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Mark Harrison and Andrei Markevich

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Quantity Versus Quality in the Soviet Market for Weapons*

Mark Harrison**

and

Andrei Markevich***

Abstract

Military market places display obvious inefficiencies under most arrangements, but the Soviet defense market was unusual for its degree of monopoly, exclusive relationships, intensely scrutinized (in its formative years) by a harsh dictator. This provided the setting for quality versus quantity in the delivery of weapons to the government. The paper discusses the power of the industrial contractor over the defense buyer in terms of a hold-up problem. The typical use that the contractor made of this power was to default on quality. The defense ministry's counter-action took the form of deploying agents through industry with the authority to verify quality and reject substandard goods. The final compromise restored quality at the expense of quantity. Being illicit, it had to be hidden from the dictator.

Keywords: Contracts, Dictatorship, Hold-Up Problem, Soviet Economy.

JEL Codes: L2, N4, P2.

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** Department of Economics, University of Warwick; Centre for Russian and East European Studies, University of Birmingham; and Hoover Institution on War, Revolution, and Peace, Stanford University. Email: mark.harrison@warwick.ac.uk.

*** Department of Economics, University of Warwick, and the Center for Economic and Financial Research, New Economic School, Moscow. Email: a.markevich@warwick.ac.uk.

Quantity versus Quality in the Soviet Market for Weapons

This paper is about an absolutely standard problem in industrial organization: contracting for goods when quality matters. What makes it novel is the context. What difference does it make when the contractor is placed not within a law-governed market economy but under a centralized dictatorship? When at any moment the dictator can step in, tear up the contract, and shoot the contractor?

Contracting for quality is a problem the world over in markets for defense goods and services. The quality of goods and services was specifically a problem in most if not all markets in the Soviet economy. In its military sector, however, the defense ministry was willing to incur the significant cost of employing tens of thousands of military procurement officers to work on site with the contractors to enforce contractual standards for the quality of military goods, endowed with sweeping powers to test and reject deliveries. As a result, the military agents were able to learn about many if not all dimensions of the quality of the goods they were accepting.

Our research has thrown up a puzzle. The military agents were not apparently corrupt, and were genuinely tough on the enforcement of quality standards. But they often colluded with contractors to conceal quantitative violations of the plan for deliveries of weapons, not on a purely private basis but with their superiors' clear knowledge and approval. We attribute this to a hold-up problem in the market for weapons. In this paper we will set out where we think the problem came from and how it worked out, and we will discuss the evidence base for our reasoning.

The paper is organized as follows. In Part 1, we discuss the particular institutional arrangements of the Soviet defense market. Part 2 suggests how the hold-up problem arose and why the advantage lay on the side of the seller. Part 3 presents our model of how the problem worked out. In this model bargaining power and collusion decide the final outcome, and Parts 4 and 5 discuss the supporting documentary evidence on bargaining power and collusion respectively. The final section concludes.

1. Quality and Quantity in Defense Markets

In all countries, markets for military goods do not work well. This is to a large extent independent of the constitution of the state and the social and economic system. In all countries, whether ownership is private or collective, and whether rulers are democratic or authoritarian, the agents on each side of the defense market are powerful and well connected. On one side a senior minister manages a government monopsony: there is only one significant customer for such items as heavy artillery, aircraft, and battleships. On the other side is a charmed

circle of big defense contractors. A few large-scale corporations supply such weapons; their ability to squeeze money out of government is augmented by the fact that they are too important for production, employment, and national security for the government to let them fail. As a direct result, defense markets everywhere are notorious for cost overruns, delayed deliveries, quality shortfalls, subsidies, and kickbacks.

It would be a mistake, however, to conclude that defense markets everywhere are uniformly the same. Just among the market economies, national arrangements have been shown to vary significantly in the degree of competition, public accountability, rent seeking, and softness of budget constraints on defense suppliers (Eloranta 2008). The Soviet market for military goods also shows several unique and fascinating features; in particular, both buyer and sellers were state-owned, so that it was to a large extent an artificial or internal market. Despite this, it supplied an army that won World War II and threatened the West for the next half century. Thus it is fully worthy of detailed study.

In writing about the market for weapons we do not mean that there was a market relationship between the Red Army and the defense ministry as unified organizations. At this high level there was political bargaining between the defense minister and a few industrial ministers, not a market relationship. The internal market tended to emerge at lower levels where individual military purchasing administrations had to select suppliers and negotiate terms with individual defense factories (Markevich and Harrison 2006).

We suggest that the market had less scope to develop for products where models were established and were in serial production year after year so that each year's contracts could be planned in advance on the basis of the previous year's experience. But for many lines including aircraft, ships, tanks, and engines defense buyers were continually trying to place contracts for new or unique items. Innovation in military machine technologies seems to have been particularly rapid in the mid-1930s and this accelerated the year-to-year turnover of products (Davies and Harrison 1997). In such periods even the crudest version of directive planning was impossible because it was never clear beforehand who would produce them and how many, to what quality standards, or at what price. This greatly extended the scope for market-oriented behavior.

The most important problem in the Soviet military market was the quality of weapons. By "quality" we mean the observable characteristics of fabricated goods such as their reliability or performance. Both quantity and quality can be observed. But they differ in the time and effort required to observe and verify them. Quantity is easily observed and verified, and quality less so.

Other investigations of Soviet defense procurement (Harrison and Simonov 2000, Markevich and Harrison 2006) have considered aspects of quality that were not freely observable at the time of purchase so that the buyer may not know the quality of what is bought until afterward. In this paper we look at the problem that arises when quality is observed before purchase but cannot be verified: the buyer is aware of substandard quality but cannot prove it to a third party.

The defense market was not the only part of the Soviet economy that had a problem with quality. Sheltered from competition and guaranteed economic survival by state plans, civilian factory managers faced strong temptations to seek a quiet life for themselves and their employees by fulfilling the plan for least effort (Granick 1954; Berliner 1957). The authorities assigned plans in rubles of gross output subject to fixed plan prices and quality specifications (*tekhnicheskie usloviia*). Quality, however, was costly to the producer. As we now know, virtually everything in the Soviet command system that appeared fixed was negotiable in practice, including plans and prices. Once plans and prices had been written down, however, the main scope for the factory to economize on effort lay in finding ways to reduce quality that were hard to verify.

