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Army, tax reforms, and well-being in eighteenth-century Russia

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Abstract

This article examines archival records on crop yields and recruit numbers in eighteenth-century Russia, analyzing their dynamics and comparing them with data on recruits' height as an indicator of changes in the standard of living. The study uses more than one hundred and ten archival sources, enabling the construction of time series. The resulting numbers confirm that the standard of living in Russia was generally low and changed in a cyclical pattern. The study reveals how military and tax reforms emerged as a significant driver of these economic fluctuations. The dataset compiled by the author not only facilitates estimations of living standards during this period but also enables researchers to address various questions in Russian social and economic history.

Keywords: standards of living, crop yield, war cycles, Russian economic history.
JEL classification: E32, N23, N33, N43, N53.

1. Introduction

The purpose of this study is two-fold. First, it intends to show that data on military recruits allow a fresh approach to the dating of war cycles and assessing their impact on the economy. It is necessary to remind that there are at least two groups of scholars who believe that wars are central to the economic wave, although there is disagreement about cause and effect. Whereas one group posits that the waves result from major wars, the second group claims that the waves arise from a two-way causality between war and economic growth. However, their arguments are derived mainly from the history of the West (Kondratieff, 1979; Goldstein, 1988; Poletaev and Savelieva, 2009).

Second, the present study evaluates the use of recruits' height data as an indicator of changes in the standard of living. These data are used extensively

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in anthropometric studies because the most common sources for male heights in the eighteenth and nineteenth centuries are military records. Anthropometric studies offer valuable insights into historical living standards (Komlos, 1993; Grubb, 1999; Carson, 2008). However, some notable researchers have raised doubts about the quality of historical height data. Their principal interpretive concern is the same: "If we see that one group is taller than another, or that a group grew taller or shorter over time, can we trust that these patterns reflect genuine differences in heights? Or do they reflect the operation of height-based selection?" (Bodenhorn et al., 2019, p. 1155).

The Russian historical experience has frequently been overlooked in these discussions. The exception is Boris Mironov's study: in 1985, he published a book providing a vast database of Russian grain prices by region and by year from 1708 to 1915. The book presented the results of researching economic cycles and argued that there was no relation between war years and years of high grain prices in the Russian Empire. Here, Mironov's method was imperfect: he only listed wars in periods of price increases and decreases (Mironov, 1985).[1]

His recent research is also relevant to the relationship between the economy and war. Using data on recruits' height and other anthropometric indicators, he showed how the standard of living in Russia changed over slightly more than two centuries. He came to the following conclusions: The standard of living changed in a cyclical pattern until the mid-nineteenth century. The pressure of taxation was the most important factor in causing these fluctuations. The pressure of taxation, in turn, was dependent in part on the state's military activity. Since the mid-nineteenth century, the Russian Empire was experiencing a breakthrough in the standard of living. Therefore, the Russian revolutions of 1905 and 1917 "were due not so much to social-economic as to political factors", particularly the power struggle between the old and new elites (Mironov, 1999, 2004, 2012).

Some historians welcomed Mironov's study; others harshly criticized it, particularly his view on the causes of the Russian revolutions (Hoch, 1999; Dennison and Nafziger, 2013; Gregory, 2014; Nefedov, 2015; Dvornichenko, 2023). As a result, most of Mironov's critics focused their attention on the post-reform period (1861–1913): they revealed several inaccuracies and errors in his calculations, doubted the quality of the recruits' height data, and criticized the methodology of historical anthropometrics. Unfortunately, only a few researchers addressed the eighteenth and first half of the nineteenth centuries. Criticisms of Mironov's findings for this period are conjectural and lack empirical statistical validation. For instance, as Steven Hoch points out, Mironov's estimates, on the one hand, are too low because the poor carried most of the conscription burden: "peasant communes could purchase recruit exemptions by paying volunteers" (Hoch, 1999, p. 324). Furthermore, it was common practice to bribe doctors to accept recruits who did not meet the minimum height requirement. On the other hand, the Russian Empire "suffered from extraordinarily high levels of infant and child mortality" (Hoch, 1999, p. 325), which tended to eliminate shorter people from the height distribution. Obviously, in the absence of empirical data, we cannot state whether Mironov's figures are overestimated or underestimated, much less assess the accuracy of their dynamics.

[1] A similar method was used by Nikolai Kondratieff (1979).

We also note that Soviet academics performed a tremendous amount of work to collect historical statistical data of the Russian Empire. However, some important data did not attract due attention of the participants in the discussion. Using these datasets and newly uncovered archival materials, we re-evaluate the relationship between military conflicts and the Russian economy.

2. Recruit statistics and war cycles

In the war cycle literature, key variables are battle deaths, the wars' frequency, and their duration (Goldstein, 1988; Poletaev and Savelieva, 2009). However, these variables are not relevant for the study of the war histories of individual countries: using such data, we cannot construct a continuous time series. Only long time series data support appropriate tests of hypotheses about the existence of cycles (Poletaev and Savelieva, 2009).

