below I will refer to p_t as the 'core deflator'. The price of new products follows that of old products but with a relative trend defined by π_t . Below I will refer to $p_t \cdot \pi_t$ as the 'new–product deflator'. The meaning of π_0 requires explanation. This is the 'choke' demand price for new products: their shadow price (in terms of old products) before they were produced, set at such a level that the demand for them equals zero. Thus the innovation involved in the transit from period 0 to i is to be understood as a reduction in the new–product relative price to the point at which demand became positive and reached x_i . While π_0 itself is unobservable, the general trend of π_t is downward, so $\pi_t < \pi_{t-1}$, first because of innovation (from 0 to i), then because of scale economies and learning (from i through m and n). Below I will refer to the relativity of π_i to π_0 as 'innovation deflation', and that of π_m (and π_n) to π_i as 'productivity deflation'.

This economy is characterised by a strong Gerschenkron effect, that is, price and quantity changes are negatively correlated; for example, machinery output grows rapidly relatively to other products while machinery prices fall relatively.[80]

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[80] Gerschenkron (1951), 000. For further discussion see Wheatcroft, Davies (1994a), 34. The terminology of Allen (1975), 64, might be considered applicable (the market is 'demand–dominated' – 'buyers set the pace, buying less as prices rise and more as prices fall') , but there is a paradoxical aspect in the Soviet case

Proposition 1. In an economy subject to core inflation, when price and quantity changes are negatively correlated, the Soviet methodology of 'unchanged' prices cannot be shown to overstate real output growth if the standard of comparison is a direct–Laspeyres index.

The reason for this is that a direct–Laspeyres index requires base year weights for products not produced until a year subsequent to the base year which are unobservable shadow prices. The latter may be greater than as well as less than the Soviet 'unchanged' prices fixed for new products.

Below I compare the Soviet methodology for computing the index number for real output of period n using 'unchanged' prices with alternative methodologies which are arguably superior, either in theory or in practice. The first comparator set is made up by the direct–Laspeyres volume and Paasche price index numbers (direct in the sense that index numbers refer directly from the current year to the reference year), which can be formulated as follows:

1. $V_L = 1 + \pi_0 \cdot x_n$
2. $P_P = p_n \cdot \dfrac{1 + \pi_n \cdot x_n}{1 + \pi_0 \cdot x_n}$

However, π_0 is unobservable. The Soviet–type Laspeyres volume index is computed by instead assigning to new products their observed innovation price $p_i \cdot \pi_i$, making:

3. $V_L' = 1 + p_i \cdot \pi_i \cdot x_n$
4. $P_P' = p_n \cdot \dfrac{1 + \pi_n \cdot x_n}{1 + p_i \cdot \pi_i \cdot x_n}$

The resulting distortion of the TsUNKhU volume index relative to a direct–Laspeyres index is defined by the ratio:

5. $D = \dfrac{V_L'}{V_L}$

$$= \frac{1 + p_i \cdot \pi_i \cdot x_n}{1 + \pi_0 \cdot x_n}$$

Thus for the Soviet–type volume index to rise above the true index ($D > 1$) it is required that the price level of new products in the innovation period should be higher than their shadow price in the base period, i.e. core inflation must proceed rapidly enough to outpace the innovation deflation of new products:

6. $p_i > \dfrac{\pi_0}{\pi_i}$

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which in a different context is more conventionally thought of as a 'seller's market'.

Real growth will be overstated if the rise of the core deflator is so rapid that the nominal introduction price of new products is absolutely higher than the shadow (choke) price applying in the base period. The choke price, however, is not observed, so the extent and even direction of the distortion induced by not applying it can hardly even be guessed.

Proposition 2. In an economy subject to core inflation, when price and quantity changes are negatively correlated, the Soviet methodology of 'unchanged' prices overstates real growth by comparison with a chain–Laspeyres index number.

The two reasons for this are that, in the Soviet methodology, (a) core inflation resulted in a relative underweighting of existing, slow–growing products relative to rapidly growing new products, and (b) productivity deflation resulted in a relative overweighting of new products once they had ceased to be new.

