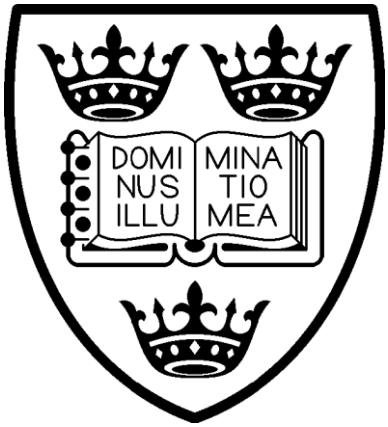

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Russian Economic Growth during the Eighteenth Century

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RUSSIAN ECONOMIC GROWTH DURING THE EIGHTEENTH CENTURY

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Abstract: We provide estimates of economic growth at decadal frequency for Russia during the eighteenth century. Although GDP per head increased between the 1690s and 1760s, this was followed by a period of negative growth between the 1760s and 1800s, leaving GDP per capita just 17 per cent higher at the end of the century than at its beginning. Although Russia's strong growth in large-scale industry during the eighteenth century has received much attention, this was starting from a very low base. Peter the Great's modernisation drive thus had only a small effect on the economy as a whole, which remained dominated by agriculture and small-scale industry.

1. INTRODUCTION

Although historical national accounts for the period before the nineteenth century have recently become available for many west European nations, there has been relatively little work on eastern Europe. Estimates of gross domestic product (GDP) and GDP per capita now exist back to the fourteenth century for Britain, the Netherlands, France, Italy, Spain and Sweden, and back to the sixteenth century for Belgium, Germany and Portugal (Broadberry et al., 2015; van Zanden and van Leeuwen, 2012; Ridolfi, 2016; Malanima, 2011; Álvarez-Nogal and Prados de la Escosura, 2013; Krantz, 2017; Schön and Krantz, 2012; Palma and Reis, 2019; Buyst, 2011; Pfister, 2011. The recent appearance of Malinowski and van Zanden's (2017) study of Poland reaching back to the fifteenth century shows the possibility of extending the historical national accounting approach to early modern eastern Europe and adding a new dimension to the debate over the Little Divergence between northwest Europe and the rest of the continent. In this paper we contribute to this process by using historical national accounting methods to evaluate the performance of the Russian economy during the eighteenth century.

Previous work has tended to paint a picture of Russia as a modernising economy delivering positive per capita economic growth during this period (Lyashchenko, 1949; Gerschenkron, 1962; Falkus, 1972; Kahan, 1985; Blanchard, 1989). The quantitative basis of this view nevertheless remains weak. Blanchard (1989: 354) argues for a 55 per cent increase of Russian national income per head during the eighteenth century, or an annual growth rate of 0.44 per cent, but his estimates are based on the application of the quantity theory of money to data on the money supply and the price level rather than built up from the output side, as in the studies of western Europe listed above. Although Kahan (1985) published a wide array of production data for Russian large-scale industry during the eighteenth century, he provided little information on the rest of the economy and the relative sizes of the main sectors, which

would have placed the growth of large-scale industry in perspective. Here, we provide that perspective by reworking Kahan's data within a national accounting framework and incorporating additional data that have become available subsequently.[1]

We combine these first estimates of Russian GDP from the output side with population data to estimate GDP per capita at a decadal frequency throughout the eighteenth century. Our main finding is that GDP per capita increased at an annual rate of 0.54 per cent between the 1690s and the 1760s, but then exhibited negative growth of -0.55 per cent per annum during the shorter period between the 1760s and the 1800s. This resulted in an average growth rate of 0.15 per cent per annum over the whole period, leaving GDP per capita 17 per cent higher in the 1800s than it had been in the 1690s.

One reason for the limited increase in per capita income over the long run is that large-scale industry, the fast-growing part of the economy, accounted for a relatively small part of economic activity in eighteenth century Russia, and therefore had a smaller effect on overall growth than earlier writers sometimes implied. This is very consistent with the slow overall growth rate of the British economy during the Industrial Revolution, despite the rapid growth of modernising industries such as cotton textiles and iron (Crafts and Harley, 1992). However, there was also an important difference from the experience of the British economy, which managed to grow enough food to keep up with a substantial increase in population growth from the mid-eighteenth century (Crafts, 1985). By contrast, Russian agriculture failed to increase output sufficiently to keep pace with the acceleration of population growth from the 1760s, so

[1] In addition, by working from the original sources where possible, we have corrected a number of minor errors in Kahan's (1985) series.

that much of the per capita income gain of the previous half century was lost and Russia did not make the transition to sustained modern economic growth.

The paper proceeds as follows. Section 2 discusses the reconstruction of population. The next 3 sections then examine the sources and methods for estimating the output of the commodity sectors, beginning with agriculture, moving on to industry and then combining both into commodity output. Section 6 then examines the service sector, while section 7 combines the sectoral estimates into an aggregate real GDP series. Dividing GDP by population yields GDP per capita, the basic measure of economic performance. In section 8, the real GDP series is combined with a general price index to produce a series of nominal GDP, which is useful for deriving key ratios such as the share of exports and imports in national income, or the ratio of national debt to national income. Section 9 then discusses Russia's economic performance in international perspective. Section 10 concludes.

2. RUSSIAN POPULATION DURING THE EIGHTEENTH CENTURY

One issue which needs to be dealt with from the outset concerns the territory to be covered by the statistics reported here. We work primarily with the population of the Russian Empire as its territory expanded from 14.1 million square kilometres in 1646 to 16.6 million km^2 in 1796 and 18.2 million km^2 in 1858. The data for the key benchmark years in Table 1 are taken from Mironov (2000: 2), based on population counts or *revizii*, but with additional data from Kahan (1985: 8) derived from more *revizii*. However, because of the substantial territorial expansion of the Russian Empire, we also provide data on the population within the territory of 1646. Figure 1 provides a map of Russia's growing territory, showing the focus of the eighteenth century expansion in the Baltic and eastern Europe.

Table 1A reports the figures for benchmark years from Mironov (2000) and Kahan (1985). Since production data are largely available for the expanding territory, we use this as the basis of our preferred index of population in Table 1B, but also provide a population index on a constant territory basis within the borders of 1646. Table 1C presents the annual growth rates of population between benchmark years on both bases. Clearly, territorial expansion accounted for a significant proportion of population growth, particularly during the periods before 1719 and after 1762. Over the long eighteenth century, 1678-1815, territorial expansion raised the annual population growth rate from 0.80 to 1.04 per cent per annum.

3. RUSSIAN AGRICULTURE

In seeking to place Russia's experience in an international comparative perspective, it will be useful to reconstruct GDP on a similar basis, built up from the output side. This involves dividing the economy into the three main sectors of agriculture, industry and services and collecting indicators of economic activity in each sector, before aggregating them together using appropriate sectoral weights.

Agriculture was the largest sector in the eighteenth century Russian economy and therefore played an important role in determining the path of GDP per capita. Our estimate of agricultural output is derived from data on the amount of cultivated land and grain yields. Table 2 provides data on the land area in Russia, taken largely from Kahan (1985: 46) with additional information for 1861 from Tsvetkov (1957). While the total land area increased by 19.8 percent between 1696 and 1796, the amount of ploughland increased much more rapidly by 254 per cent. Although the overall land quality was low compared with much of the rest of Europe, a growing part of the fertile black soil (*chernozem*) region was brought under cultivation, facilitating an increase in grain yields (Figure 2). This upward trend in yields is visible in Table

3, but the susceptibility of this region to drought also meant a high degree of variability in yields. Without systematic information on any change in seed sown per hectare, we have assumed no change, so that the trend in yield per seed is taken to represent the trend in yield per hectare.[2] However, we have checked the grain yields in Table 3 with data for the 1760s and 1790s from Prokhorov (1997), Rubinshtein (1957) as well as archival sources (RGADA. F. 248, D. 3577, RGADA. F. 1239. Op. 1. D. 5134, Op. 3, D. 5920, 59239, 59132, 58964, 59213, 59130), which yield similar levels.

Rye was the habitual consumption crop in eighteenth century Russia, so the rye yield series has been used in the calculation of agricultural output in Figure 3. All the data series are also provided in index number form at decadal frequency in Appendix Table A1, benchmarked on the 1800s. The ploughland area has been interpolated log-linearly between the benchmark years, while the grain yield has been held at the low level of the 1710s for the preceding two decades. The population has also been interpolated log-linearly between the benchmarks from Table 1B. Multiplying the ploughland series by the index of rye yields results in an index of output. This can then by divided by population to yield a series for output per head. Agricultural output per head increased between the 1690s and the 1740s, as ploughland kept pace with the moderately growing population and grain yields trended upwards in line with average temperature (Luterbacher et al., 2004; Kahan, 1985: 13-14). This growth was linked to the colonisation of the fertile black soil region shown in Figure 2, which raised grain yields as well as expanding the cultivated area (Nefedov, 2010: 143). The rise in yields was also a result of the adoption of the Lithuanian scythe in place of the traditional reaping hook in the black soil and steppe regions (Milov, 2006). Between the 1740s and 1760s, however, agricultural output per head stagnated as population growth increased and a slow decline in ploughland per head

[2] The two moved closely together in medieval Britain (Campbell, 2000: 323, 335).

was just balanced by rising grain yields. From the 1760s, however, grain yields began to fall as the weather became more variable while population growth continued to outstrip the cultivated area, so that agricultural output per head trended downwards (Kahan, 1985: 49). By the 1800s, agricultural output per head was no higher than it had been in the 1700s.

Ideally, of course, it would be useful to have separate output estimates for the livestock sector in addition to the arable sector, but for Russia, there is very little systematic information available from which to build an independent time series, so that we follow a common practice in the economic history of pre-industrial Europe of treating grain output as an indicator of overall agricultural activity. We can nevertheless estimate the size of the non-grain agricultural sector for the benchmark year 1805, which will be needed to weight agriculture alongside industry and services. Here, we have used the ratio between grain production and net output in livestock and other agriculture, forestry and fisheries from Markevich (2019) for the much later year of 1897 to provide the scaling factor. Although this is nearly a century later, it should be borne in mind that agriculture accounted for over half of GDP at that time, leaving little room for fundamental structural change to have occurred during the preceding century. The value of net output in agriculture in 1805 on this basis is set out in Table 4.

4. RUSSIAN INDUSTRY

We follow the standard procedure of combining indices of gross output with value added weights for the benchmark decade of the 1800s, to produce an index of industrial production for eighteenth century Russia. However, we also need to make a distinction between large-scale industry carried out in manufactories and small-scale or cottage industry. The individual series included in the production index for large-scale industry cover both the major capital goods and consumer goods industries, and can be divided into three main groups. The best-

documented sector is metals, with separate data for silver, gold, copper, pig iron and bar iron. Food processing contains separate series for salt and alcohol, while textiles is represented by wool and linen. Although in many cases data are available at annual frequency for at least part of the eighteenth century, there are usually gaps for short periods, so that it makes sense to provide series at decadal rather than annual frequency.