For this reason, we focus on Lyubomir Beskrovny (1958, 1973) data on the number of recruits, covering more than a century and a half. In 1699, Peter the Great introduced a new approach to conscription that, with minor changes, was to endure until 1874. On numerous occasions, Russian monarchs raised the numbers of recruits by decreeing additional levies in response to the progress of wars. However, the recruitment was not conducted on an annual basis, making it difficult to analyze this data.[2] Consequently, we considered three-year periods starting from 1699.

Can Beskrovny's recruitment data be considered reliable? Our analysis began with a close examination of the primary source document,[3] which shows only slight variations from Beskrovny's published figures. However, the document in question records only the annual totals of conscripted recruits, without providing any information necessary to evaluate their reliability. Fig. 1 sheds light on this question by summarizing the number of recruits and the government's decrees on conscription. Certain decrees announced and organized individual recruitment campaigns, while others introduced partial reforms to the conscription system itself. We can see that the series broadly co-move: periods with more conscription-related decrees typically coincide with higher recruitment. We also note that the data on the decrees are reliable: we took them from "*Complete collection of laws of the Russian Empire"* (Complete collection, 1830). Therefore, although Beskrovny's data are far from ideal, they are reliable and suitable for estimating long-term trends.

Fig. 1 also shows five complete and one incomplete medium cycles with peaks in 1709–1711, 1721–1723, 1736–1738, 1757–1759, 1769–1771, and 1787–1789. Adding to that, Beskrovny's data for the first half of the nineteenth century reveal medium cycles peaking in 1811–1813, 1829–1831, and 1853–1855 (Beskrovny, 1973, pp. 71–79, 85–86). Note that the clear cyclical pattern in the data argues against a significant demographic influence. Studies reconstructing population from fragmentary evidence reveal a strong linear trend (Kahan, 1985; Broadberry and Korchmina, 2024), contrasting sharply with our cyclical indicators. It follows

[2] Furthermore, the intervals between recruit levies could last for several years, as was the case in 1749–1753, 1760–1766, 1774–1775, 1791–1792, and 1800–1801.

[3] Russian State Archive of Ancient Acts (RSAAA), F. 1261, Op. 12, D. 4.

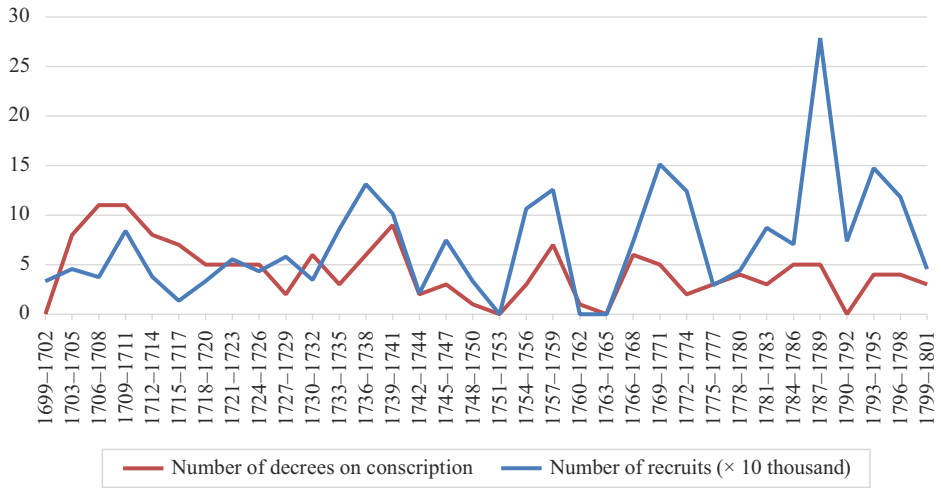

Fig. 1. Decrees on conscription and recruit statistics, 1699–1801.

Sources: Beskrovny (1958, pp. 26–37, 294–297); Complete collection (1830, Vol. 42, part 2, pp. 785–788).

that adjusting for per capita recruit dynamics would not meaningfully change *the periodization* of these cycles.

Note also that a wide range of statistical tools has been used by researchers for the empirical detection of medium and long waves: spectral analysis, log linear trends, filter design approach, wavelet analysis, and other methods (Poletaev and Savelieva, 2009; Metz, 2011; Gallegati et al., 2017). However, there is still considerable disagreement about these methods. As a rule, they are used for finding evidence on the existence of waves after World War II. For this period, waves are difficult to detect because of the positive trend displayed by data. In contrast, analyses of the preceding period typically rely on identifying cyclical patterns either through visual inspection or by applying an adapted Kondratieff's method (Zschocke, 1984; Mironov, 1985; Rastyannikov and Deryugina, 2009). Our dataset possesses a key characteristic that simplifies this task: the period under observation shows no pronounced secular trend. Consequently, a visual inspection of Fig. 1 is sufficient to identify a distinct succession of medium-term waves. The only difficulty is that the number of recruits was approximately the same in 1721–1723 and 1727–1729. However, we cannot consider the years 1727–1729 as the peaks of military activity because at that time a third of the troops were sent on a long vacation.[4]

To verify our findings, we conducted an additional verification using Kondratieff's methodological framework. This involved calculating a theoretical trend series,[5] which was then subtracted from the empirical data series. The resulting residual series represents the empirical deviations from the modeled long-term trend. This latter curve contained all the remaining components from the original data. To isolate the medium-term cycles of interest, this residual series was then smoothed using a six-year moving average, which filtered out short-term fluctuations and random noise (Fig. 2). We then repeated this procedure using a different

[4] Complete collection (1830, Vol. 8, p. 242).