In the hope of limiting such producer opportunism the authorities relied firstly on industrial self-regulation. Every factory, civilian or military, had its own quality department or OTK (otdel tekhnicheskogo kontroliia) responsible for ensuring that its products came up to standard. Not surprisingly, this was largely ineffective: managers had little incentive to make self-regulation stick, and the staff employed to carry out quality assurance typically saw themselves as low-status employees paid to provide a fig-leaf to cover up for management when things went wrong; when they tried to work professionally to external benchmarks, managers slapped them down (Harrison and Simonov 2000; Markevich and Harrison 2006).

Above the factory level, the ministers in charge of the supply of military goods had to account for their quality to Stalin and this forced them to care about quality; periodically, at least, they said that they did. When they spoke up for quality, they often made inspirational speeches and issued decrees about the enforcement of standards and benchmarks that were accompanied by fearsome threats of punishment for violation. In practice, however, the ministry had its own plan to fulfil; conscientious adherence to quality standards could threaten not only the incomes of workers and managers but also the authority and prestige of the minister. Declarations in favor of quality beforehand tended to give way to a crude quantity drive in the course of events.

By focusing on the problem of quality we do not mean to imply that the Red Army's military equipment was not good enough to fight wars and win battles. The quality of weapons has both economic and military aspects that are conceptually distinct, although practically related. The economic aspect of quality decides whether the equipment creates producer and consumer surpluses sufficient for both buyer and seller to be willing to agree the terms of an exchange beforehand and remain satisfied with the results afterward. The military aspect decides whether the buyer can use the weapons to beat the enemy. In World War II, Soviet weapons such as the T-34 tank, BM-13 "Katiusha" rocket mortar, and Il-2 assault aircraft won a reputation for rugged serviceability and firepower. Militarily, they were good enough. This does not mean that they always performed according to contract. This chapter is about the economic aspect of quality: on what terms was the defense contractor willing to provide it, and did defense buyers get what they paid for? This is an important problem because, even if the

weapons were good enough for the battlefield, it determined the price that had to be paid to get them.

2. The Hold-Up Problem in the Soviet Defense Market

The hold-up problem provides a way of understanding quality issues in the Soviet market for weapons. A hold-up can arise wherever one partner must invest in an exclusive relationship with another in order to realize the benefits of a potential exchange (Goldberg 1976: 439; Williamson 1985: 61-63). In a market in which buyer and seller have an exclusive relationship, the hold-up can arise on either side or both sides at once, but in our case it will generally be one-sided: the buyer cannot identify and select the best-matched seller without first undertaking a costly search, exchange of information, and negotiation.

Suppose the buyer faces a fixed selection cost, which is also the cost of switching from one seller to another. Once it is formed, the relationship with the particular seller is then worth at least this fixed cost to the buyer and this value is what the buyer stands to lose if the initial relationship breaks down. It becomes part of the quasi-rent that is the profit created by the relationship, but it need not accrue to the buyer. Who actually receives it will depend on post-contract renegotiation. The seller can hold up the buyer: by threatening to withdraw from the relationship, the seller can face the buyer with a potential loss at least equal to the switching cost so the buyer should be willing to pay the seller up to this value to avoid this loss. The extent of the transfer will depend on the relative bargaining strengths of the two sides; the party with more to lose is more likely to lose it.

The risk presented by the hold-up problem is that, in order not to be held up and so make a loss, agents will avoid investing in the relationship-specific assets that make them vulnerable; as a result, society as a whole will lose the gains from trade. The hold-up problem has standard solutions, however, that should bring the incentives of the buyer and supplier approximately back into alignment (Schmitz 2001). Vertical integration brings the parties together under a single authority and completely replaces their market relationship by hierarchy. There are also intermediate solutions that retain the market relationship but regulate it by long-term contracts with some combination of joint financing of initial joint costs and contingent rules for distributing the subsequent benefits.

In market economies defense markets are generally thought to have a potential for hold-up problems (Rogerson 1994), with the advantage to the buyer. Defense contractors must acquire specialized research and production assets in order to produce goods for which there is only a single purchaser; if the relationship ends or breaks down these assets will be less valuable in their best alternative use. In both world wars, for example, the vast capital expansion of war industries in the major market economies had to overcome business resistance and was largely government-financed for this reason. During World War II, for example, the U.S. Defense Plant Corporation and other federal agencies provided and afterward wrote off capital facilities for war production to

the private sector that Robert J. Gordon (1969) valued at \$45 billion (at 1958 prices).

In the Soviet case the producer did not have this vulnerability. Soviet firms generally acquired capital goods free of charge, the cost to society being made up by government grants. In the market for military equipment this weakened the hand of the defense ministry and eliminated any scope for it to hold up the industrial contractors. The latter could still hold up the defense ministry, on the other hand, as long as defense buyers faced positive selection costs.

It seems unlikely that selection was a problem for the buyer of established products that did not change from one year to the next. Once contractors and their capacities were known from experience they could be written into plans, and as long as the product assortment did not change this limited their bargaining power. When the military needed a new product in contrast, defense buyers had to expend significant resources on identifying potential suppliers and negotiating with them. In other words, we can think of Soviet defense purchasing as going on partly within a vertically integrated sphere where planners assigned quotas for established products to established suppliers, and partly in an internal market where new suppliers had to be found for new products.

For new products the defense ministry was forced each year to wage a frustrating military-style "contracts campaign" (described in detail by Markevich 2008) in the internal market, in order to place new orders with industrial suppliers. In an earlier study Harrison and Simonov (2000: 231) identified major obstacles to the contracts campaign as "the difficulty of finding willing suppliers of new defense products, and the desire of industry to secure a relatively homogenous assortment plan which would allow concentration on long runs of main products without a lot of attention to spare parts and auxiliary components, no matter how essential to the customer"; the resistance of potential contractors could go so far as to leave significant orders completely unfilled.

When the placing of contracts ran into difficulties, the government was reluctant to intervene on principle; it insisted that the defence ministry had to solve its problems with industry on the basis of their informal working relationship.¹ When the defense ministry appealed to the government to force state-owned enterprises to accept its orders, the government typically did not take action.² Even in the course of accelerated rearmament, industrial firms were able to refuse defense orders with impunity. In 1938, for example, defense industry factory no. 145, the sole supplier of two-headed lubricators for artillery, refused a contract on the grounds that its workshop was under reconstruction;

¹ GARF, 8418/4/39: 1 (Rykov to Voroshilov and Kuibyshev, 1930).