The data series for large-scale industry are set out in Tables A2 to A5 of Appendix 1, together with detailed sources and notes, while the data for small-scale industry and total industry are given in Table A6. The starting point for large-scale industry has been the series provided in Kahan (1985), based largely on the manufactories set up as a result of Peter the Great's industrialisation policies, which aimed at modernising Russia sufficiently to secure its position as a European great power. However, to obtain an overview of Russia's overall industrial output, it is important to balance these generally rapidly growing parts of large-scale industry with coverage of small-scale cottage industry (*kustarnye promysly*) which was not so affected by the stimulus of government policy.

4.1 Large-scale industry: Metals

Russia's metal industries were stimulated by the industrialisation policies of Peter the Great during the first quarter of the eighteenth century, and continued to make substantial progress during the rest of the century.

The government was heavily involved with the non-ferrous metal industries because of its demand for silver and copper for coinage. Output of the key non-ferrous metals is shown in Figure 4. The production of silver experienced a temporary boom under Peter the Great, as well as a more sustained period of growth from the 1730s to the 1770s. Gold was produced largely

as a by-product of silver production and therefore followed a similar pattern of growth, although data on the output of gold during the first half of the century are available only as a total over the period 1704-47 so that the Peter the Great boom does not register. Over the century as a whole, silver and gold production grew at an annual rate of around 7 per cent, while copper production grew at 3.5 per cent per annum. Because of copper's use in coinage and armaments, the state pursued a policy of import substitution during the eighteenth century, leading towards autarky.

Iron was the most important metal industry in eighteenth century Russia. The production of both pig iron, an intermediate product, and bar iron, the final product, are shown in Figure 5. The industry grew faster than the copper industry at 4 to 5 percent per annum. A key stimulus was Peter the Great's desire to become self-sufficient in armaments production, but the industry also developed a large export trade to England during the eighteenth century as state demand proved insufficient to absorb the whole output of the new works established during Peter the Great's reign. The most important iron-producing region was the Urals, with its high-quality ores and abundant supply of fuel and water required for heat and power. By the end of the eighteenth century, the Urals and Siberia supplied 81.8 per cent of Russia's iron output, with European Russia accounting for the other 18.2 per cent (Strumilin 1954: 463).

4.2 Large-scale industry: Food and drink

Kahan (1985) provides data on two important food and drink industries, salt and alcohol, which were controlled by the state. Output of these two industries is graphed in Figure 6. The state acted as a monopsonist in salt and from the 1750s imposed a high tariff to protect domestic production. However, since the Baltic provinces were very far from the main Russian sources of production, they continued to import salt from abroad. The main Russian centre of salt

production was Perm province in the northern Urals, although there was a brief period in the mid-century when Elton salt lake, east of the lower Volga, became more important. However, disruption during the Pugachev rebellion soon allowed Perm province to rebuild its dominant position. Salt output grew at an annual rate of 1.85 percent during the eighteenth century as a whole, yielding a per capita growth rate of 0.8 percent.

The sale of alcohol was a government monopoly during the eighteenth century, and output can be derived from data on alcohol tax revenue, deflated by the unit price of alcohol per *vedro*, a Russian liquid measure approximately equal to 2.7 imperial gallons. Alcohol production grew faster than salt production from the 1740s, at an annual rate of 2.4 per cent per annum between the 1720s and 1800s. As a cross-check, we can also deflate alcohol tax revenue by the general price index from Mironov (2012a: 310), obtaining similar results.[3] It is nevertheless likely that these official estimates of alcohol production substantially understate the total including illegal domestic alcohol production, perhaps by as much as 50 per cent (Troitskii, 1966: 153, Volkov, 1979).

4.3 Large-scale industry: Textiles and other industries

In textiles, government played an important role in the wool industry through placing orders for cloth that was needed for army uniforms. Both the demand and supply sides of the wool industry can be quantified through monitoring orders placed by the military and the supply response through producer deliveries. Where possible, we have used the supply side data, but it has been necessary to interpolate the figures for the 1770s and 1780s using the demand side estimates. Despite being able to meet all the army's needs by mid-century, the wool cloth

[3] The growth rate of alcohol output is slightly faster at 2.8 per cent using the general price index, as the relative price of alcohol increased across the century. However, the pattern of growth is very similar, with much of the increase occurring between the 1740s and the 1770s.

manufactories were not able to establish themselves in the civilian market, where they were unable to compete with small-scale domestic producers at the lower end of the market and with foreign producers at the higher end.

Peter the Great set up state-owned manufactories for the production of sail cloth and broad linen, which he also saw as providing demand for domestically produced flax and hemp, and providing potential for increased exports. In contrast to the wool industry, the linen manufactories succeeded in finding export markets, and linen output in Table A4 is based on linen exports taken from Kahan (1985: 89), interpolated before the 1750s using the number of linen manufactories from Kahan (1985: 88). Output of both woollen and linen cloth grew at similar rates over the eighteenth century , as can be seen in Figure 7.

Other large-scale industries include glass & pottery, chemicals, paper and miscellaneous (including shipbuilding). Although we do not have independent time series data for these industries, we know that they also expanded rapidly so assume that they grew in line with textiles (Kahan, 1985: 86-88, 99, 105-108, 117-118).

4.4 Total large-scale industrial production

The net output weights for large-scale industry in Table 5A are derived from material on industry in 1804/05 from the Russian State Historical Archive (*Rossiskii Gosudarstvennyi Istoricheskii Arkhi*v) at St Petersburg. Data are available on production volumes and unit prices, which can be used to derive gross output (Rybakov, 1976). Information is also provided on inputs so that it is possible to derive estimates of net output. Since the coverage is not complete, we report here the sectoral shares and leave to Table 7 the estimation of the rouble value of industrial net output.

The metal industries were dominated by ferrous metals, with pig iron and bar iron together accounting for 66 per cent of 1805 net output in the sectors for which we have time series production data. Since the iron industry grew more slowly than gold and silver and not much faster than copper, it must also have been the most important metal at the beginning of the eighteenth century.

In the food and drink industries, alcohol dominated salt by 1804/05, although the shares would have been closer in the early eighteenth century, since alcohol production grew more rapidly than salt. Turning to textiles, the woollen cloth industry remained a little smaller than the linen cloth industry within the manufactories, although linen cloth was much more important in small-scale industry.

Figure 8 plots the aggregate large-scale industrial production index, together with the three component series of metals, food & drink and textiles & other. Total large-scale industrial production grew at an annual rate of 3.3 percent, or 2.2 per cent on a per capita basis. All three component series grew rapidly, although food & drink was somewhat slower than metals or textiles & other. It is important, however, to realise that large-scale industry was but a very small part of the economy. To get a picture of overall industrial production, it is necessary to consider the role of small-scale or cottage industry.

4.5 Small-scale industrial production

Small-scale enterprise was quickly eclipsed by large-scale producers in metals and mining, where economies of scale were important. However, in industries such a textiles, food & drink and small household goods such as candles, small-scale industrial production continued to

dominate large-sale manufactories (Kahan, 1985: 120-124). For the industries in Table 5B it is possible to gauge the value of gross output in 1805 and apply the ratio of inputs to gross production from large-scale industry to derive net output and hence arrive at an indication of the relative size of the large-scale and small-scale sectors of industry in Table 5C.

For textiles, the level of production is obtained by multiplying population with the per person consumption of cloth, which Konotopov et al. (1992) put at 11 arshin per year. This is multiplied by the unit price of linen to derive gross output and net output is assumed to be the same proportion of gross output as in the large-scale linen industry. For food and drink, we have assumed that large-scale enterprise accounted for only half of the alcohol consumed, leaving the other half to be provided by small-scale enterprise. For other industry, we use data on the production of wax and tallow candles from the Russian State Historical Archive at St Petersburg. Textiles accounted for around three-quarters of cottage industry, with food & drink the next most important sector. In contrast to large-scale industry, there is no suggestion of rapid growth or economic development in Russian cottage industry during the eighteenth century, so output is assumed to grow in line with population.

4.6 Total industrial production

Figure 9 plots the path of total industrial production. Although large-scale industry grew at the rapid rate of 3.62 per cent per annum, small-scale industry grew in line with population at a much slower annual rate of 1.04 per cent. Since small-scale industry had a weight of more than 60 per cent in total industrial production, the overall annual growth rate of industry was 1.46 per cent, or just 0.42 per cent on a per capita basis. As in the case of the British Industrial Revolution, rapid growth in the modernising sector had only a limited impact on the overall growth rate because it was starting out from a very small level (Crafts and Harley, 1992).

5. RUSSIAN COMMODITY PRODUCTION

Before moving on to the analysis of services, it will be useful to construct an index of commodity production, which provides a basis for the estimation of output in commerce, the sector that was responsible for the transport, distribution and finance of agricultural and industrial production. In late eighteenth century Russia, agriculture accounted for 72 per cent of commodity output. The importance of agriculture shows up clearly in Figure 10, where commodity output moves very closely in step with agriculture for both long term trend and shorter term fluctuations. Dividing commodity output by population provides a series for commodity output per head, which looks very similar to the path of agricultural output per head in Figure 3, but with a small amount of growth injected by the inclusion of industry. The data series for commodity output are set out in Table A7 of Appendix 1, together with sources and notes.

6. RUSSIAN SERVICES

For services, we have followed the approach of Broadberry et al. (2015), which builds in turn upon Deane and Cole (1962), constructing volume indices of the main branches, distinguishing between commerce (including distribution, transport and finance), government and other domestic services. These volume indices are then combined using value added weights to produce an overall index for services. The data series for services are set out in Tables A8 to A9 of Appendix 1, together with detailed sources and notes.

6.1 Commerce

The output of the commerce sector is tracked using volume indicators of foreign and domestic trade. For foreign trade, we rely mainly on the value of exports deflated by the general price

index. The value of exports in current prices is taken from Kahan (1985: 164) for the period 1742-1799, with data for additional years from other sources, including Repin (1985), Strumilin (1954), Semenov (1859), Chulkov (1788) and Troitskii (1966). The export value series is deflated using the price index from Mironov (2012a). The volume of domestic trade is tracked using the commodity output index constructed in section 5. In deriving the weights for foreign and domestic trade in the commerce series, we follow Blanchard (1989: 236) in assuming that "economic activity was characterised by an exceptionally high level of self-consumption amongst both lords and peasants", but raise the marketed share to 10 per cent from Blanchard's very low figure of 6 per cent. This results in a value of 165 million roubles for domestic trade in 1805, compared with 72 million roubles for the value of exports at that time. The two series are therefore combined with weights of 69.6 per cent for domestic trade and 30.4 per cent for foreign trade in Figure 11. Since foreign trade grew faster than commodity output, the commerce sector grew a bit more rapidly than domestic trade.

6.2 Government and other domestic services

The government raised revenue to provide services of civil administration and defence. Data are available on both the revenue and expenditure sides of the government budget, but are more complete for the revenue accounts, which form the basis of the series charted in Figure 12. The revenue data are taken from Chechulin (1906: 254), Strumilin (1966: 307) and Mironov (2012b: 200), and are interpolated between the 1700s and 1720s. The expenditure data, which show the same trend, are taken from Kahan (1985: 337, 344) and Troitskii (1966: 224, 243). Government grew rapidly under Peter the Great, followed by a period of relative stagnation before a return to rapid growth from the 1740s. Other domestic services, including rent for housing, are assumed to grow in line with population. This follows a long tradition reaching back to Deane and Cole (1962).