[5] Secular trend for the period from 1699 to 1801: $y = 0.2237x + 3.1434$.

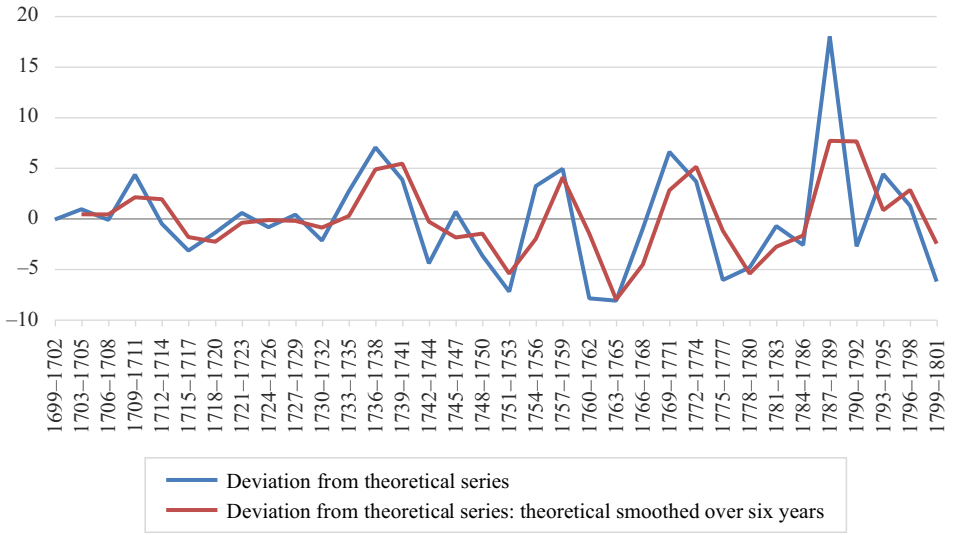

Fig. 2. Number of recruits in Russia, 1699–1801.

Source: Beskrovny (1958, pp. 26–37, 294–297).

trend equation[6] because the choice of the specific form of the curve may affect the results. Furthermore, we repeated the analysis, extending the dataset to include the first half of the nineteenth century. This is important because the ends of the curves may have an effect both on the form of a curve and on its direction (Kondratiev, 1998). Nevertheless, these tests reveal distinct medium-term cycles, broadly confirming the chronology proposed above. Attempting to establish an exact chronology for the cycles is impractical, given that Beskrovny's data do not possess absolute precision.

The average interval between them is 18 years. In most cases, these peaks coincide with the periods of major wars and rebellions: the Great Northern War (1700–1721), the Bashkir Rebellion (1704–1711), the Pruth River Campaign (1711), the Persian Expedition of Peter the Great (1722–1723), the Bashkir Rebellion (1735–1740), the Russo-Turkish War (1735–1739), the Seven Years' War (1756–1763), the War of the Bar Confederation (1768–1772), the Russo-Turkish War (1768–1774), the Russo-Turkish War (1787–1791), the Russo-Swedish War (1788–1790), the Russo-Persian War (1804–1813), the Russo-Turkish War (1806–1812), the French invasion of Russia (1812), the Russo-Turkish War (1828–1829), the November Uprising (1830–1831), and the Crimean War (1853–1856).

Obviously, wars were forcing the government to increase the number of recruits. But military conflicts were not the only reason for the cyclicality. Even if Russia had not waged any wars in the eighteenth century, the government would still have carried out periodic conscriptions. We assume that natural deaths (i.e., non-battle deaths) were also forcing the government to periodically increase the size of the army. Furthermore, the numerical strength of the Russian army constituted a dual strategic determinant: it could influence both the Russian emperors' decisions regarding military engagement and foreign powers' calculations concerning potential aggression against Russia. The available documen-

[6] Secular trend for the period from 1699 to 1801: $y = 0.0055x^2 + 0.0325x + 4.2908$.

tary evidence allows us to advance this hypothesis (Pekarsky, 1862, pp. 93–94; Collection, 1886, pp. 4–21; Limonov, 1989, pp. 316–317). Therefore, we assume there was a two-way causality between the wars and the number of recruits.

3. Living standards and tax burden

As mentioned above, Mironov's recent research shows that the standard of living in Russia changed in a cyclical pattern. It declined in 1701–1730, 1751–1760, 1771–1795, 1821–1825, 1856–1865, 1891–1895, and 1901–1905, but rose in 1731–1750, 1761–1770, 1796–1820, 1826–1855, 1866–1890, 1896–1900, and 1906–1915 (Mironov, 2012). This corresponds directly to periods of growth or decline in the recruits' height, but it is necessary to link data on the average height of males in the reference group (Table 1, column 3) to birth years (Table 1, column 1), not the year when these measurements were taken (Table 1, column 2). This is necessary because "in a sequential comparison of height data, whether year upon year or quinquennium upon quinquennium, the first year of life — i.e., the birth year — is decisive in determining height" (Mironov, 2012, p. 32).