² GARF, 8418/24/2: 7-9. (Ivanov and Nikolaev to Safonov, 1934).

meanwhile, it started to sell off unique equipment required for the manufacture of these products.³

We suggest that search costs in the internal market left the Soviet defense buyer vulnerable to a hold-up. Given this, what form did the hold-up take? Under Soviet arrangements, once the contracts campaign was over, the main opportunity for the seller lay in undershooting on quality, knowing that the buyer would have difficulty in taking its business away. The buyer, in turn, could limit but not eliminate the harm imposed by the seller's behavior by accepting an illegal compromise. The compromise required conspiracy between the parties since, if not hidden, it would trigger an intervention by the dictator that both parties preferred to avoid.

3. A Model

We illustrate with a simple dynamic game of three moves: the defense buyer's search, the contractor's hold-up, and a readjustment.

There are two players, Defense and the Contractor. Defense aims to maximise the military utility of its available equipment, derived from some expectation of its effectiveness in use on the battlefield. This effectiveness is decided by their quantity and quality. Defense seeks a Contractor to supply units of a particular weapon, for example a tank or an airplane, that can be of high or low quality. The Contractor aims to maximise a surplus over costs. This surplus could be measured equally well in monetary terms or in terms of the reduced effort required to extract Defense's cash; which is more appropriate depends on the form in which rents were shared within the Soviet industrial firm, but does not matter for present purposes.

Off stage is a Dictator, whom we do not model explicitly (but see Markevich 2007). The Dictator shares Defense's preferences over quality and, when the players have contracted between themselves, he validates the contract and, where necessary and possible, he intervenes to give it force; he will punish contract violations that are verifiable.

In our model, only quantity is verifiable. When the quality of performance matters, a contract can be performed consummately or perfunctorily. Oliver Hart and John Moore (2006), for example, "suppose that trade is only partially contractible. Specifically, we distinguish between perfunctory performance and consummate performance, or performance within the letter of the contract and performance within the spirit of the contract. Perfunctory performance can be judicially enforced, while consummate performance cannot." In our model consummate performance is more costly to the producer, and perfunctory performance is less valuable to the buyer.

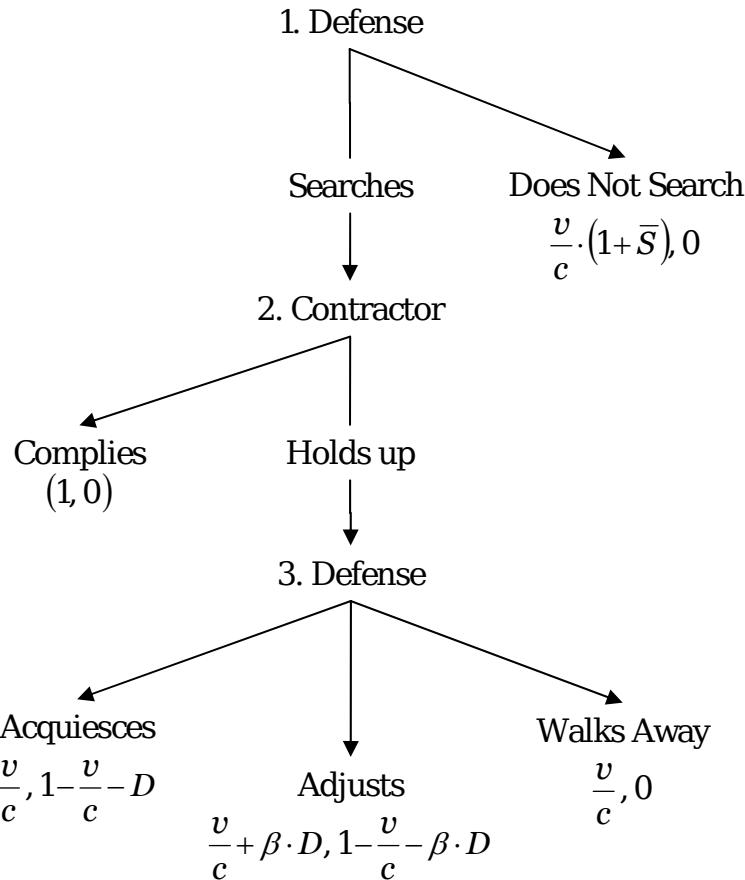
The supply side of our economy has two sectors. There is a vertically integrated sphere in which a high-priority buyer such as the defense ministry can routinely procure goods of low quality; that is, on being notified of military requirements, the planner can assign the production quota to a producer that, selected randomly, provides low

³ RGAE, 7515/ 1/ 404: 46-53 (Savchenko to Mikhail Kaganovich, 1938).

quality and low cost. Items of high quality are available only within an internal market that the buyer must search to identify an appropriate contractor. While the administered sphere is governed by hierarchy and arbitrary assignment, the internal market is governed by matching, negotiation, and contracts.

Before the game, the Dictator endows Defense with a fixed sum of rubles for the procurement of weapons. We normalise this budget to $1 + \bar{S}$ where \bar{S} is the fixed cost of searching for a high-quality contractor; \bar{S} is payable if and only if Defense chooses to search.

Figure 1. Timing and Payoffs



Note: Payoffs are (Defense, Contractor).

Symbols:

- α Probability that Nature permits high quality
- β Bargaining power of Defense
- c Contractor's relative cost per unit of low quality: $1 > c > 0$
- D Deadweight loss from hold-up
- \bar{S} Defense's fixed cost of search
- v Defense's relative utility per unit of low quality: $1 > c > v > 0$

Figure 1 illustrates the timing of the game. At various points Defense must take its budget, or what is left of it, either to the administered sphere (to the right) or to the market (down and to the left). At the first move Defense can seek to allocate this budget to weapons of High and Low quality, and Low has the advantage over

High that it is available without search. If Defense chooses at the outset to procure goods from the administered sphere without searching, its entire budget of $1 + \bar{S}$ can be spent on Low. Under the prevailing law of contracts and prices, the low-quality items are acquired at cost, so the producer receives a zero surplus.

Alternatively, Defense can enter the market for High by paying the search cost \bar{S} as an entry fee. Down this path, Defense and the Contractor agree terms for a contract, but \bar{S} is now a sunk cost so Defense can commit only 1 to the purchase of High.