6.4 Total service sector output

As for commodity production, service sector provision is tracked using a volume index derived from indices for each sector, but with value added weights for 1805 from Table 6. The income generated within the commerce sector is set at 10 per cent of commodity output or 165 million roubles, as explained in the section on commerce. The value of government net output is set at 137 million roubles, in line with government revenue for that year, while rent and domestic services are set equal to the sum of commerce and government, broadly in line with the structure of services in Britain in 1700 (Broadberry et al., 2015: 162). This results in a value of net output in total services of 604 million roubles, which at 26.6 per cent, is still a substantially smaller share of GDP than for Britain in 1700 (Broadberry et al., 2015: 194). Comparing Figures 10 and 12 it is clear that the volume of services grew more rapidly than the volume of commodity production. This was a result of the state-driven growth of industrial production and exports, which led to an expansion of commerce as well as the government sector.

7. RUSSIAN GDP AND PER CAPITA GDP

Having constructed volume indices for output in agriculture, industry and services, these can now be aggregated into an index of real GDP using the sectoral net output weights from Table 7. The value of net output in agriculture is taken from Table 4, and the value for services from Table 6. For industry, net output is derived as 38.2 per cent of agricultural net output, in line with Hermann's (1790) ratio for 1788. The resulting series for GDP is shown in Figure 13 together with the component sectoral outputs, which are also provided together with sources and notes in Table A10 of Appendix 1. Agriculture emerges as the slowest growing sector, while the fastest growing sector was industry but with services also growing substantially faster than agriculture.

Figure 14 shows the impact of this output growth on GDP per capita, while annual growth rates for the component series are provided in Table 8. Although GDP grew at 1.19 per cent per annum over the long eighteenth century, most of this was extensive growth as population grew by 1.04 per cent per annum, so that GDP per capita grew by just 0.15 per cent per annum. However, even this meagre growth in living standards over the century as a whole was the result of a period of positive growth of per capita income between the 1690s and 1760s at 0.54 per cent per annum, followed by a period of negative growth at an annual rate of -0.55 per cent from the 1760s to the 1800s, with the reversal occurring during a period of rapid population growth.

This pattern of a period of positive economic growth followed by a period of negative economic growth is typical of most pre-industrial European economies for which we have data covering the period between the late middle ages and the mid-nineteenth century. The only exceptions identified so far are the British and Dutch economies, which began to experience a pattern of episodic growth, interspersed with periods of remaining on a plateau rather than experiencing negative trend growth of GDP per capita, suggesting that the key to modern economic growth had more to do with reducing the rate and frequency of shrinking rather than accelerating the rate of growing (Broadberry and Wallis, 2017).

8. NOMINAL GDP

Although our estimates have been derived in real terms using volume data, it is possible to obtain a rough estimate of nominal GDP by reflating real GDP with the general price index from Mironov (2012a). With real GDP increasing by a factor of 3.7 over the long eighteenth century and the price level increasing by a factor of 3.1, nominal GDP increased by a factor of

more than 13, as can be seen in Figure 15. Since it is sometimes useful to have a figure for GDP in current roubles, we also provide nominal GDP in this form in the final column of Table A11, by benchmarking the 1800s figure on the 1805 value from Table 7.

9. RUSSIA'S EIGHTEENTH CENTURY ECONOMIC PERFORMANCE IN INTERNATIONAL PERSPCTIVE

9.1 A comparison with Britain in 1796

It is possible to compare the new GDP per capita estimates for eighteenth century Russia with the estimates for Britain from Broadberry et al. (2015). However, this requires converting the estimates for both countries into a common currency. The standard procedure in the economic history literature is to work in terms of 1990 international dollars, as in Maddison (2010). Since Broadberry et al. (2015) provide GDP per capita in 1990 international dollars for Britain, we can arrive at a figure for Russian GDP per capita in the same units by establishing Russian GDP per capita as a proportion of British GDP per capita in a benchmark year. This we do in Table 9 by comparing prices in the two countries in 1795/96, when prices are available for a good sample of products in both countries. Taking a weighted average of these price ratios establishes the purchasing power parity (PPP) between the two currencies.

We begin in Table 9A with food prices, taken from Clark (2004) for Britain and the Russian State Archive of Ancient Acts[4] and Moscow Gazette (*Moskovskie vedomosti*) for Russia. The weights are based on Feinstein's (1995) analysis of budget studies in Britain at the end of the eighteenth century, with the weights reflecting the relative importance of different food and non-food items in household expenditure.[5] Feinstein's weights are for broad

[4] The data were collected partly in the project "Living Standards in Russia in the eighteenth century" (led by Elena Korchmina), supported by HSE (Moscow) in 2020.
[5] Ideally we would also have Russian weights and take the geometric mean of the PPP at British and Russian weights, but budget studies are not available for Russia during this period.

categories of expenditure, and within those categories we have taken unweighted averages of individual items. The market exchange rate was £1 = 5.65 silver roubles (Denzel, 2010: 359, 368), so a PPP of £1 = 3.43 roubles indicates that food was relatively cheap in Russia.

However, relatively expensive food in Britain was offset by cheaper prices for other manufactured goods, so that the PPP for other goods in Table 9B is £1 = 8.28. This reflects technical progress in Britain during the Industrial Revolution, which particularly affected the price of cloth and iron. Again, we use British weights, this time from Broadberry et al. (2015: 134), reflecting the relative importance of textiles, metals and other goods.

In Table 9C, we derive the overall PPP as a weighted average of the PPPs for food and other goods, but taking account of the different shares of agriculture and non-agriculture in commodity output in Britain and Russia from Broadberry et al. (2015: 194) and Table 7, respectively. The overall PPP for 1795/96 works out at £1 = 4.87 roubles, which implies that the exchange rate for the silver rouble deviated from purchasing power parity by almost 14 per cent. The overall price level was lower in Russia largely as a result of much cheaper food, offset by more expensive other goods. This is consistent with a general finding that when comparing per capita incomes between countries at different levels of development, using the exchange rate tends to exaggerate the difference in living standards. Hence in Table 10, we see that at the silver exchange rate, Russian GDP per capita was 36.9 per cent of the British level. However, using the PPP which allows for the lower price level in Russia, suggests that Russian GDP per capita was 42.9 per cent of the British level. Taking the 1796 level of British GDP per capita in 1990 international dollars as $2,028 (Broadberry et al., 2015) and Russian GDP per capita as 42.9 per cent of the British level, yields a figure of $869 for Russian per capita GDP at the end of the eighteenth century in 1990 international dollars.

9.2 A comparison with Europe, 1690s-1800s

Table 11 and Figure 16 place Russia's economic performance during the long eighteenth century in an international comparative perspective. The first thing to note is that during this period GDP per capita in Russia was always substantially higher than in Poland, the only other East European economy for which we have data. Second, the strong growth of Russian GDP per capita during the reign of Peter the Great substantially narrowed the gap with Britain and the Netherlands, the richest west European economies and also with Sweden, Russia's rival power in the Baltic region. Indeed, by the 1740s, Russia had caught up with Sweden, although this owed as much to Swedish decline as to Russian growth (Figure 16). In addition, Russian GDP per capita peaked at 67 per cent of the British level (Table 11). After this, however, although Russia remained on a par with Sweden, the gap with northwest European economies widened again as growth accelerated in Britain and GDP per capita at first stagnated and then began to shrink in Russia. By the end of the eighteenth century, Russia had pulled further ahead of Poland, but was still lagging substantially behind Italy. This is broadly consistent with the views of Mau and Drobyshevskava (2012), who survey three hundred years of Russian catching-up. They note that the modernisation begun under Peter the Great enabled Russia to briefly narrow the gap with the leading countries of Europe, before falling back again as the reform process stalled.

9.3 Comparing Russia in the eighteenth and nineteenth centuries

In assessing the plausibility of our estimates of Russian GDP per capita in the eighteenth century, it is useful to make a comparison with the late nineteenth century. From 1885 onwards, it is possible to provide a continuous series of Russian GDP per capita. This is based on Maddison's (1995) benchmark for 1990 and time series covering the period 1928-1990,

extended back further in time using the estimates of Markevich and Harrison (2011) for the period 1913-1928 and Gregory (1982) for the period 1885-1913. Projecting back from 1990, these data result in a GDP per capita in 1885 of $865 in 1990 international dollars, which suggests that Russian GDP per capita at the end of the eighteenth century was at about the same level as the late nineteenth century. This would be consistent with the estimates of Blanchard (1989: 354), who found similar levels of GDP per capita in 1807/09and 1868/70, although his pattern of a catastrophic 60 per cent decline in per capita GDP between the 1800s and the 1830s followed by a more than complete recovery by the 1860s seems hard to square with Mironov's (2012a) evidence on biological status during this period.[6] Filling in the gap in Russia's historical national accounts between the 1800s and the 1880s seems an urgent priority.

9.4 Explaining Russia's economic performance

Agriculture was the largest sector of the Russian economy during this period, and its performance was the key driver of GDP per capita. Agricultural output grew faster than population between the 1690s and 1740s, then stagnated between the 1740s and 1760s before declining so that output per head was no higher in the 1800s than it had been in the 1700s. The territorial expansion of the first four decades, particularly into the black soil region, thus permitted a combination of intensive and extensive growth. But as the rate of population growth increased from the 1740s, output per head began to stagnate and this led to absolute decline from the 1760s as ploughland failed to keep up with population growth and grain yields fell back.

[6] Even if a large decline occurred in the money supply, which forms the basis of Blanchard's GDP estimates, a fall in real output of such a magnitude could not have occurred without mass starvation.

Although per capita agricultural output was no higher in the 1800s than during the 1690s, GDP per capita was 17 per cent higher. This owed much to the growth of large-scale industry, begun under Peter the Great. This impacted most obviously on the metals branch, where Russia was transformed into a major iron exporter. The state-led modernisation strategy also had significant effects in textiles via government orders for linen sailcloth and woolen military uniforms. There was also strong growth of alcohol and salt production under government intervention in the food and drink industry. However, this rapid growth in large-scale industry was swamped by slower growth in small-scale industry, as consumer demand was held back due to the taxes raised to pay for the industrial policies. This underlines a conclusion drawn by Crafts and Harley (1992) from the British Industrial Revolution, that even rapid growth in the modernising sector can have only a small effect on the overall growth of the economy in the early stages of industrialisation because it is starting from a low base.

The modernisation policies also contributed to growth of per capita GDP through both commerce and government. The boost to services output came directly through the expansion of government services (administration and defence) and indirectly through the growth of commerce associated with increasing exports, as Russia emerged from political and economic isolation (Kahan, 1985: 163).

10. CONCLUSIONS

This paper provides an overview of economic growth in Russia during the eighteenth century, using a historical national accounting approach. Previous work has focused on the modernisation of the Russian economy begun by Peter the Great, involving state-driven expansion of large-scale industry, particularly in metal production, giving the impression of progress towards modern economic growth. However, although GDP per capita increased by

around 30 per cent between the 1690s and 1760s, this was followed by a period of strong negative growth or shrinking, so that by the 1790s, GDP per capita was just 17 per cent higher than it had been a century earlier.