According to Mironov, the pressure of taxation was the most important factor in causing these fluctuations. Why did the government increase or reduce the tax

Table 1
Mean male height by birth cohort and the number of recruits in Russia, 1701–1825.

Birth years	Conscription years	Height of reference group [a] (centimeters)	Number of recruits (thousands)
1	2	3	4
1676–1680	1701–1705	n/a	45.5
1681–1685	1706–1710	n/a	69.5
1686–1690	1711–1715	n/a	101.3
1691–1695	1716–1720	n/a	36.3
1696–1700	1721–1725	n/a	75.9
1701–1705	1726–1730	164.8	96.9
1706–1710	1731–1735	163.9	104.2
1711–1715	1736–1740	163.9	203.8
1716–1720	1741–1745	163.3	80.4
1721–1725	1746–1750	163.1	77.5
1726–1730	1751–1755	161.4	61.5
1731–1735	1756–1760	162.2	170.7
1736–1740	1761–1765	163.4	0 [b]
1741–1745	1766–1770	163.7	167.8
1746–1750	1771–1775	164.0	181.1
1751–1755	1776–1780	162.3	73.3
1756–1760	1781–1785	162.3	140.1
1761–1765	1786–1790	162.7	369.8
1766–1770	1791–1795	163.4	147.4
1771–1775	1796–1800	163.0	163.9
1776–1780	1801–1805	162.6	308.0
1781–1785	1806–1810	161.6	393.6
1786–1790	1811–1815	161.4	726.2
1791–1795	1816–1820	161.3	315.4
1796–1800	1821–1825	162.2	54.6

Note: [a] This is the mean height of males having identical characteristics: age, birth year, social estate, marital status, occupation, etc.
[b] See footnote 2.
Sources: Mironov (2012, pp. 95–96); Beskrovny (1958, pp. 26–36, 294–297; 1973, pp. 71–74).

burden? First, the pressure of taxation was dependent on the state's military activity. Mironov takes into account the increase in direct and indirect taxes during military conflicts. He also observes that from 1707 certain population groups obtained the right to buy an exemption (15 rubles per recruit), and the government later repeatedly raised the cost of a new conscript (to 100 rubles in 1734, to 120 rubles in 1766, to 360 rubles in 1776, and to 500 rubles in 1783; see Mironov, 2012, p. 109–110). To this, we can add that Russian peasant communities were responsible for providing recruits to the army from their villages and paid emergency fees for the supply of recruits. Often, these fees equaled about half of a poll tax (Mustafin, 2019), instituted by Peter the Great in 1724 to fund the Imperial Army.

Second, Mironov notes that "each new ruler granted a remission of arrears and temporary reduction in state pressure on the poll-tax population" (Mironov, 2012, p. 108). Upon ascending the throne in 1725, Catherine I reduced the poll tax from 74 to 70 kopecks. Temporary reductions were made in 1728, 1730, 1740, and 1741. In historiography, the easing of the fiscal burden is traditionally explained by political or class interests (Troitsky, 1966; Anisimov, 1982). We should note that, on the one hand, these reductions coincided with peacetime. An exception, at first glance, is the poll tax reduction by Elizabeth, whose reign began during the Russo-Swedish War (1741–1743). However, upon her accession, she concluded an armistice with Sweden, casting doubt on the continuation of the war. On the other hand, the reductions in the poll tax also aligned with the period when the Russian government faced no obligations to service external debt. Prior to 1769, Russia financed all its military campaigns without resorting to foreign borrowing. Here, for comparison, it is useful to consider the "ratchet effect" observed in the history of other European countries. This effect demonstrates that an inflated wartime budget fails to return to its prewar level, meaning taxes did not decline in post-war countries. This occurs "because the wartime accumulation of debt places new burdens on the state" (Tilly, 1990, p. 89).

We should examine the history of the salt tax in greater detail, as it underwent the most substantial changes of any levy in eighteenth-century Russia. Until 1705, the price of this commodity was determined by market forces, with a specific duty levied for the benefit of the state. The increase in military expenditures necessitated the introduction of a state monopoly on the salt trade: the government began purchasing it from contractors and selling it to the population at a set price. As a result of this reform, consumer costs approximately doubled (Dmitrieva and Kozlov, 2020).

After the death of Peter I, the government began seeking opportunities to reduce the tax burden. It is evident that the onset of peacetime made this feasible. Consequently, in 1728, the government decided to abolish the state monopoly: free trade in salt was permitted, with a duty of 5 kopecks levied per pood of salt sold. However, the reform yielded unexpected consequences: the abolition of the state monopoly led to a nearly threefold reduction in revenue from salt sales (Troitsky, 1966). This occurred because consumer prices remained largely unchanged (Table 2), and thus the anticipated increase in consumption did not materialize. To estimate price dynamics, we utilized data from the Moscow market due to its unique position: it was nearly equidistant from key salt-producing centers and functioned as a marketplace for salt from different regions. According to

Table 2
Prices for salt in Moscow under state (1725–1727, 1732–1734) and free (1728–1730) trade.