In some ways the appropriate comparison for a Soviet–type volume index is not with a theoretically pure direct–Laspeyres index since the latter cannot be computed without observing the unobservable π_0 in the denominator of equation 6. A more practical comparison would be with the chain–Laspeyres and chain–Paasche indexes of volume and price:

$$7. \quad V_{CL} = \left(1 + \pi_i \cdot x_m\right) \cdot \frac{1 + \pi_m \cdot x_n}{1 + \pi_m \cdot x_m}$$

$$8. \quad P_{CP} = p_i \cdot \frac{p_n \cdot \left(1 + \pi_m \cdot x_m\right)}{p_i \cdot \left(1 + \pi_i \cdot x_m\right)} \cdot \frac{p_n \cdot \left(1 + \pi_n \cdot x_n\right)}{p_m \cdot \left(1 + \pi_m \cdot x_n\right)}$$

$$= p_n \cdot \frac{1 + \pi_m \cdot x_m}{1 + \pi_i \cdot x_m} \cdot \frac{1 + \pi_n \cdot x_n}{1 + \pi_m \cdot x_n}$$

When price and quantity changes are negatively correlated, we should expect a run of chain–Laspeyres index numbers to drift below a run of direct–Laspeyres index numbers. Therefore, the condition for a TsUNKhU index to drift above a more satisfactory index–number formulation should be weaker when the comparator is the chain–Laspeyres formula than in comparison with a direct–Laspeyres index. The distortion of the TsUNKhU volume index relative to the chain–Laspeyres index in period *n* could be given as:

$$9. \quad D' = \frac{V_L^*}{V_{CL}^*}$$

$$= \frac{1 + p_i \cdot \pi_i \cdot x_n}{1 + \pi_i \cdot x_m} \cdot \frac{1 + \pi_m \cdot x_m}{1 + \pi_m \cdot x_n}$$

Resolving this expression is a little tedious, but the condition for the TsUNKhU index to overstate real growth relative to the chain–Laspeyres index ($D' > 1$) can be expressed in terms of the change in the core deflator as:

$$10. \quad p_i - 1 > \frac{\left(\frac{\pi_m}{\pi_i} - 1\right) \cdot \left(\frac{x_n}{x_m} - 1\right)}{\frac{x_n}{x_m} + \pi_m \cdot x_n}$$

The denominator of the right hand side of the inequality is always positive. The right hand side is therefore negative so long as the numerator is negative:

$$11. \quad \left(\frac{\pi_m}{\pi_i} - 1\right) \cdot \left(\frac{x_n}{x_m} - 1\right) < 0$$

that is, if relative quantity changes are inversely correlated with lagged relative price changes. Therefore, given a negative association between relative price and quantity changes, a rising absolute price level for old products is sufficient to satisfy the inequality in equation 10 and generate hidden inflation in the TsUNKhU index. For the latter to exceed a chain–Laspeyres index it is not necessary for the new–product deflator to be rising absolutely, falling absolutely, or stable, but its rate of change must be less than that of the core deflator.

Proposition 3. Even when price and quantity changes are negatively correlated, the Soviet methodology of 'unchanged' prices can understate real growth by comparison with a chain–Laspeyres index number, given a sufficient fall in the core deflator.

Equation 10 also suggests that, without lifting the assumption of an inverse correlation of relative price and quantity changes, under some circumstances the statistical mechanism underlying the TsUNKhU index could lead to hidden deflation and an understatement of real growth. This possibility does not have practical application to Soviet industry or the economy as a whole, but is not just theoretical and did apply to index numbers for machinery and military equipment in particular periods.