Although Russia began to close the gap with northwest Europe between the 1690s and 1760s, the rest of the century saw a renewed widening of the GDP per capita gap. Whereas the British and Dutch economies had been holding on to gains in per capita income during the late medieval and early modern periods, so that each growth episode was followed by a plateau on which the next growth episode could build, the eighteenth century Russian economy continued to follow the familiar pattern of pre-modern Europe, with episodes of growing followed by episodes of shrinking. Although the period of shrinking from the 1760s coincided with a period of rapid population growth, it should also be noted that population growth was still positive during the earlier period of per capita income growth. This suggests that Russia's limited per capita growth over the eighteenth century as a whole was not purely a Malthusian phenomenon. Indeed, with its expanding frontier, Russia was in a position to reap the benefits of Smithian growth, but the institutional framework of autocracy and serfdom meant that the long run gains in living standards were very limited.

TABLE 1: Population of Russia, 1646-1815

A. Population in millions

	Total population	Population within the borders of 1646
1646	7.0	7.0
1678	11.2	9.6
1719	15.6	13.6
1744	18.2	
1762	23.2	18.1
1782	28.4	
1796	37.4	23.8
1815	46.3	28.6

B. Population in index number form (1815=100)

	Expanding territory	Constant territory
1646	15.1	24.5
1678	24.2	33.6
1719	33.7	47.6
1744	39.4	
1762	50.1	63.3
1782	61.4	
1796	80.8	83.2
1815	100.0	100.0

C. Population growth (% per year)

	Expanding territory	Constant territory
1678-1719	0.81	0.85
1719-1762	0.93	0.67
1762-1796	1.41	0.81
1796-1815	1.13	0.97
1678-1815	1.04	0.80

Sources and notes: Mironov (2000: 4), with additional information for 1744 and 1782 from Kahan (1985: 8).

TABLE 2: Land area in Russia, 1696-1861 (1,000 hectares)

	Ploughland	Meadow	Forest	Total land area	Ploughland/ total land (%)
1696	31,976	67,068	213,416	405,091	7.89
1725	41,848	66,296	213,958	418,219	10.01
1763	53,865	63,308	205,890	423,128	12.73
1796	81,359	76,650	217,322	485,465	16.76
1861	98,033	71,781	207,279	490,318	19.99

Sources and notes: Kahan (1985: 46) with additional information for 1861 from Tsvetkov (1957: 115).

TABLE 3: Grain yields per seed in Russia, 1710s to 1800s

	Rye	Wheat	Oats	Barley
1710s	2.9	3.9	2.7	3.9
1720s	3.6	3.7	4.1	4.5
1730s	3.2	3.9	3.3	4.0
1740s	4.3	3.6	3.8	3.7
1750s	3.7	3.3	3.5	4.3
1760s	4.7	3.8	4.5	4.7
1770s	4.2	4.3	4.8	4.2
1780s	3.3	3.2	3.4	3.5
1790s	3.1	3.0	3.6	3.1
1800s	3.5			

Sources and notes: Kahan (1985: 49), with additional information for 1800s from Mikhailovskii (1921: 4).

TABLE 4: Net output in Russian agriculture, circa 1805

	Net output (m roubles)	Shares (%)
Grain production	504	41.8
Livestock	408	33.8
Other agriculture, forestry & fisheries	294	24.4
TOTAL AGRICULTURE	**1,206**	**100.0**

Sources and notes: Agriculture: net output in grain production is obtained by multiplying population in 1805 with per capita grain consumption from Kahan (1985: 57) valued at a weighted average of the price of rye and wheat in 1805 (Moscow Vedomosti, 1805, annual average) and adding the value of grain exports from Valetov (2017). Livestock and other agriculture, forestry & fishing are obtained using their ratios to grain production in 1897 from Markevich (2019).

TABLE 5: Industrial net output weights, circa 1805

A. LARGE-SCALE INDUSTRY

	Within sector weights (%)	Main sector weights (%)
Silver	9.4	2.4
Gold	3.4	0.8
Copper	21.4	5.4
Iron	29.5	7.4
Pig iron	36.3	9.2
METALS	100.0	**25.2**
Salt	9.4	2.8
Alcohol	90.6	27.0
FOOD & DRINK	100.0	**29.8**
Woollen cloth	47.6	7.0
Linen cloth	52.4	7.7
TEXTILES	100.0	**14.7**
Glass & pottery	68.9	20.9
Chemicals	22.8	6.9
Paper	3.0	0.9
Miscellaneous	5.3	1.6
OTHER	100.0	**30.4**
FACTORY INDUSTRY		**100.0**

B. SMALL-SCALE INDUSTRY

	Within sector weights
Textiles	75.7
Food & drink	15.7
Other	8.6
SMALL-SCALE INDUSTRY	**100.0**

C. TOTAL INDUSTRY

	Main sector weights
Large-scale industry	39.2
Small-scale industry	60.8
TOTAL INDUSTRY	**100.0**

Sources and notes: Derived from RGIA (Russian State Historical Archive - St Petersburg) F. 17. op. 1. d. 44.

TABLE 6: Service sector net output, circa 1805

	Net output (m roubles)	Weights (%)
Commerce	165	27.3
Government	137	22.7
Rent & domestic services	302	50.0
TOTAL SERVICES	604	100.0

Sources and notes: Value of commerce in 1805 set equal to 10 per cent of commodity output, with government net output set equal to government revenue and other domestic services obtained as the sum of commerce and government, in line with Broadberry et al. (2015) for 18th century Britain.

TABLE 7: GDP by major sector, circa 1805

	Net output (m roubles)	Weights (%)
Agriculture	1,206	0.531
Industry	461	0.203
Services	604	0.266
TOTAL GDP	2,271	100.0

Sources and notes: Agriculture is taken from Table 4 and services from Table 6. Net output in industry is obtained as 38.2% of agricultural net output, in line with Hermann's (1790) ratio for 1788.

TABLE 8: Annual growth rate of Russian GDP, population and GDP per capita, 1690s-1790s (per cent per annum)

	GDP	Population	GDP p.c.
1690s-1760s	1.35	0.80	0.54
1760s-1800s	0.91	1.46	-0.55
1690s-1800s	1.19	1.04	0.15

Sources and notes: Derived from Appendix Table A10.

TABLE 9: A Russia/GB PPP for 1795/96

A. FOOD

	Units	Russian price (Rbs)	British price (£)	Weights (%)	PPP (Rbs per £)
Wheat	kg	0.097	0.018	10.6	5.45
Wheat flour	kg	0.093	0.027	10.6	3.50
Rye	kg	0.044	0.012	10.6	3.75
Oats	kg	0.019	0.010	10.6	1.95
Barley	kg	0.024	0.010	10.6	2.37
GRAIN & FLOUR				53	3.40
Peas	kg	0.048	0.010	2.5	4.83
Potatoes	kg	0.006	0.004	2.5	1.59
VEGETABLES				5	3.21
Beef	kg	0.139	0.056	15	2.49
MEAT				15	2.49
Butter	kg	0.408	0.073	4	5.59
Eggs	dozen	0.090	0.031	4	2.92
DAIRY & EGGS				8	4.26
Sugar	kg	0.306	0.092	2.5	3.32
Ginger	kg	3.659	0.234	2.5	15.65
SUGAR & SPICES				5	9.48
Hops	kg	0.391	0.120	7.5	3.26
Tobacco	kg	0.588	0.349	7.5	1.68
DRINK & TOBACCO				15	2.47
TOTAL FOOD				100	3.43

B. OTHER GOODS

	Units	Russian price (Rbs)	British price (£)	Weights (%)	PPP (Rbs per £)
Cloth	yards	0.527	0.050	62.8	10.54
Bar iron	cwt	4.745	0.845	13.4	5.62
Candles	kg	0.366	0.087	11.9	4.23
Soap	kg	0.306	0.090	11.9	3.40
OTHER GOODS				100	8.28

C. ALL GOODS

	PPP (Rb per £)	PPP (£ per Rb)	GB weights (%)	Russian weights (%)
FOOD	3.43	0.29	0.51	0.72
OTHER GOODS	8.28	0.12	0.49	0.28
Overall PPP, GB weights	5.80			
Overall PPP, Russian weights	4.09	0.24		
OVERALL PPP, geometric mean	4.87			
Market exchange rate	5.65			

Sources and notes: British prices for food, candles and soap from Clark (2004). Russian prices for food, candles and soap from Moscow Vedomosti, 1796, RGADA. F. 248. Op. 112. D. 222, F. 1204. Op. 1. D. 19315, 19341, 19342 (annual average, our calculations). Weights for food derived from Feinstein (1995: 22). British prices for cloth from Harley (1998: 79) and bar iron from Gayer, Rostow and Schwartz (1953, Vol. 1: 28-31). Russian prices for cloth and bar iron from Semenov (1859, vol. 3: 502-

503). Weights for other goods derived from Broadberry et al. (2015: 134). Weights for combining food and other goods prices derived from Broadberry et al., (2015: 194) for Britain and from Table 7 for Russia. The overall PPP at British weights is calculated with the Rb per £ sectoral PPPs while the overall PPP at Russian weights is calculated using the £ per Rb sectoral PPPs for consistency. Market exchange rate for the silver rouble from Denzel (2010: 359, 368).

TABLE 10: A benchmark estimate of Russia/GB GDP per capita circa 1796

Russia	
Nominal GDP (million Rbs)	1,633
Population (millions)	37.4
Nominal GDP per capita (Rbs)	43.66
Great Britain	
Nominal GDP (£ million)	209.18
Population (millions)	10.0
Nominal GDP per capita (£)	20.92
Exchange rates	
Silver exchange rate (Rbs per £)	5.65
PPP (Rbs per £)	4.87
Comparative Russia/GB GDP per capita (%)	
At silver exchange rate	36.9
At PPP	42.9
GDP in 1990 international dollars	
GB	2,028
Russia	869