Years	1725–1727	1728–1730	1732–1734
Mean price (kopecks per pood)	24	22	24
Number of observations	33	31	29
Standard error of mean	0.07	0.23	0.15

Sources: Central State Archive of Moscow (CSAM), F. 421, Op. 1, D. 1087, 1134, 1220, 1299, 1359, 1456, 1573, 1575, 1576, 1693, 1699, 1779, 1780, 1782, 1783; RSAAA, F. 236, Op. 1, D. 207; F. 1441, Op. 2, D. 1385.

the official version, the introduction of free trade even led to an increase in prices.[7] Therefore, the reinstatement of the state monopoly in 1731 should not be viewed as an attempt by the government to increase the tax burden during peacetime.

Over the following decade, the government refrained from implementing any changes. It appears that the first proposal to raise the price of salt emerged only during the Russo-Swedish War (1741–1743). In the late 1740s, P. I. Shuvalov advanced a similar proposal, advocating for a unified salt price of 35 kopecks across most regions. This measure was implemented in 1750, but it did not signify an increase in the overall tax burden. The government, upon announcing the increase in the salt price, concurrently declared a decrease in the poll tax. Indeed, between 1751 and 1755, it was lowered. Soon thereafter, in 1756, due to rising military expenditures, the price of salt was raised again from 35 to 50 kopecks per pood (Troitsky, 1966). Consequently, during the reign of Elizabeth, the nominal price of salt more than doubled. The real price of the commodity reached 10.4 grams of silver, a level remarkably close to that of 1647.[8]

During the reign of Catherine II, the government twice reduced the price of salt: by 10 kopecks in 1762 and by a further 5 kopecks in 1775. These reductions occurred during peacetime: the first following the Seven Years' War, and the second after the Russo-Turkish War (1768–1774) and Pugachev's Rebellion (1773–1775). It should be noted that although Russia began receiving foreign loans in 1769, the indemnities exacted from Turkey enabled the repayment of a substantial portion of this debt (Dmitrieva and Kozlov, 2020, p. 286). Consequently, the post-war financial environment afforded the government the latitude to reduce the tax burden. By early 1791, a confluence of pressures — including the salt monopoly's unprofitability, the ongoing Russo-Turkish War (1787–1791), and a burdensome external debt — compelled a 5-kopeck increase in the price of salt (Kahan, 1985).

The pattern observed — wartime tax hikes followed by peacetime reductions — stands in contrast to the typical "ratchet effect" seen in global history. These instances should, however, be interpreted as exceptions that prove the rule: the absence of a crippling external debt — a condition rarely present in other states — allowed for repeated tax reductions in the early modern period. Based on the foregoing analysis, it can be inferred that the standard of living in Russia declined during periods of military activity and increased in peacetime. As illustrated in Fig. 3, this pattern is evident in the inverse link between the number of recruits and the mean height of males. We observe that as the number of recruits

[7] Complete collection (1830, Vol. 8, pp. 530–531).

[8] Following the reform under Tsar Alexis Mikhailovich, the average price of salt, for example in Vologda, reached 29 kopecks (12.6 grams of silver) per pood (RSAAA, F. 1201, Op. 1, D. 49; F. 1441, Op. 1, D. 1441).

Fig. 3. Number of recruits and mean male height in Russia, 1701–1800.

Sources: Mironov (2012, pp. 95–96); Beskrovny (1958, pp. 26–36, 294–297; 1973, pp. 71–74).

dropped, the mean male height typically increased, and vice versa. That finding is confirmed by the available data for the first half of the nineteenth century (Beskrovny, 1973, pp. 71–79, 85–86; Mironov, 2012, pp. 118–120). The most notable exceptions occurred during Anna's reign (1730–1740) and the early years of Catherine the Great's rule (1762–1796).

As noted above, the identified medium cycles emerged, in part, due to the structural characteristics of Russia's recruitment-based military system. Our findings demonstrate that these cyclical patterns exerted a substantial influence on fluctuations in fiscal pressure and, accordingly, on the standard of living in Russia. From this, we can assume that following the introduction of universal conscription under the modern system in 1874, the dynamics of living standards in Russia became less cyclical. This conclusion is strongly supported by Mironov's research: "The second half of the 1860s, however, saw the start of a long period of increasing stature that lasted until World War I" (Mironov, 2012, p. 120). Only twice and briefly, in 1891–1895 and 1901–1905, did height fall.

Overall, Mironov's data show that the eighteenth century is notable for the decline in the living standard of the Russian population. This was also due to epidemiological conditions, rising dues, and declining agricultural yields, primarily caused by colder climatic conditions (Mironov, 2012). "Much of European Russia witnessed", Mironov claims, "a higher frequency of unfavorable climatic conditions — harsh winters, strong winds, prolonged precipitation, and the like" (Mironov, 2012, p. 98). In the meantime, he does not regard these factors — including agricultural yields — as the cause of cyclical fluctuations in population well-being. However, there are also opposite views: "For the overwhelming majority of the inhabitants of eighteenth-century Russia, the rhythm of life," Arcadius Kahan wrote, "was determined not by the wars or reforms of Peter the Great, nor by anything his successors managed to accomplish or failed to do, but by the conditions of the agricultural cycle of plowing, planting, and harvesting the Russian fields. The sustenance of the vast majority of Russians depended less upon the level of rents, the burden of government taxation, or

profits derived in domestic or foreign trade than upon the work of nature. Of paramount importance was the size of the harvest, the ratio of harvested grain to the seed planted (the output-seed ratio)" (Kahan, 1985, p. 46). However, both historians relied on fragmentary crop-yield data in their analyses (Indova, 1970).