Down the path to the internal market, the Contractor must deliver units of High to Defense in contractually agreed quantities and qualities, for example, 500 tanks of a specific model and subject to agreed technical and performance standards, at prices fixed on the basis of the Contractor's production costs. In that case the Contractor again covers its costs and receives zero.

For the Contractor, *consummate fulfilment is no better than loss of the contract*. Perfunctory fulfilment is the only way the Contractor can extract a surplus of revenue over costs, and this must be at the expense of Defense. The Contractor's surplus could be gained by delivering the agreed number of tanks produced with lower standards of care or quality of materials, for example. As a result the quality standards agreed in the contract would be violated, and the tanks would be of less military value than Defense anticipated.

In the second move along this path the Contractor chooses between consummate and perfunctory execution of the contract, and perfunctory execution is its dominant strategy.

Given perfunctory fulfilment, the third move belongs to Defense, which at first sight must either acquiesce (to the left), or walk away (to the right), leave the market and return to the administered sphere where it can spend its remaining budget on Low. This option provides Defense with its reservation utility, which turns out to be v/c . Defense will acquiesce provided its loss from perfunctory fulfilment is kept within a limit set by this reservation utility.

The Dictator will also acquiesce provided that the total number of units of any quality remains the contracted number. It is true that he shares Defense's preference for consummate fulfilment, and in principle Defense could appeal to the Dictator for justice, but the latter could observe only the quantity, not the quality of fulfilment. Or, in other words, we assume that the probability of proving perfunctory fulfilment in court was zero.

We will show that the Contractor's gain is less than the harm done to Defense; there is a deadweight loss D . Our intuition is that the hold-up involves the substitution of Low for High, and the relative cost of Low must exceed its relative utility ($c > v$) since otherwise Low would always be preferred. This creates an opportunity for Defense to lessen the harm done and offer a benefit to both parties in further renegotiation. A final round of bargaining eliminates the deadweight loss by restoring quality at the expense of quantity. The two parties share the gain in proportion to their mutual bargaining power, β for Defense, so $1 - \beta$ for the Contractor. Because bargaining is at the

expense of quantity, however, there is no longer even perfunctory fulfilment. The fact that the contract is no longer fulfilled in quantity risks the intervention of the Dictator. Only Defense can give permission for this to go forward, and must collude with the Contractor to hide it.

We now analyse the players' possible payoffs. At the outset the Dictator gives Defense a budget of $1 + \bar{S}$ rubles to procure a stock of a particular weapon. Defense has preferences over weapons that can be of high or low quality based on their military applications, so its (military) utility function is:

$$V = H + v \cdot L \quad (1)$$

Here H and L are the (non-negative) quantities of High and Low respectively. For calibration each unit of H gives Defense one unit of utility, and v is the relative utility of a unit of L . Defense maximises V , subject to procurement costs C remaining within its budget, but the amount of its budget that will be available to spend on procurement depends on whether or not Defense engages in the costly search for a high quality supplier. Thus:

$$\text{No search: } C \leq 1 + \bar{S} \quad (2)$$

$$\text{Search: } C \leq 1 \quad (2a)$$

Meanwhile, procurement costs are also the Contractor's production costs:

$$C = H + c \cdot L \quad (3)$$

Again for calibration, each unit of H costs the Contractor one ruble and c is the relative ruble cost of a unit of L . We assume that the unit value and cost of High exceed the unit value and cost of Low respectively, and the relative unit cost of Low to the seller exceeds its relative value to the buyer:

$$1 > c > v > 0 \quad (4)$$

How much utility is available to Defense depends, first, on its choice to search or not. If Defense declines to search and sets out to procure only Low, given the cash available, and combining equations (1) and (3) with inequality (2), it follows that its utility and procurement will be:

$$V_{\text{no-search}} \leq \frac{v}{c} \cdot (1 + \bar{S}) \text{ and } L_{\text{no-search}} \leq \frac{1}{c} \cdot (1 + \bar{S}) \quad (5)$$

If Defense searches the market and finds a Contractor for High, in contrast, the utility available to it from a contract is found by combining equations (1) and (3) with inequality (2a):

$$V_{\text{search}} \leq 1 - (c - v) \cdot L \quad (5b)$$

From (4), and using stars to denote the terms of Defense's optimal contract, this expression is maximized when $L = 0$, so:

$$V^* = 1; H^* = 1; L^* = 0 \quad (6)$$

We find the motivation for the subsequent hold up in the Contractor's problem: since its contract revenue cannot exceed 1, it can

create a surplus only by reducing total costs (equation 3) below the contracted level. The Contractor will covertly substitute units of Low for the same number of units of High, one for one, up to a limit set by two constraints. One is Defense's participation constraint, and the other is the Dictator's intervention constraint. We assume that, while the Dictator shares Defense's preference for high quality, he does not observe the substitution; he sees only the number of items delivered. He has no basis to intervene while this number matches the quantity H^* stipulated in the contract. The Contractor is safe while it delivers $H + L \geq H^*$. Recall that $H^* = 1$, so we will write the Dictator's *intervention constraint* as:

$$H \geq 1 - L \quad (7)$$

As for keeping up the contractual relationship, the Contractor must maintain Defense at or above its *reservation utility*. This is the utility that would be available if Defense now stopped trying to procure High, walked away from the contract, returned to the administered sphere, and asked the planner to assign a supplier of Low. Combining equations (1) and (3) with inequality (2a) and setting $H = 0$ gives the utility from spending 1 in this way as v/c and this is Defense's reservation utility. Using primes to denote the values obtaining in the hold-up, it gives us Defense's *participation constraint*:

$$H \geq \frac{v}{c} - v \cdot L \quad (8)$$

Combining equations (7) and (8), Defense will remain within the relationship *and* the Dictator will not intervene as long as:

$$L' \geq \frac{1}{c} \cdot \frac{c-v}{1-v} \text{ and } H' \geq \frac{v}{c} \cdot \frac{1-c}{1-v} \quad (9)$$