The condition for hidden deflation is quite restrictive. A core deflation process is necessary but not sufficient since, from equation 10, core inflation is sufficient but not necessary for hidden inflation. Some simplifying assumptions help us towards the intuition. Assume that the lagged negative correlation of quantity on price changes displays unit elasticity; this means the numerator on the right hand side of equation 10 can be set equal to -1. Fix π_i and x_m equal to 1; combining this with the elasticity assumption we can rewrite the denominator simply as $x_n + 1$, where x_n is the growth in quantity of new products relative to existing ones. The condition for hidden inflation can be be obtained by reversing the inequality sign in equation 10 and inserting these new assumptions:

$$12. \quad p_i - 1 < \frac{-1}{x_n + 1}$$

In other words, for hidden deflation in the TsUNKhU index the core deflator must not only fall, but fall faster than the growth in relative quantity of new products.

References

Archives

RGAE: Rossiiskii Gosudarstvennyi Arkhiv Ekonomiki, Moscow

Papers and publications

Allen, R.G.D. (1975), Index numbers in theory and practice, Basingstoke

Bergson, A. (1953), *Soviet national income and product in 1937*, New York

Bergson, A. (1961), *The real national income of Soviet Russia since 1928*, Cambridge, MA

Berliner, J.S. (1976), *The innovation decision in Soviet industry*, Cambridge, MA

Boretsky, M. (1987), 'The tenability of the CIA estimates of Soviet economic growth', *Journal of Comparative Economics*, **11**, 517–42

Boretsky, M. (1990), 'CIA's queries about Boretsky's criticism of its estimates of Soviet economic growth', *Journal of Comparative Economics*, **14**, 315–26

Boskin, M.J., Dulberger, E.R., Gordon, R.J., Griliches, Z.V., and Jorgensen, D. (1996), *Towards a more accurate measure of the cost of living*, Final Report to the Senate Finance Committee from the Advisory Commission to Study the Consumer Price Index
(URL: *http://www.geocities.com/CapitolHill/2394/cpi_rep.html#exec*)

Central Intelligence Agency, National Foreign Assessment Center (1980), *Comparing planned and actual growth of industrial output in centrally planned economies*, ER80–10461, Washington, DC

Clark, C. (1939), *A critique of Russian statistics*, London

Clark, C. (1957), *The conditions of economic progress*, 3rd edn, London

Davies, R.W. (1978), 'Soviet industrial production, 1928–1937: the rival estimates', University of Birmingham, Centre for Russian and East European Studies, Soviet Industrialisation Project Series no. 18

Davies, R.W. (1994), 'Industry', in Davies, R.W., Harrison, M., Wheatcroft, S.G., eds, *The economic transformation of the USSR, 1913–1945*, Cambridge, 131–57

Diewart, W.E. (1987), 'Index numbers', in Eatwell, J., Milgate, M., Newman, P., eds, *The new Palgrave dictionary of economics*, **2**, Basingstoke and London, 767–79

Dobb, M. (1948), 'Further appraisals of Russian economic statistics', *Review of Economics and Statistics*, **30**(1), 34–8

Dobb, M. (1949), 'Comment on Soviet economic statistics', *Soviet Studies*, **1**(1), 18–27

Edgeworth, F.Y. (1925), 'The plurality of index numbers', *Economic Journal*, **35**, 379–88

Fabricant, S. (1940), *The output of manufacturing industries, 1899–1937*, New York

Gerschenkron, A. (1947), 'The Soviet indices of industrial production', *Review of Economics and Statistics*, **29**(4), 217–26

Gerschenkron, A. (1951), A dollar index of Soviet machinery output, 1927–28 to 1937, The RAND Corporation, Report R–197, Santa Monica, CA

Gordon, R.J. (1990), *The measurement of durable goods prices*, NBER: Chicago, IL, and London

Griliches, Z. (1961), 'Hedonic price indexes for automobiles: an econometric analysis of quality change', in *The price statistics of the federal government*, General Series no. 3, NBER: New York

Grossman, G. (1960), *Soviet statistics of physical output of industrial commodities*, Princeton, NJ

Harrison, M. (1990), 'The volume of Soviet munitions output, 1937–3945: a reevaluation', *Journal of Economic History*, **50**(3), 569–89

Harrison, M. (1996), *Accounting for war: Soviet production, employment, and the defence burden, 1940–1945*, Cambridge