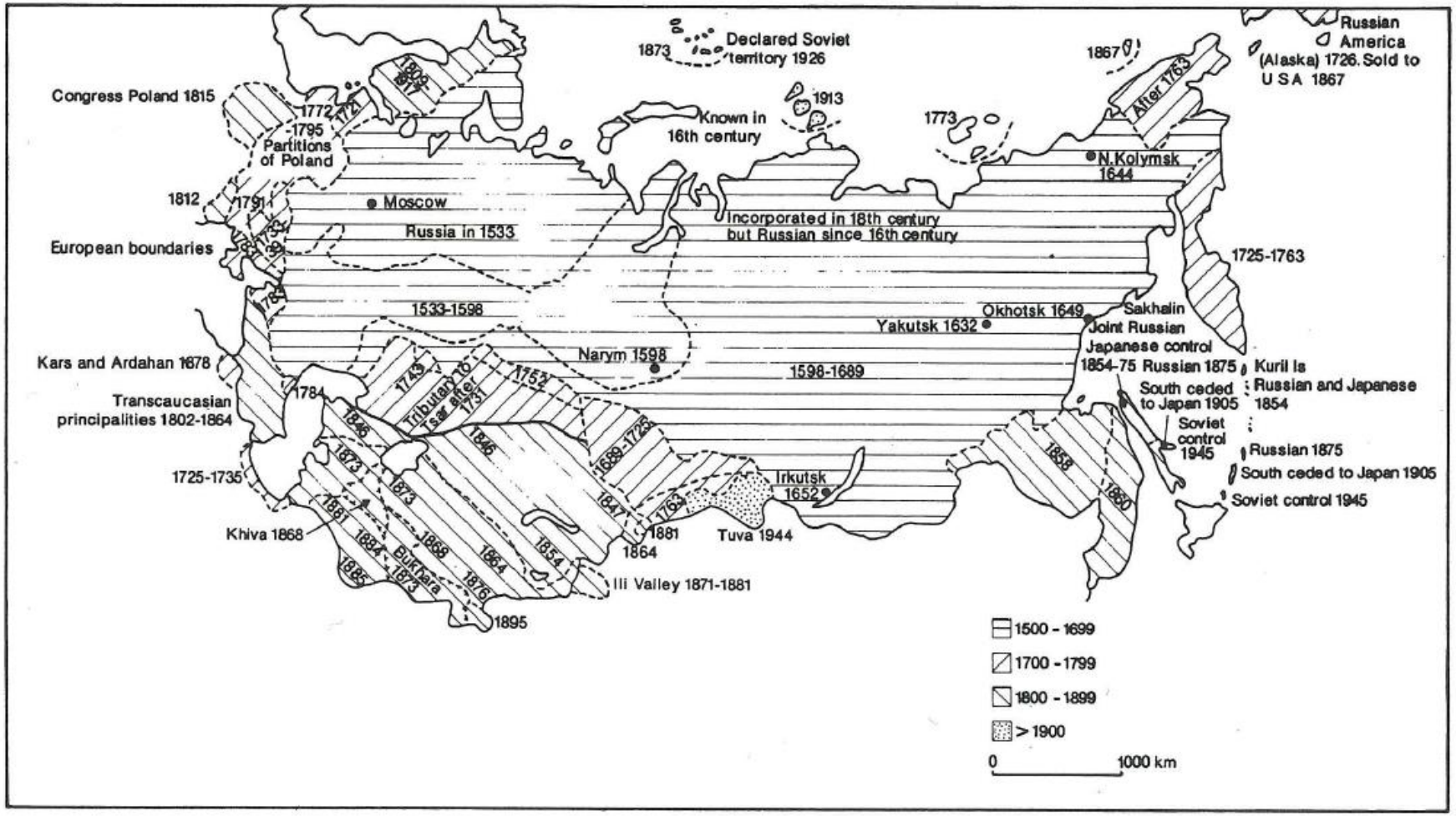
Sources and notes: Nominal GDP from Table A10 for Russia and from Broadberry et al. (2015) for GB. Population from Table 1 for Russia and from Broadberry et al. (2015) for GB. Silver exchange rate from Denzel (2010). PPP from Table 9. GDP for GB in 1990 international dollars from Broadberry et al. (2015).

TABLE 11: An Anglo-Russian comparison of GDP per capita, 1690s to 1800s

	Russia ($1990)	GB ($1990)	Russia/GB (%)
1690s	772	1,484	52.0
1700s	783	1,563	50.1
1710s	793	1,467	54.0
1720s	944	1,605	58.8
1730s	894	1,641	54.5
1740s	1,107	1,653	67.0
1750s	980	1,710	57.3
1760s	1,129	1,835	61.5
1770s	1,120	1,842	60.8
1780s	973	1,871	52.0
1790s	869	1,957	44.4
1800s	907	2,080	43.6

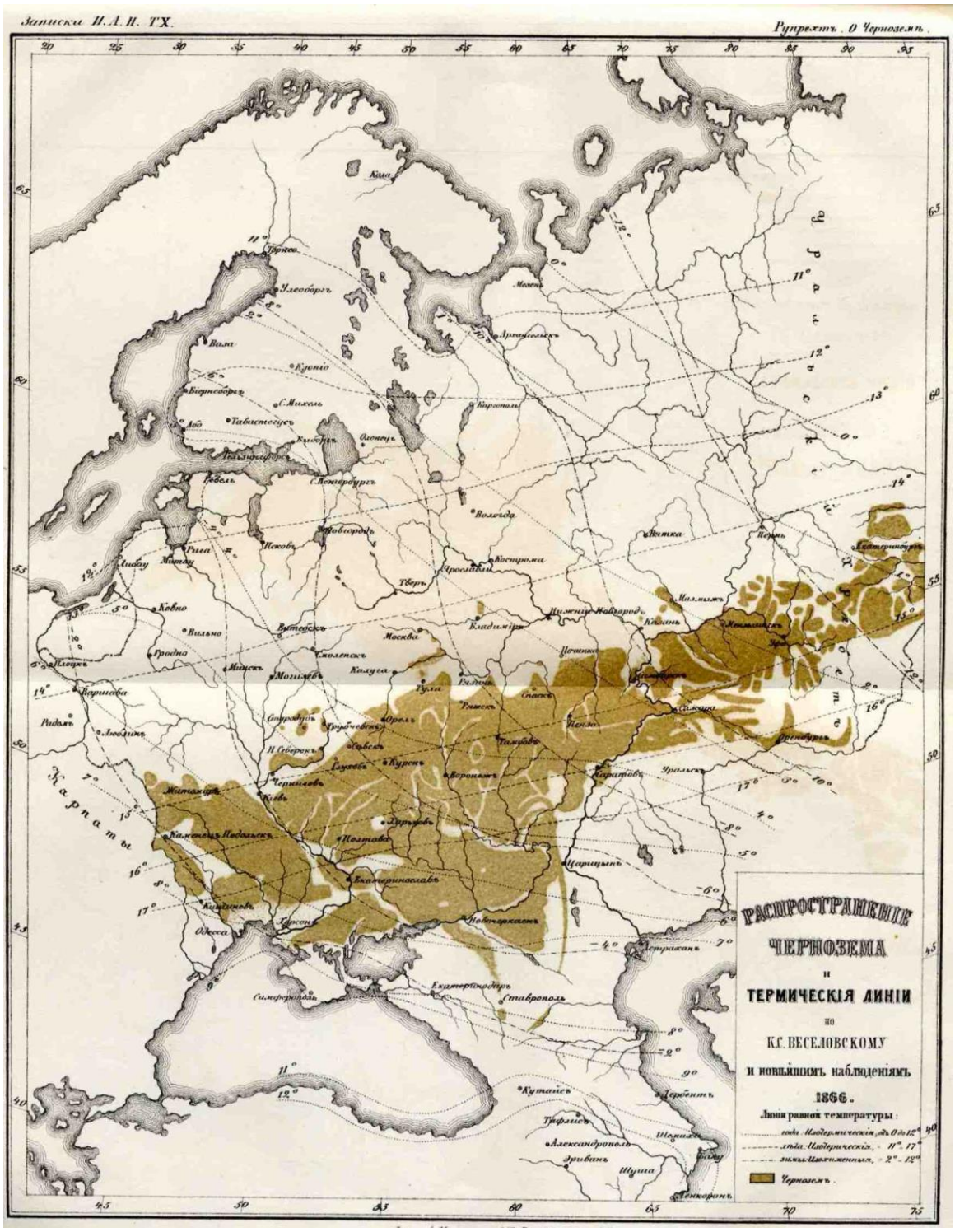
Sources and notes: Russian GDP per capita from Table A10. GB GDP per capita from Broadberry et al. (2015).

FIGURE 1: The territorial expansion of Russia



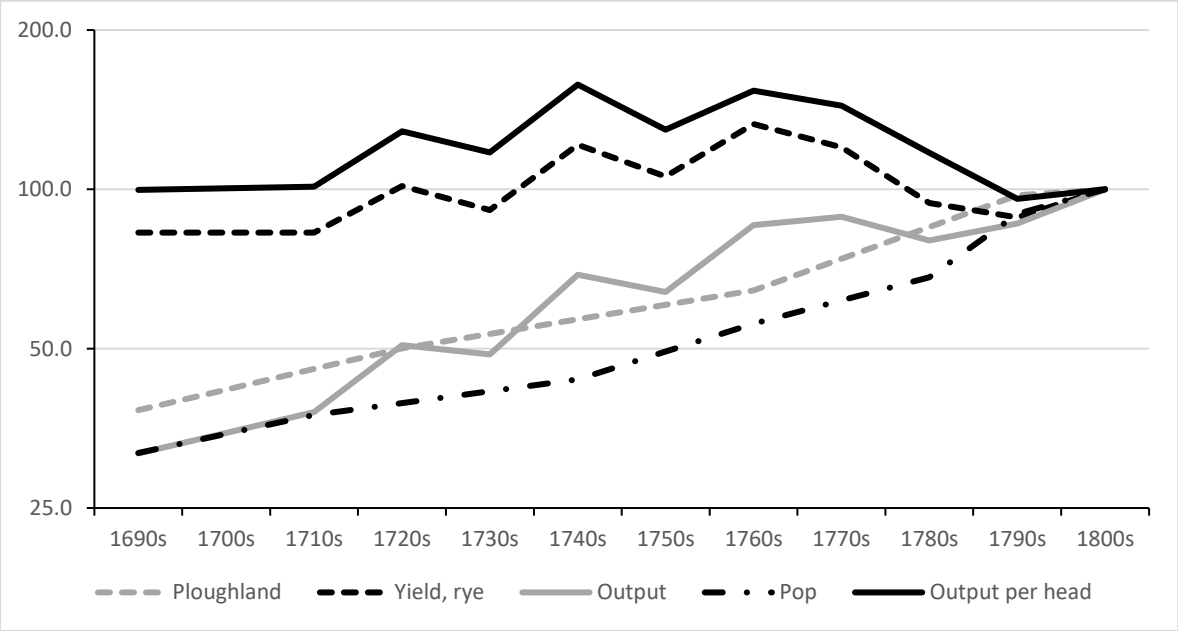
Source: Mellor (1982: 27).

FIGURE 2: Black soil territory in Russia



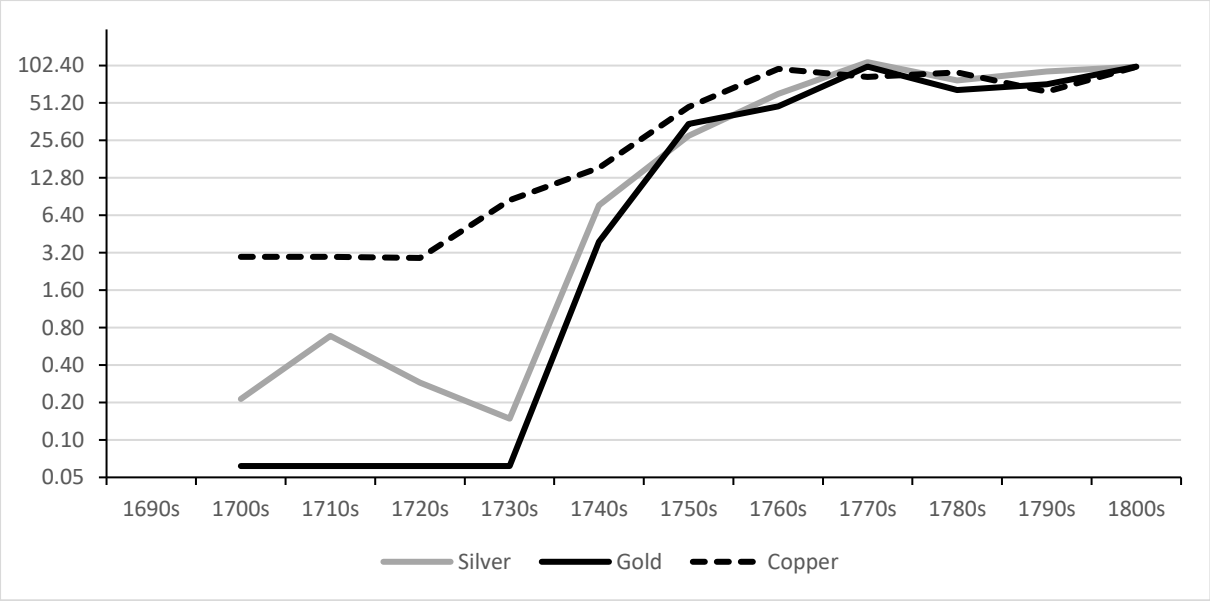
Source: Map:'The spread of black soil and thermal lines'. Veselovskii (1857).