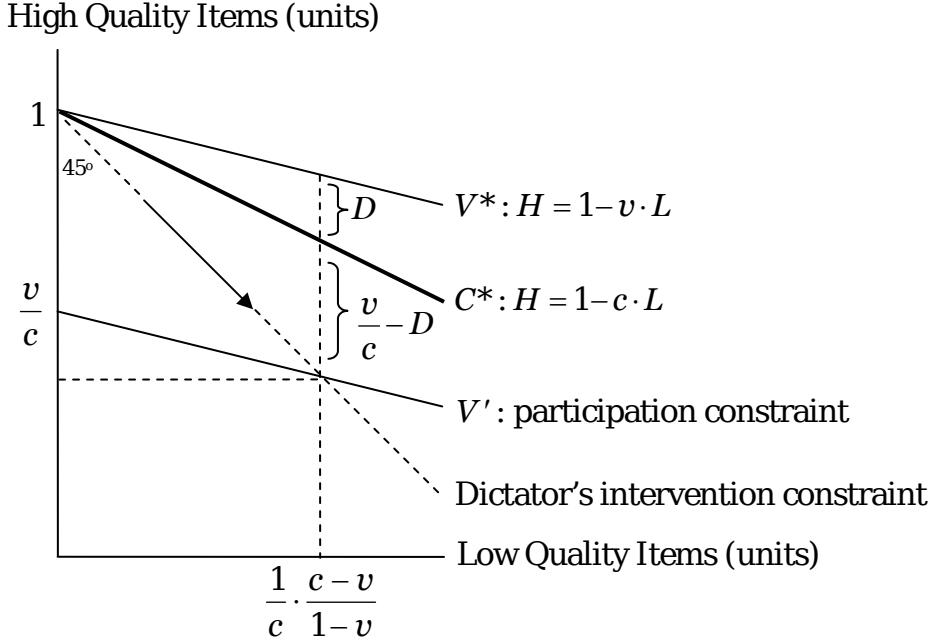
Figure 2 illustrates the hold-up in High, Low space. The contract was made where the Contractor's offer curve C^* meets Defense's budget-constrained indifference curve V^* at the vertical (H) axis.

In the hold-up the Contractor moves down the Dictator's intervention constraint until it reaches the point of intersection with Defense's participation constraint. The Dictator's intervention constraint is a downward-sloping 45° line along which the combined numbers of H and L remain unchanged from the number of H specified in the contract. Above this line the Dictator observes customary bickering among his agents but will see verifiable grounds for intervention only below the line. Defense's participation constraint is a line with the same slope as V^* , displaced downwards by the utility, measured in units of H , that Defense will give up before reaching its reservation utility and renouncing the contract. Above this line Defense knows it is being cheated, but it will walk away only below the line.

Payoffs to each side now vary from those anticipated in the contract. The relative magnitudes are driven by our assumption that the comparative cost of Low exceeds the comparative utility of High (inequality 4: $1 > c > v > 0$). Military utility was previously 1. The Contractor's perfunctory fulfilment drives it down to the reservation

level v/c . The Contractor's utility was previously zero. Now it increases because the substitution of Low for High reduces total costs that, under consummate fulfilment, were also previously equal to 1. The reduction in total costs, which is the Contractor's gain, may be computed from equations (3) and (9) as $1 - \frac{v}{c} \cdot \frac{1-c}{1-v} - \frac{c-v}{1-v}$.

Figure 2. The Hold-Up



The chief proposition of the model is that in the hold-up, total costs fall by less than the reduction in military utility, so there is a *deadweight loss*. The loss is found by subtracting the Contractor's gain from Defense's loss, that is:

$$D = 1 - \frac{v}{c} - \left(1 - \frac{v}{c} \cdot \frac{1-c}{1-v} - \frac{c-v}{1-v} \right) \quad (10)$$

which simplifies to $\frac{(c-v)^2}{c \cdot (1-v)}$. Again from $1 > c > v > 0$ we can check that

$$1 > \frac{(c-v)^2}{c \cdot (1-v)} > 0 \text{ and } D \text{ is a positive fraction.}$$

Anticipating such losses, what can Defense do? The standard solutions that we listed above involve market regulation by long-term contracts or market suppression through vertical integration. In the Soviet context we see that the standard solutions could not apply. Stalin ruled out vertical integration of Defense with the Contractor because he did not want to encourage the formation of a powerful military-industrial complex. The historical record shows that military interests advocated integration with the defense industry, but Stalin opposed it and quickly ruled it out. In 1927, for example, army commanders

Tukhachevskii, chief of the general staff, and Unshlikht, a member of the Revolutionary Military Council, sought powers for the Red Army over appointments to the defense industry, plans and reports of defense producers, and plans for capital investment in the industry Stalin rejected these proposals (Harrison and Simonov 2000: 230; Samuelson 2000: 42-47; Sokolov 2008). Tukhachevskii's subsequent resignation as chief of staff was most likely prompted by the failure of his ambition to control the defense industry (Samuelson 2000: 55-59). As for Stalin's motivations, divide-and-rule was a basic mechanism on which he built his power and this included keeping soldiers and industrialists at odds (Harrison 2003). Finally, vertical integration may have been impractical when military-technical requirements and industrial technologies were changing rapidly.

An intermediate solution to the hold-up problem is long-term contracting. Again, Defense could not apply this in the Soviet context. One reason is that, under Soviet rules, all contracts were rewritten at least once a year (Markevich 2008); no long term contract was worth more than the paper it was printed on. More formally, the Dictator could not credibly promise to uphold long-term agreements between Defense and the Contractor for sharing the gains from trade since he visibly had the power to break any contract and could not bind himself. Finally, long-term contracting may have been ruled out by the same rapidly changing military-technical requirements and industrial technologies.

Defense's last resort was to strike a bargain with the Contractor to restore quality at the expense of quantity, eliminate the deadweight loss, and share the gain from doing so. The gain was shared according to the players' relative bargaining power. Defense was still held up by the Contractor, but less inefficiently than otherwise. In the process the Dictator's intervention constraint was violated and so the readjustment was sustainable only if the players colluded to conceal the violation.