4. Living standards and crop yields

One should address the archival data on crop yields. We use the records of monastic books to assess the level of this indicator. Most of the surviving books were written by members of the Don Monastery, the Medvedeva Pustyn Monastery, the Tikhonov Pustyn Monastery, the Sharovkin Monastery, the Zhizdrinsky Monastery, the Vidogozhsky Monastery, the Zlatoust Monastery, the Znamensky Monastery, the Joseph-Volokolamsk Monastery, and the Dudin Monastery. Our research also draws on data from dissertations (Baranov, 1954; Slesarchuk, 1955; Komissarenko, 1984) that have been largely overlooked in the historiography, which contain material on the Pafnutiev Borovsky Monastery and the Spaso-Evfimiev Monastery. Many of these monasteries also owned villages in neighboring provinces. Our data on crop yield, therefore, refer to the Central Non-Black Earth Region.[9] The data allow us to construct rye yield series that cover the period from 1700 to 1760. Unfortunately, following Catherine the Great's secularization in 1764, information on crop yields was rarely collected in the monasteries.

Homogeneity of data is a prerequisite for calculating averages and constructing accurate time series (Poletaev and Savelieva, 2009, pp. 235–237). In the context of this study, the primary risks emerge from aggregating data obtained from different types of households — monastic, court, nobility, and peasant. Their heterogeneity is primarily due to differences in agricultural practices and methods of yield accounting. These records are unevenly represented. Only monastic estates are documented most comprehensively. Data on other estate types are fragmentary (Volkov, 1959), and their inclusion in the analysis could distort the overall dynamics. However, natural and climatic factors could not exert a selective influence within the same region; they determined the yields of all types of households. Consequently, our data are well-suited for describing yield *dynamics* in the Central Non-Black Earth Region.

We compiled a substantial dataset for historical analysis. Each sample exceeds thirty observations, with individual sizes ranging from 68 to 123 data points (Table 3). This robust volume of data resulted in a low standard error, indicating that the sample means are tightly clustered around the population mean. We examined the data for normality and found that thedistributions are unimodal and broadly mound-shaped, although some skewness is visible (Fig. 4). Consequently, the results of calculating the arithmetic mean, median, and mode are similar. For our analysis, we selected the arithmetic mean. A comparison of our results with other average indicators did not reveal any discernible lag effect, most likely due to the close interdependence of the studied variables. In particular, anthropomet-

[9] For a correct comparison of our data with Mironov's, we use the zoning he proposed. Mironov classified the territories of Vladimir, Vologda, Kaluga, Kostroma, Moscow, Nizhny Novgorod, Smolensk, Tver, and Yaroslavl provinces (within their end-of-nineteenth-century borders) as the Central Non-Black Earth Region (Mironov, 1985, p. 34).

Table 3
Rye yields in the Central Non-Black Earth Region of Russia.

Years	Rye yields (crop capacity) [a)]	Number of observations	Standard error of mean
1701–1705	2.6	69	0.16
1706–1710	2.4	83	0.11
1711–1715	2.5	69	0.12
1716–1720	2.3	102	0.10
1721–1725	2.1	76	0.10
1726–1730	2.3	68	0.20
1731–1735	1.7	96	0.08
1736–1740	3.3	78	0.21
1741–1745	2.0	123	0.10
1746–1750	2.6	62	0.18
1751–1755	2.3	78	0.16
1756–1760	2.6	105	0.13

Note: [a)] Seed-grain ratio.
Sources: Crop capacity in 1700–1740, 1751–1760: CSAM, F. 421, Op. 1, D. 65, 69, 125, 143, 192, 194, 234, 236, 255, 283, 310–312, 335, 441, 472, 475, 501, 530, 541, 582, 583, 668, 745, 746, 825, 827, 889, 1004, 1049, 1051, 1072, 1112–1114, 1494, 1636, 1640, 1731–1734, 1821, 1843–1845, 1940, 2194, 2195, 2377, 2380, 2499–2501, 2571, 2627, 3062, 3063, 3627, 3726, 3823, 3825, 3927, 4085, 4087, 4179, 4180, 4303, 4363, 4430, 4497; RSAAA, F. 390, Op. 1, D. 7025; F. 236, Op. 2, D. 4077; F. 1190, Op. 1, D. 3; F. 1191, Op. 1, D. 499, 500, 504; F. 1192, Op. 3, D. 20 (1732), 32 (1733), 57 (1751); Department of Manuscripts of the Russian State Library, F. 29, D. 122; Baranov (1954, p. 102); Slesarchuk (1955, pp. 128–141); Komissarenko (1984, pp. 24–49); *crop capacity in 1741–1750:* see Fig. 4.