FIGURE 3: Agricultural output per head in Russia, 1690s to 1800s (1800s=100)



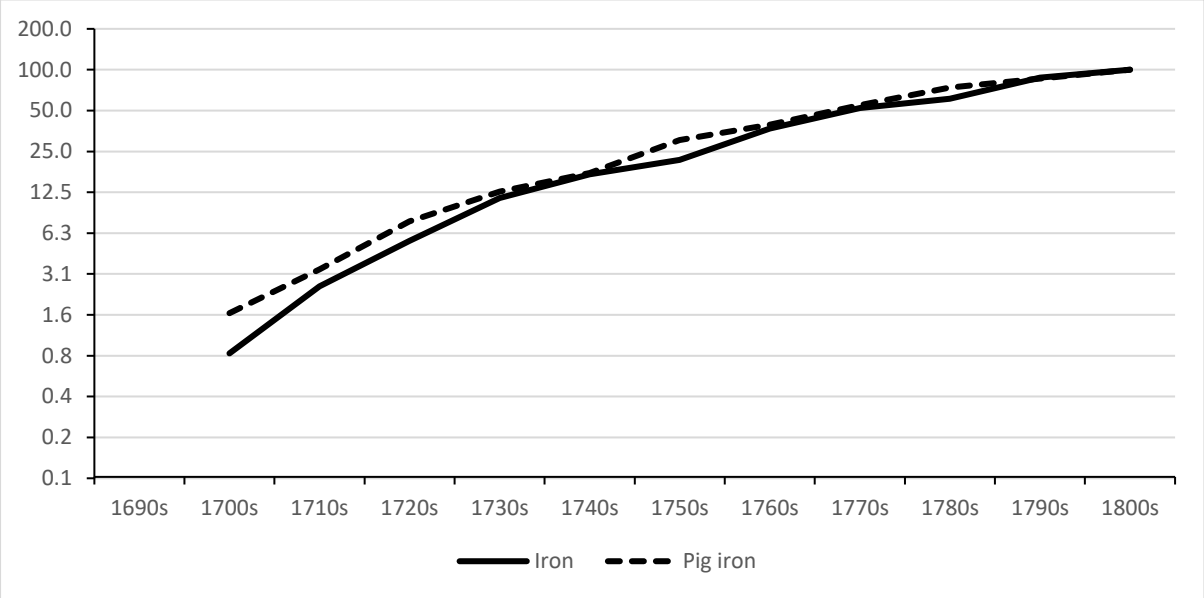
Source: Appendix Table A1.

FIGURE 4: Large-scale industrial production in Russia, 1690s to 1800s: Non-ferrous metals (1800s=100)



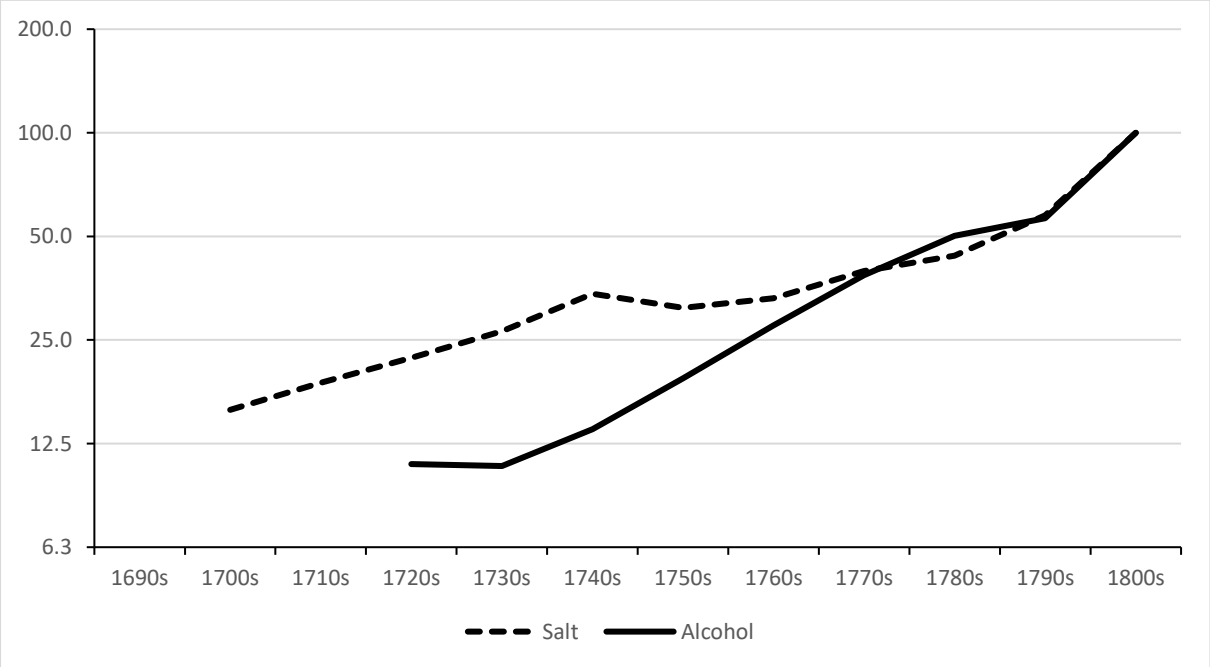
Source: Appendix Table A2.

FIGURE 5: Large-scale industrial production in Russia, 1690s to 1800s: Ferrous metals (1800s=100)



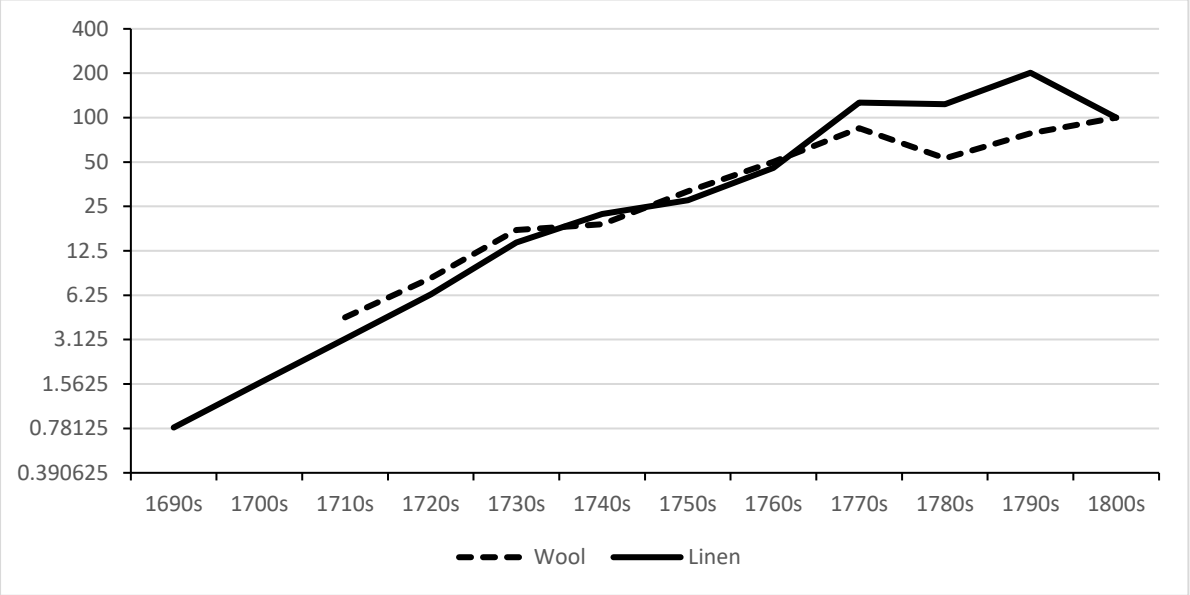
Source: Appendix Table A2.

FIGURE 6: Large-scale industrial production in Russia, 1690s to 1800s: Food and drink (1800s=100)



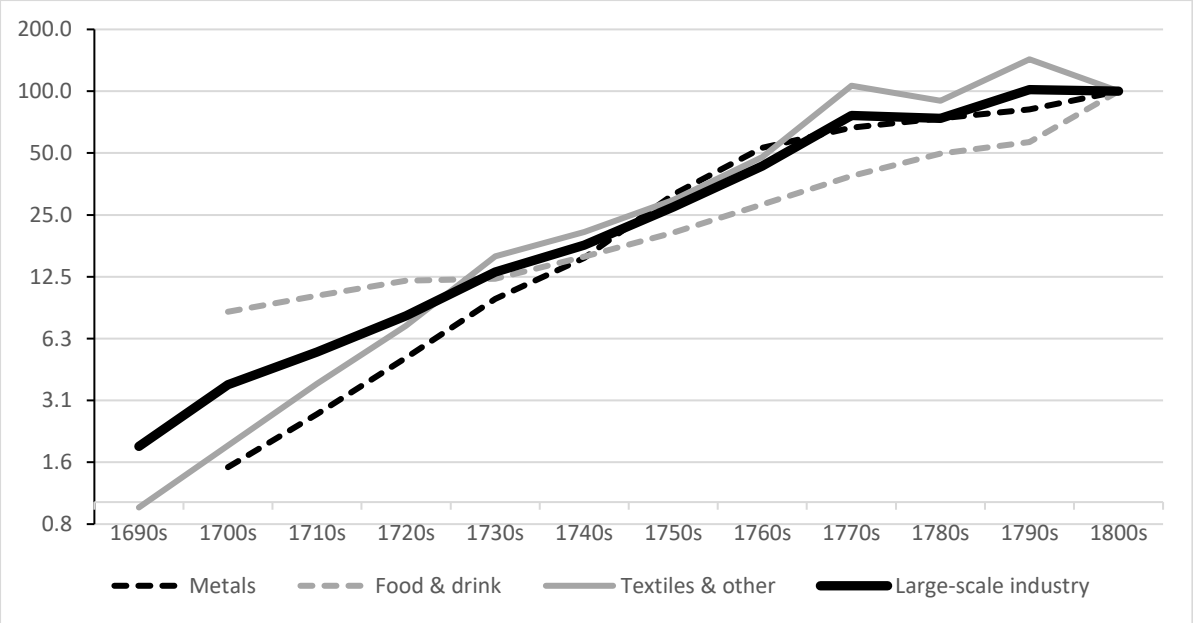
Source: Appendix Table A3.