First, we define limits on the bargain. At one limit, defense could keep the entire gain by holding the Contractor's costs constant. Total costs at hold-up, producing some low quality items, were $\frac{v}{c} \cdot \frac{1-c}{1-v} - \frac{c-v}{1-v}$ (equation 10). In the figure, all points in the shaded triangle lie in the forbidden zone below the Dictator's intervention constraint, the 45° line. We use double-primes to denote the values resulting from the readjustment. Increasing the delivery of High and eliminating Low from the package, for the same cost the Contractor could deliver:

$$H''_{upper-bound} = \frac{v}{c} + D > H' \text{ and } L'' = 0 \quad (11)$$

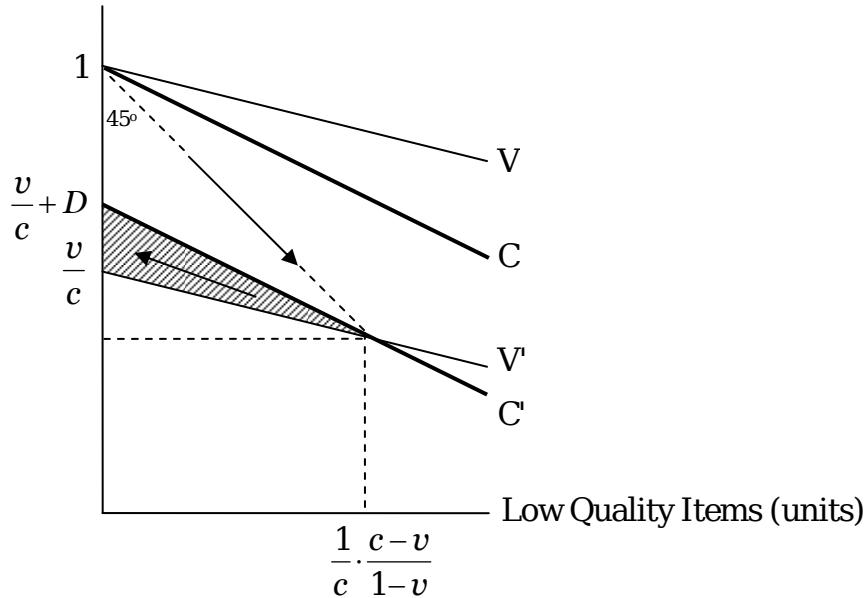
At the other limit, the Contractor could keep the entire gain by holding Defense at its reservation utility v/c . The Contractor could achieve this by eliminating low-quality items from the package and delivering:

$$H''_{lower-bound} = \frac{v}{c} > H' \text{ and } L'' = 0 \quad (12)$$

The shaded triangle in Figure 3 illustrates the upper and lower limits of the compromise. The arrow pointing northwest shows the direction of the resulting move. All points in the shaded triangle lie in the forbidden zone below the Dictator's intervention constraint, the 45° line.

Figure 3. Readjustment

High Quality Items (units)



The final outcome can be thought of as arising from the exogenous bargaining power β of Defense as a weighted average of the two bounds, so:

$$H'' = \frac{v}{c} + \beta \cdot D \quad (13)$$

Whatever bargain is struck, however, $H'' < H^*$. The plan is being violated in quantity, and the final readjustment moves both players into a region where the Dictator would intervene on being informed. The Contractor faces a clear risk: after the bargain, Defense can denounce it to the dictator for breaking the contract in quantity, and the Dictator can confiscate the Contractor's surplus or worse. To be willing to strike the bargain, the Contractor must bind Defense not to denounce it afterward, and Defense must be willing to be bound. There has to be a mechanism for collusion: Defense must join a conspiracy that hides not just the hold-up but also the bargain that restores quality at the expense of quantity. Otherwise, both sides will have to accept the deadweight loss and remain at the hold-up.

Finally, by weighing up all possible outcomes of the game, we learn about Defense's best initial choice. The best outcome for Defense is consummate fulfilment of the contract, which pays 1. But only perfunctory fulfilment pays the Contractor a surplus, so that is what the Contractor will always prefer. Given that Defense decided to search for high quality and because the Contractor will never deliver consummate

performance, Defense's payoff from the illicit bargain dominates all others. Backward induction then tells Defense whether or not to search in the first place. In this game, Defense's best choice is to search the market only if the unconditional expected payoff from search and contract followed by hold-up and renegotiation, $\frac{v}{c} + \beta \cdot D$, exceeds the payoff $\frac{v}{c} \cdot (1 + \bar{S})$ from going straight to the administered sphere without searching first; simplifying,

$$\text{Search if } \beta \cdot c \cdot D > v \cdot \bar{S} \quad (14)$$

In words, Defense should prefer to search for High only when its relative bargaining power, the relative cost of Low, and the potential deadweight loss (which stands for the scope for bargaining after the hold-up), are sufficiently large in comparison with the relative utility of Low and the cost of searching.

4. Bargaining Power

What decided bargaining power? The main instrument that the defense ministry used for bargaining in the market for weapons was its network of purchasing officers and the knowledge and experience that they could bring to bear.

The defense ministry's use of teams of serving officers, the so-called military agents (voennye predstaviteeli, voenpredy) permanently deployed to contractors' sites to regulate procurement from industry has been described previously in the literature on quality in the Soviet defense market (e.g. Albrecht 1993, Alexander 1978, Almquist 1990, Holloway 1982). It is well known that the military agents were charged with oversight of production, including adherence to technological standards and delivery schedules. To fulfil these obligations the military agents were entitled to free access to the entire factory site at any time, day or night, and to all documentation relating to technology, production, and mobilization. The management was obliged to support the military agents with necessary accommodation and equipment. Faced with substandard products the military agents could halt acquisition and, if necessary, production itself. Managers had no right to interfere directly in the work of the military agents, but could appeal over their heads to higher authority.

Our impression of the military agents through the Stalin period is that they were increasingly numerous – more than 20,000 in number by 1940 – and well trained. To protect their independence from management the military agents were salaried by the defense ministry and were prohibited from accepting rewards or benefits from the side of industry. By the standards of those they worked alongside they were well paid and not unduly taxed by overtime or other burdens; most likely for these reasons, they were generally free of corruption (Markevich and Harrison 2006).

There was little, therefore, that should prevent us from seeing the military officers in industry as the loyal agents of their employer, the defense ministry. The ministry itself clearly put a high value on their

services: in wartime, for example, at a time when the front was crying out for additional officers, the ministry three times rejected proposals that would have redeployed many military agents to the battlefield.⁴

Numerous anecdotes, moreover, testify with notable consistency that industry's officials and representatives saw the military agents in an adversarial light. This hostility arose because the military agents made frequent use of the main instrument at their disposal for enforcing quality, their right to refuse to accept goods and equipment that were not up to standard. By rejecting deliveries they threatened the ability of the defense contractors to show compliance with supply plans and contracts, and correspondingly threatened the careers and personal security of the industrial managers.