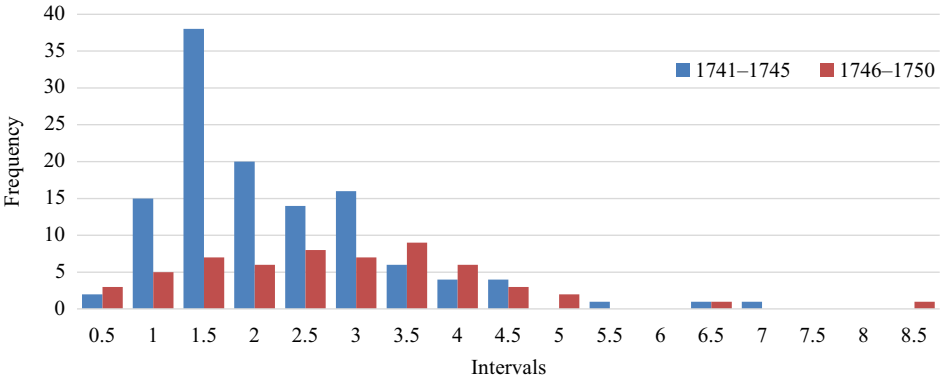

Fig. 4. Rye yields in the Central Non-Black Earth Region in 1741–1745 and 1746–1750.

Sources: 1741–1745: CSAM, F. 421, Op. 1, D. 2740, 2741, 2743, 2860, 2958, 3060, 3061; RSAAA, F. 390, Op. 1, D. 7025, 7706, 7720, 9380, 10148, 10285, 10297, 10307, 10416; F. 1190, Op. 1, D. 3; *1746–1750:* CSACM, F. 421, Op. 1, D. 3217, 3297, 3318, 3322, 3386, 3502, 3624, 3627; RSAAA, F. 390, Op. 1, D. 14560; F. 1190, Op. 1, D. 3; F. 1191, Op. 1, D. 514.

ric measures appeared to react quickly to economic shocks because "the first year of life… is decisive in determining height" (Mironov, 2012, p. 32).

We also assessed the reliability of the data. The central methodological challenge was the lack of independent sources for verification. In one and the same village, different fields could have completely different yields. Consequently, we can only assess data reliability by comparing trends in average values. We can compare our findings with Mironov's data on grain prices (Mironov, 1985). Our verification showed that his data are reliable and suitable for estimating long-term trends (Mustafin, 2017). We can see that the relationship between both indicators

Table 4
Mean male height, rye yields and prices in the Central Non-Black Earth Region of Russia.

Years	Rye yields (crop capacity)[a)]	Rye prices (grams of silver / *chetvert*)	Mean male height (centimeters)
1701–1705	2.6	n/a	163.8
1706–1710	2.4	10.9	163.1
1711–1715	2.5	11.9	163.5
1716–1720	2.3	24.7	163.2
1721–1725	2.1	32.1	162.5
1726–1730	2.3	18.4	165.6
1731–1735	1.7	23.1	167.7
1736–1740	3.3	17.7	163.6
1741–1745	2.0	25.9	163.9
1746–1750	2.6	19.6	163.7
1751–1755	2.3	18.7	162.4
1756–1760	2.6	17.4	162.0

Note: [a)] Seed-grain ratio.
Sources: Crop capacity: see Fig. 4 and Table 3; *rye prices:* Mironov (1985, pp. 190–210); *male height:* Mironov (2002, pp. 532–539).

was inverse: as the rye yield increased, the prices typically decreased, and vice versa (see Table 4).

Finally, it should be noted that a monastic book often covered only one year. In several cases, the date and origin of the sources had to be established. The authors of some monastic books avoided Arabic numerals, employing the Cyrillic numeral system instead. All these factors require a tremendous amount of work to construct the time series.

Let us turn to the results. Table 4 and Fig. 5 show that they confirm Mironov's study. Crop yields remained consistently low throughout the study period, with the output-seed ratio maintaining a narrow band between 1.7 and 3.3. The relationship between the indicators was, in most cases, direct. The notable exceptions were the periods of tax increases in 1746–1750 and 1756–1760, when the government abruptly raised state prices for alcohol and salt (Troitsky, 1966).

However, our results question Mironov's conclusion that "the most favorable period for popular well-being was 1731–1750 (the reign of Anna and the first decade under Elizabeth)" (Mironov, 2012, p. 96). Table 4 and Fig. 5 show that some of the worst harvests (an output-seed ratio of 1.7) occurred in 1731–1735. There was a widespread famine in those years, confirmed by many testimonies of contemporaries (Petruhintsev, 2001). As mentioned above, in 1731–1735, the number of recruits significantly increased, which could not but affect the well-being of the population. However, Mironov claims that the mean height of males was 167.7 centimeters (see Table 4). This is also questionable because all his other figures for the eighteenth century are significantly lower, specifically below 167 centimeters (Mironov, 2012, pp. 532–539). Regrettably, he did not publish regional mean height statistics for males during the nineteenth and early twentieth centuries. Nevertheless, the available data on Russia retain significant analytical value: only in 1901–1905 did the mean height (168.8 centimeters) exceed the 1731–1735 figure for the Central Non-Black Earth Region (Mironov, 2012, pp. 118–119). This is particularly surprising given the author's own assertion that "Russia overcame the livings standards crisis of eighteenth century and achieved significant progress. The breakthrough in biological status and livings