FIGURE 7: Large-scale industrial production in Russia, 1690s to 1800s: Textiles and other (1800s=100)



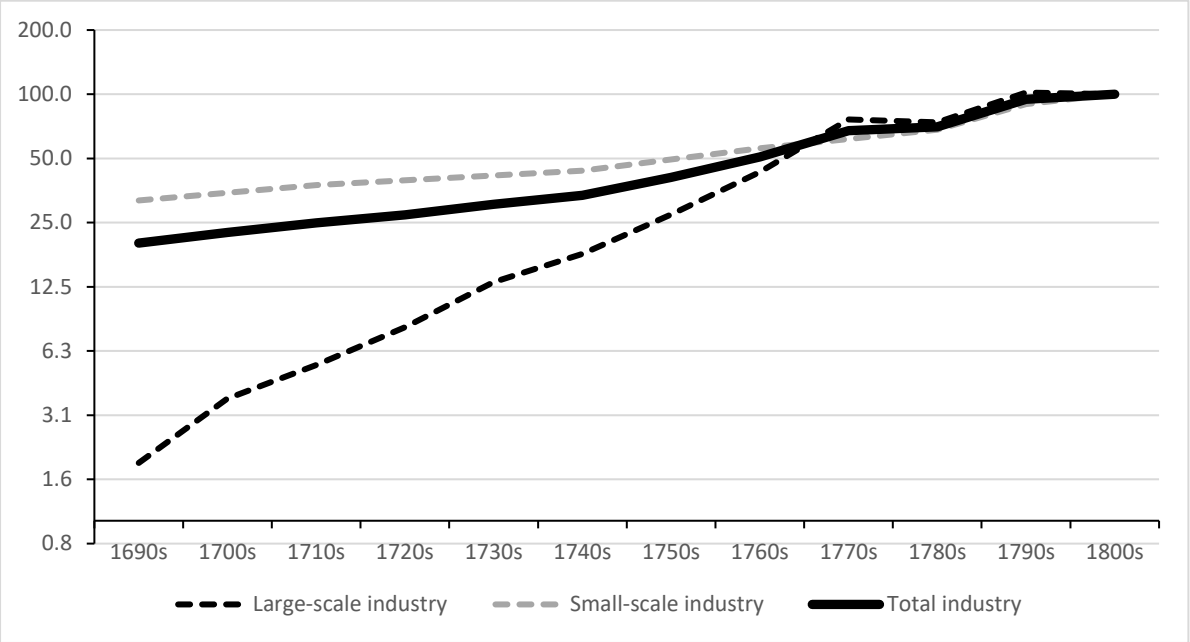
Source: Appendix Table A4.

FIGURE 8: Large-scale industrial production in Russia, 1690s to 1800s (1800s=100)



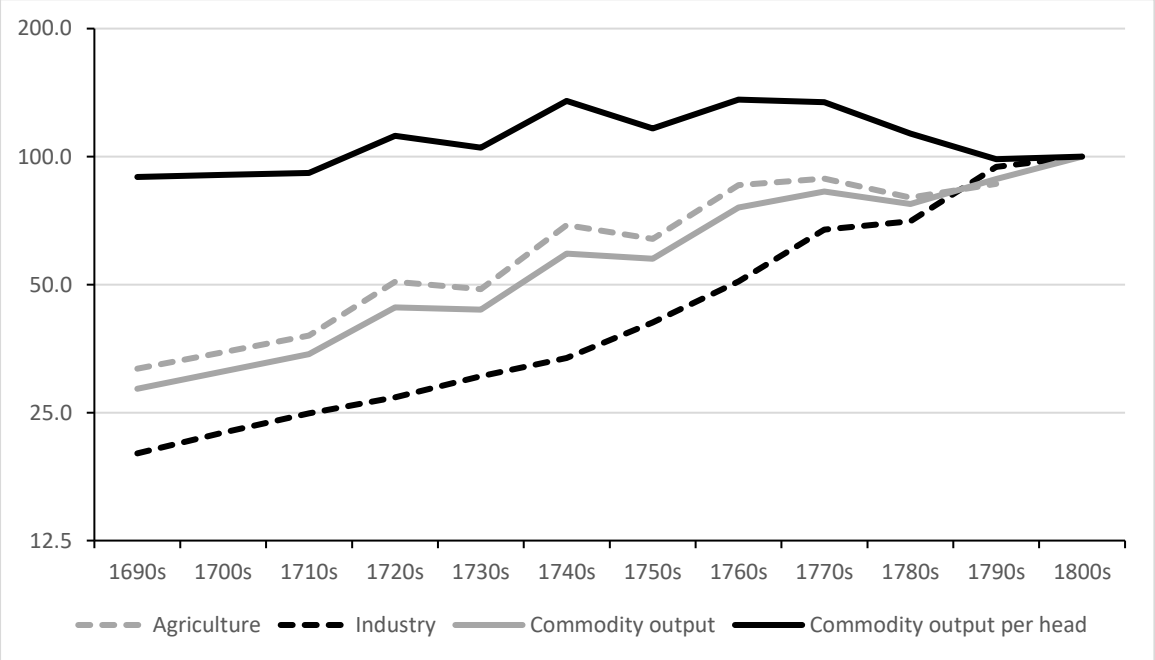
Source: Appendix Table A5.

FIGURE 9: Total industrial production in Russia, 1690s to 1800s (1800s=100)



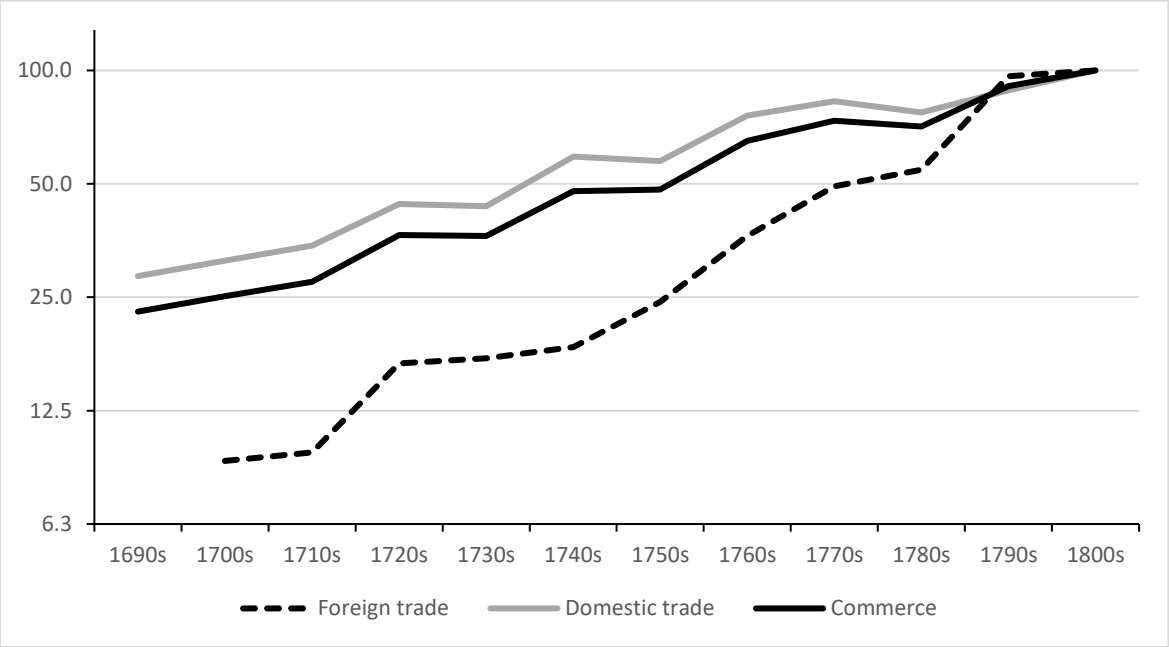
Source: Appendix Table A6.

FIGURE 10: Commodity production in Russia, 1690s to 1800s (1800s=100)



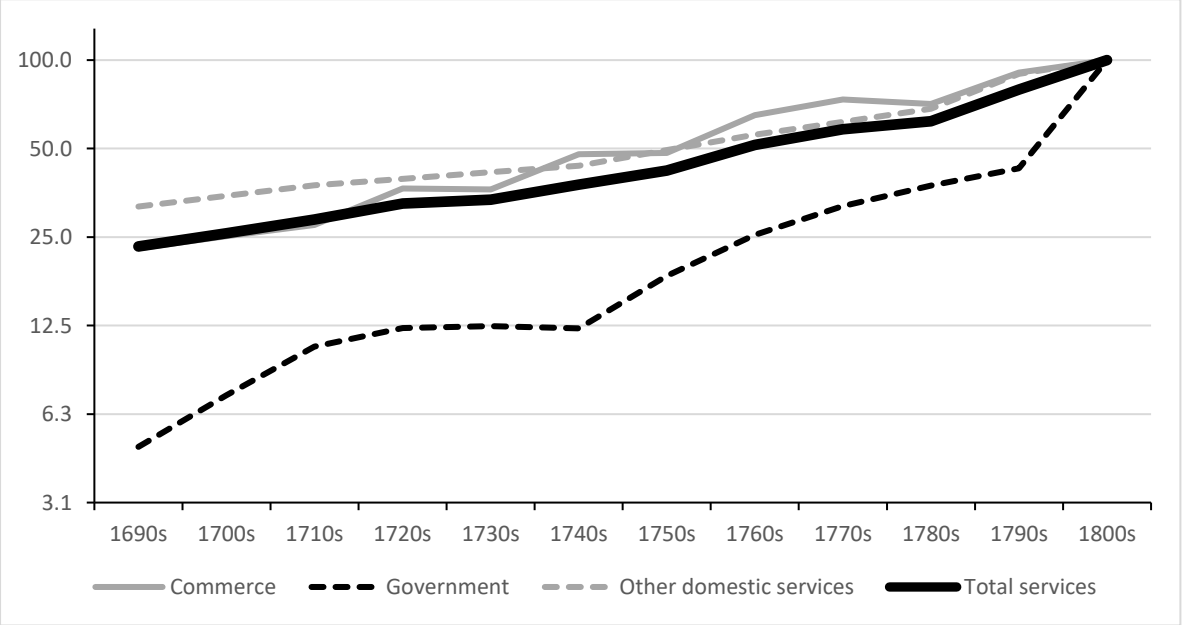
Source: Appendix Table A7.