There is no doubt that military agents were willing and able to exercise these powers; many cases are reported when high proportions of monthly deliveries were returned or scrapped, sometimes up to 100 percent. In January and February 1934, for example, the Tula gun factory produced 3,000 carbines and 106 ShKAS machine guns, but only 800 rifles were accepted for the defense ministry and no machine guns at all. The 3,000 carbines "were presented for acceptance 23,000 times, almost 8 times per carbine on average."⁵ In March 1938 the military agents rejected the entire monthly output of defense industry factory no. 205 "in view of the totally unsatisfactory installation of electric plugs in all articles supplied."⁶ This degree of screening was much tougher than that arising from industrial self-regulation. Among the aircraft that the OTK of factory no. 126 passed in 1940, for example, the military agent found up to 80 defects.⁷ In the first nine months of 1940 of 6.6 million shell cases produced at munitions factory no. 184 the OTK scrapped less than three percent; after that, the military agent scrapped a further 10.5 percent.⁸

The power of the military agent to reject on grounds of quality was nonetheless more limited than might appear at first sight. One reason was the inability to verify observed quality to others. Military agents rarely looked to higher authority to impose punishments for low quality, and when they did they were typically unsuccessful. In 1933, for example, a military agent tried to use the party committee of aircraft factory no. 24 to bring to account those responsible for "malicious toleration of defective parts," but without success.⁹ We have found only one case that, of naval armament factory no. 347, where a military agent took the managers to court on criminal charges of supplying substandard goods; the court cast doubt on the accusations and the file was returned for further enquiries. A review by KPK, the ruling party's

⁴ Hoover/ RGANI, 6/2/49: 9 (July 7, 1943).

⁵ Hoover/ RGANI, 6/1/22: 34 (March 7, 1934); emphasis in the original omitted.

⁶ RGAE, 7515/1/404: 158 (Savchenko to M. Kaganovich, 1938).

⁷ Hoover/ RGANI, 6/2/27: 108 (July 29, 1940).

⁸ Hoover/ RGANI, 6/2/34: 158-159 (December 27, 1940).

⁹ Hoover/ RGANI, 6/1/91: 10 (March 17, 1934).

"control" (audit) commission, found that the judicial route was inappropriate and substituted dismissal for the criminal charges.¹⁰

Another limitation on the authority of the agent was that the contractor had avenues of appeal, and not infrequently in shifting the blame for delivery problems onto the military agents. In the case of the rejected output of the Tula gun factory in 1934 KPK auditors concluded that "discord between management and representatives of military acceptance on the score of product quality" lay behind persistent plan breakdowns.¹¹ In 1944 the KPK official for the Khabarovsk region reported that "vexatious litigation," with managers on one side and the OTK and military agents on the other, had taken hold of aircraft factory no. 126 on the issue of parts and components that did not conform to the blueprints. "These disputes . . . sometimes drag on for weeks . . . while business stands still."¹² If agents demanded inflexible adherence to standards, they laid themselves open to criticism for excessive zeal or caution. A KPK factory report of 1940, for example, condemned the OTK and military agent at aircraft factory no. 126 for "a tendency to over-insurance."¹³ Surveying the work of military agents in 1943 the KPK demanded that "the military agent should in most cases rule on the acceptability of one or another deviation [from standards] so as not to delay products for the front."¹⁴ Thus, while military agents may have tried not to accept goods that were clearly unserviceable, there was pressure on them to tolerate some level of defects.

Finally, the army needed weapons. In the years of urgent prewar rearmament, equipment supplied to military units often turned out to be unfit for service although the military agents had previously passed them as acceptable. Since high-ranking officials of the defense ministry were sometimes complicit in this, it must be supposed that for the armed forces, too, quantity was sometimes more important than quality. Chief of the air force purchasing administration Efimov, for example, was accused of colluding with malpractices: "not only did [he] not take measures to restore order but [he] even suppressed criticism of the defects, describing the communists who raised the criticisms as "cry-babies" and threatening them with dismissal."¹⁵ Confirmation of this hypothesis is found in evidence (discussed by Markevich and Harrison 2006) that standards were allowed to slip further in wartime.

In short, when military agents did not rigorously enforce defense ministry guidelines on substandard equipment, the main reason was that, as loyal agents of the armed forces, they could not reject everything that industry supplied.

It may be asked why, in the course of repeated interaction, the industrial and defense ministries did not learn about each others' preferences and resources so as to converge on a mutually beneficial

¹⁰ Hoover/ RGANI, 6/ 6/ 1616: 128 (May 13, 1941).

¹¹ Hoover/ RGANI, 6/ 1/ 22: 36 (March 7, 1934).

¹² Hoover/ RGANI, 6/ 2/ 27: 108- 109 (July 29, 1940).

¹³ Hoover/ RGANI, 6/ 2/ 27: 109 (June 29, 1940).

¹⁴ Hoover/ RGANI, 6/ 2/ 49: 9 (July 7, 1943).

¹⁵ Hoover/ RGANI, 6/ 2/ 17: 47 (KPK bureau decree, December 3, 1939).

equilibrium in which the defense ministry obtained goods of the quality it required and the industrial contractors were able to fulfil their plans without the need for costly rejections and plan failures. Most likely the annual process of plan and contract revision prevented the hold-up problem from being solved by long-term contracting. Instead, the planning process focused each side on extracting the maximum short-term advantage from the other, year after year. Another reason may be that learning was inhibited by very rapid change in the product assortment: in the 1930s, for example, one year's procurement of aircraft rarely replicated the profile of purchases in the year before to any significant extent.

5. Collusion

To summarise, the defense ministry tried to reach across the market for weapons by deploying thousands of military engineers to the factories of the defense industry. These agents had a dual role. Their first duty was to prevent the defense ministry from being held up and to enforce its contracts. They monitored the process of contract fulfilment with special regard to quality, and aimed to reject items for purchase when their quality fell below some threshold level. The work of the military agents made the quality of military goods to a large extent observable at the time of purchase. When contractors tried to cut the supply of high-quality items, the defense ministry sought to prevent their replacement by low-quality items, and this opened contractors up to penalties for defaulting on quantity. In practice, however, the military agents and their superiors tended not to make trouble for the contractors over quantitative shortfalls. This suggests that the contractor's cooperation was available at a price: the defense ministry had to accept shortfalls on quantity and help conceal them from the dictator's prying eyes.