Hicks, J.R. (1940), 'The valuation of the social income', *Economica*, **7**, 105–24

Hodgman, D.R. (1954), *Soviet industrial production, 1928–1951*, Cambridge, MA

Jasny, N. (1951a), *The Soviet economy during the plan era*, Stanford, CA

Jasny, N. (1951b), *The Soviet price system*, Stanford, CA

Jasny, N. (1952), *Soviet prices of producers' goods*, Stanford, CA

Jasny, N. (1961), *Soviet industrialization, 1928–1952*, Chicago, IL

Kaplan, N.M., Moorsteen, R.H. (1960), 'Indexes of Soviet industrial output', 2 vols, The RAND Corporation, Research Memorandum RM–2495, Santa Monica, CA

Khanin, G.I. (1988), 'Ekonomicheskii rost: al'ternativnaia otsenka', *Kommunist*, no. 17, 83–90

Khanin, G.I. (1991), *Dinamika ekonomicheskogo razvitiia SSSR*, Novosibirsk

Khanin, G.I., Selyunin V. (1987), 'Lukavaya tsifra', *Novyi mir*, 1987, no. 2, 181–201

Kondrat'ev, N.D. (1926), '...' in *Ekonomicheskii biulleten' Kon'iunkturnogo Instituta*, 1926, no. 2, 000–000

Moorsteen, R. (1962), *Prices and production of machinery in the Soviet Union, 1928–1958*, Cambridge, MA

Moorsteen, R., Powell, R.P. (1966), *The Soviet capital stock, 1928–1962*, Homewood, IL

Nove, A. (1957), '"1926/7" and all that', *Soviet Studies*, **9**(2), 117–30

Nutter, G.W. (1962), *The growth of industrial production in the Soviet Union*, NBER: Princeton, NJ

Pitzer, J.S. (1990), ‘The tenability of the CIA estimates of Soviet economic growth: a comment’, *Journal of Comparative Economics*, **14**, 301–14

Rotshtein, A.I. (1936), *Problemy promyshlennoi statistiki*, Moscow

Seton, F. (1952), ‘Pre–war Soviet prices in the light of the 1941 plan’, *Soviet Studies*, 3(4), 345–64

Starovskii, V. (1960), ‘O metodike sopostavleniia ekonomicheskikh pokazatelei SSSR i SShA’, *Voprosy ekonomiki*, no. 4, 103–17

Stone, R. (1956), ‘*Quantity and price indexes in national accounts*’, OECD: Paris

Studenski, P. (1958), *The income of nations*, **1**, *History*, New York

TsSU (1928), *Universal’nyi spravochnik tsen*, 3rd edn, Moscow

TsSU (1956), *Narodnoe khoziaistvo SSSR*, Moscow

Turetskii, I. (1934), ‘K probleme tsenovykh pokazatelei v plane’, *Plan*, no. 5, 38–41

Turetskii, Sh. (1935), ‘Dlia chego planiruetsia produktsiia v neizmennykh tsen 1926–27 g.’, *Plan*, no. 11, 62–4

United States Department of Labor, Bureau of Labour Statistics (1997), Measurement issues in the consumer prices index (URL: *http://stats.bls.gov/cpigm697.htm*)

Wagenführ, R. (1933), ‘Die Industriewirtschaft: Entwicklungstendenzen der deutschen und internationalen Industrieproduktion 1860 bis 1932’, *Vierteljahrschafte zur Konjunkturforschung*, S. 31, Berlin

Wheatcroft, S.G., Davies, R.W. (1994a), ‘The crooked mirror of Soviet economic statistics’, in Davies, R.W., Harrison, M., Wheatcroft, S.G., eds, *The economic transformation of the USSR, 1913–1945*, Cambridge, 24–37

Wheatcroft, S.G., Davies, R.W. (1994b), ‘Agriculture’, in Davies, R.W., Harrison, M., Wheatcroft, S.G., eds, *The economic transformation of the USSR, 1913–1945*, Cambridge, 106–30

Wiles, P.J.D. (1962), *The political economy of communism*, Oxford