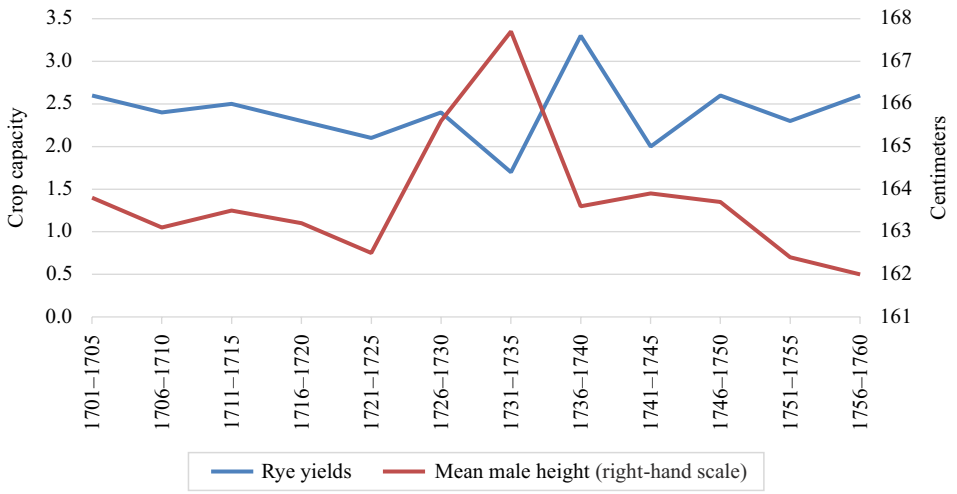

Fig. 5. Rye yields and mean male height in the Central Non-Black Earth Region of Russia.

Sources: Crop capacity: see Fig. 4 and Table 3; *rye prices:* Mironov (1985, pp. 190–210); *male height:* Mironov (2002, pp. 532–539).

occurred after the great reforms, just as Russia entered the epoch of a market economy" (Mironov, 2012, p. 120). All of the above suggests either an error[10] or a typographical inaccuracy in the reported mean height for 1731–1735.

Finally, it must be emphasized that the Central Non-Black Earth Region examined here is crucial to the research objectives, principally due to its status as the most populous region in the Russian Empire. A comparable situation probably existed in the Central Black Earth Region, given the considerable similarity in yield figures (Volkov, 1959). By contrast, yields in other regions were notably different. These areas were less densely settled and characterized by a significant non-Russian population. The Russian Imperial Army, however, was composed almost entirely of ethnic Russians. Therefore, Mironov's anthropometric data for other regions likely provide a less accurate reflection of living standards. Note also that published crop yield data from the governors' reports are available for Catherine the Great's reign (Rubinstein, 1957). Based on these limited data sets, we cautiously hypothesize a modest increase in crop yields during this period. However, the expansion of military forces during this period implies a corresponding rise in fiscal pressure (Dmitrieva and Kozlov, 2020). Therefore, Mironov is probably right that "the biological status thus dropped most sharply during… the reign of Catherine the Great" (Mironov, 2012, p. 96).

5. Conclusion

We proposed using data on the number of recruits to analyze Imperial Russia's military activity. A fundamental benefit of these data, in contrast to other variables, is that they allow us to construct a continuous time series and evaluate the impact

[10] Probably, the source of the error lies in the sampling research. Mironov's calculations of the regional averages for the periods 1726–1730, 1731–1735, and 1736–1740 were based on relatively small samples of 31, 48, and 66 observations, respectively. In contrast, the sample sizes for the Petrine and Elizabethan reigns are substantially larger, comprising between 213 and 1940 data points.

of wars on Russia's economy. Using the data on the number of recruits, we identified seven complete and two incomplete medium cycles, with an average length of 18 years. These cycles emerged, in part, due to the structural characteristics of Russia's recruitment-based military system. Our findings demonstrate that these cyclical patterns exerted a substantial influence on fluctuations in fiscal pressure and, accordingly, on the standard of living in Russia.

We used the records of monastic books to assess the level of rye yields in the Central Non-Black Earth Region of Russia. In particular, we used more than one hundred and ten archival sources, enabling the construction of time series for 1700–1760. Our findings were compared with Mironov's data on rye prices in this region and demonstrated an inverse relationship between these indicators: as the rye yields increased, the prices typically decreased, and vice versa. This confirms the data's reliability. We, therefore, hope that our dataset will enable researchers to address various questions in Russian social and economic history.

Our paper aimed to compare the results with Mironov's data on recruits' height. The analysis confirms that the standard of living in Russia was generally low and changed in a cyclical pattern. In particular, the relationship between the rye yields and Mironov's data on male height was, in most cases, direct. Notable exceptions were the periods of tax increases. However, our results allow us to question Mironov's conclusion that the most favorable period for popular well-being was Anna's reign. Our data show that some of the worst harvests occurred in 1731–1735, and the number of recruits significantly increased, which could not but affect the well-being of the population during this period.

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