In setting out the hold-up problem in the market for weapons, we made two predictions. First we suggested that, when held up by the seller, the buyer would find it more important to uphold quality than quantity. Second, we suggested that buyer and seller would be jointly interested in collusion to conceal the resulting shortfall on quantity. Consistent with these expectations, we find that military agents typically took a harder line over quality than quantity. They were ready to offer some leeway to contractors over quantitative fulfilment as the price for maintaining quality. The outcome was a bargain which fell short of the initial contract but, by restoring quality at the expense of quantity, was more efficient than the contractor's initial post-contract offer. The defense ministry was still held up, but less inefficiently than would have happened otherwise, and in return allowed its agents to help conceal the contractor's otherwise verifiable shortcomings.

Procurement delays were often concealed. The KPK archive contains many cases of reports falsified by both civilian and defense enterprises. The usual form was to exaggerate output over the accounting period by including *pripiski*, goods that did not exist yet but would be produced in the next period. *Pripiski* allowed the enterprise to claim fulfilment of the plan and entitlement to a bonus by "borrowing" future output.

This practice involved criminal deception. A single enterprise could not undertake it successfully in isolation, therefore; ministerial superiors had to know about it and the customer had to go along with it in silence. The wider the circle involved, the greater were the risks of disclosure. Despite such risks, however, in the seller's market for civilian goods the power of suppliers was often enough to win the cooperation of both superiors and purchasers (Berliner 1957). Arthur J. Alexander (1978: 59n) speculated that the same would be found in the defense industry, and the archives show that he was right.

A KPK report of 1946 for example, claimed that a tank factory director "is systematically engaging in the *pripiska* of goods that have not finished production" and that his chief administration, although aware of this, "has not only not prevented but has even rewarded it."¹⁶ Similarly, the KPK found that in 1944 the relevant administration of the armament ministry told a factory director "to report inflated information to the ministry."¹⁷ In September 1944 the KPK acknowledged that *pripiski* were widespread: in 1943 and 1944 an armament factory had "continually reported falsely inflated information about the fulfilment of the factory's program, typically using from 5 to 20 days of the following month to complete production"; an aircraft factory had reported "incorrectly inflated information about plan fulfilment" in 1943 and for the months of January, February, and March 1944; the managers of a tank factory "have also been deceiving the government and ministries by reporting false information on the fulfilment of the production program."¹⁸ There were even *pripiski* in a vehicle repair factory of the defense ministry itself; the ministry's vehicles administration, while "aware of all the factory's shortfalls and lack of management, took no measures to overcome them."¹⁹

Widespread *pripiski* indicate a systematic tendency for industry to ignore delivery deadlines: goods were regularly delivered to the defense ministry a month or more late. The military agents could never have been unaware of this. Military agents virtually never took action to enforce deadlines. Of all the cases of *pripiski* that the KPK uncovered, only two were reported by military agents. In September 1941 a military engineer reported an unacceptable delay in an order for gas protection equipment placed with the ministry of general engineering.²⁰ Intervention by the KPK secured a new deadline for the order, but no penalty for the delay. In 1943 a military agent and his senior technician reported on "deception and irregularities" at an electrical factory; this led to a special audit commission which confirmed the various violations.²¹ We have found no other cases.

¹⁶ Hoover/ RGANI, 6/2/98: 81, 85 (August 2, 1946).

¹⁷ Hoover/ RGANI, 6/2/67: 11 (1944).

¹⁸ Hoover/ RGANI, 6/6/1583: 10-13 (July 15, 1944).

¹⁹ Hoover/ RGANI, 6/6/1583: 31 (October 26, 1948).

²⁰ Hoover/ RGANI, 6/6/47: 18 (September 29, 1941).

²¹ Hoover/ RGANI, 6/2/55: 1-2 (KPK bureau decree, October 28, 1943).

External KPK auditors themselves uncovered other *pripiski*. When they did so, they found that the military agents had colluded in the deception. In 1944, for example, the military agent had joined the director of an armament factory in signing a cable reporting 101.5 percent fulfilment of the April program when both knew this to be false since it took part of the May program into account. Significantly, higher officials representing *both seller and buyer* had approved the *pripiska* by April 30.²² They justified this on the basis of precedent; the defense official noted that he had approved similar arrangements in other cases "to avoid a breakdown of the plan and provision for the needs of the troops."²³ It was the same in the tank factories. In 1942 the KPK officer for Sverdlovsk district found evidence of largescale *pripiski* for September, October, and November at the Uralmash factory not just "with the ministry's knowledge" but "on the instruction" of the minister and deputy minister, and with the collusion of the military agent.²⁴

In short, deadlines for the supply of armament seem to have caused little anxiety to military agents; and even their superiors were ready to approve delays. The military agents did have to *look* as if they supported firm deadlines. This led them to collude with enterprise managers in falsifying reports of plan fulfilment. In return, they gained cooperation over quality.

Conclusions

Military market places display obvious inefficiencies under most institutional arrangements, but that of the Soviet Union was characterized by monopoly and exclusivity to an unusual degree. This presents a particular problem in the scope for one side to hold up the other. We have shown that in the Soviet defense market it was the seller that was best placed to hold up the buyer. The form that the hold-up typically took was for the contractor to default on quality.

This hold-up problem could not be resolved by the conventional means recommended by economic theory: vertical integration was not in Stalin's political interest, and long-term contracting was ruled out by the discretionary logic of command planning under a dictator. Instead, the defense ministry sought to solve the problem by deploying agents through industry to observe quality and reject substandard goods, threatening industrial contractors with an easily verifiable shortfall on quantity. The defense ministry was prepared to employ tens of thousands of purchasing agents and pay them well for their loyalty, even in the midst of a total war. These agents, however loyal, still had to reach a compromise with the industrial producers. In the typical bargain the military agents agreed to overlook quantity violations in return for greater cooperation on quality.

²² Hoover/ RGANI, 6/2/63: 159-160 (June 5, 1944).

²³ Hoover/ RGANI, 6/2/63: 21 (July 8, 1944).

²⁴ RGAE, 8752/4/108: 151-151ob (December 7, 1942).

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