FIGURE 11: Commerce in Russia, 1690s to 1800s (1800s=100)



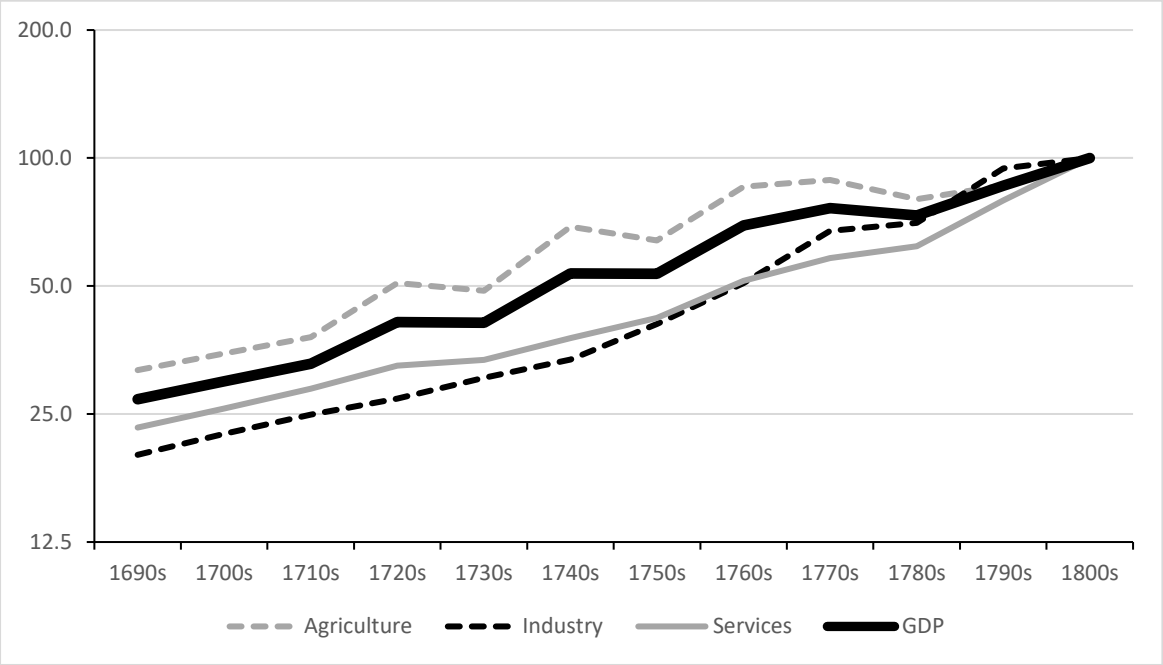
Source: Appendix Table A8

FIGURE 12: Government and other services in Russia, 1690s to 1800s (1800s=100)



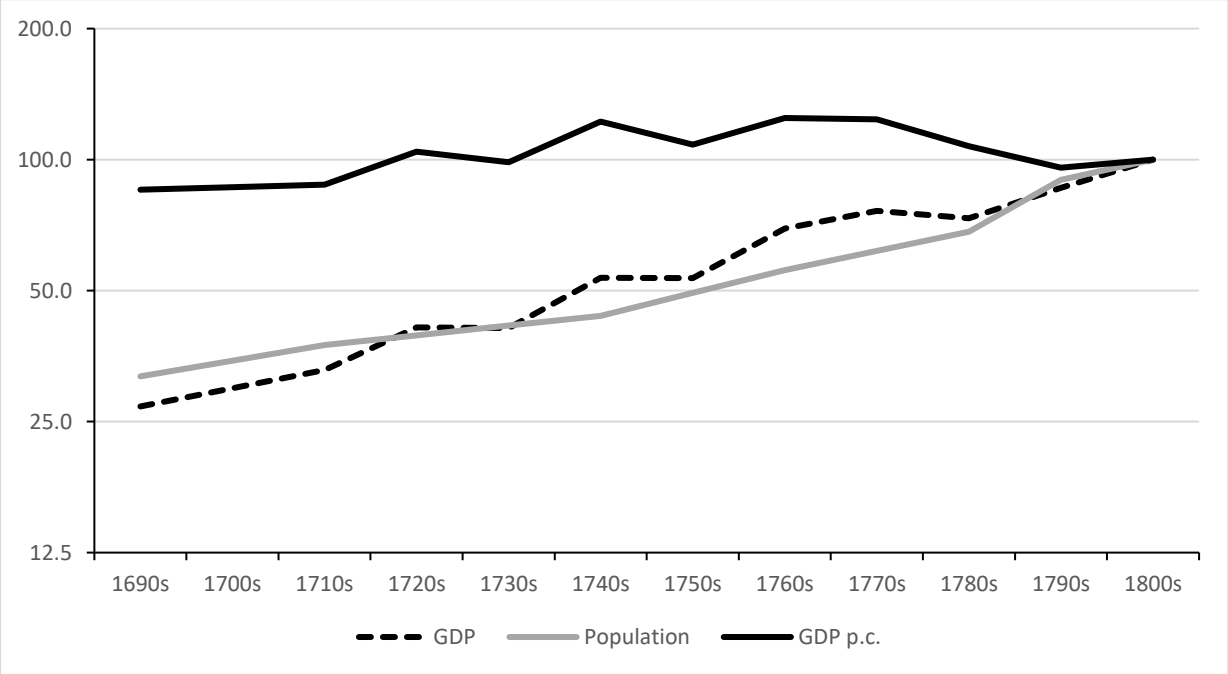
Source: Appendix Tables A8 and A9.

FIGURE 13: GDP in Russia, 1690s to 1800s (1800s=100)



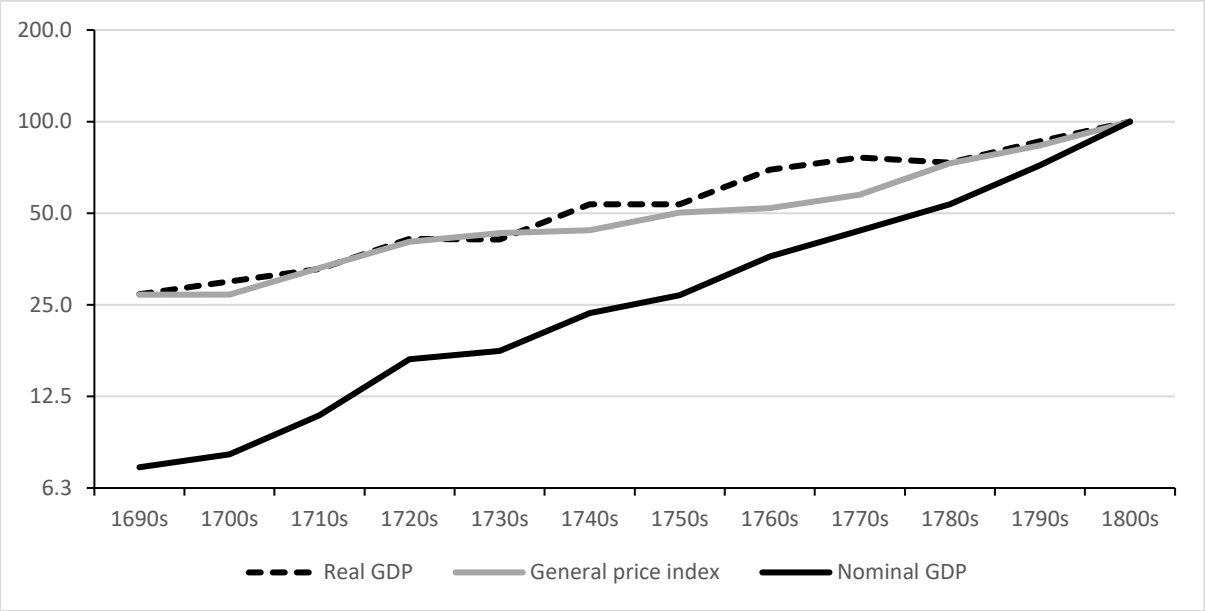
Source: Appendix Table A10.

FIGURE 14: GDP per capita in Russia, 1690s to 1800s (1800s=100)



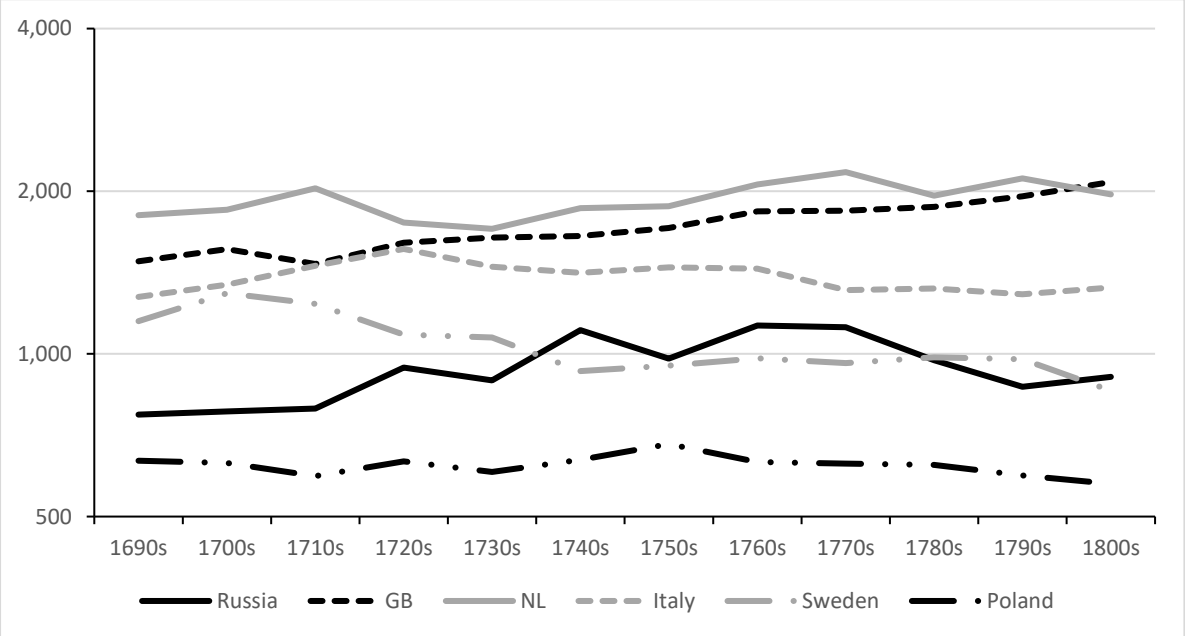
Source: Appendix Table A10.

FIGURE 15: Nominal and real GDP in Russia, 1690s to 1800s (1800s=100)



Source: Appendix Table A11.

FIGURE 16: GDP per capita in Russia and other European economies, 1690s-1800s (1990 international dollars)



Sources and notes: Russia: Table 9; GB: Broadberry et al. (2015); NL: van Zanden and van Leeuwen (2012); Italy: Malanima (2011); Sweden: Schön and Krantz (2012); Krantz (2017); Poland: Malinowski and van Zanden (2017).

APPENDIX 1: DATA SERIES

TABLE A1: Agricultural output per head in Russia, 1690s to 1800s (1800s=100)

	Ploughland	Yield, rye	Output	Population	Output per head
1690s	38.3	82.9	31.7	31.8	99.8
1700s	41.9	82.9	34.7	34.5	100.5
1710s	45.8	82.9	37.9	37.5	101.2
1720s	50.1	101.4	50.8	39.5	128.7
1730s	53.3	91.4	48.8	41.5	117.4
1740s	56.8	121.4	69.0	43.7	157.8
1750s	60.5	105.7	64.0	49.4	129.6
1760s	64.5	132.9	85.7	55.8	153.6
1770s	74.0	120.0	88.8	61.7	143.9
1780s	84.9	94.3	80.0	68.2	117.2
1790s	97.4	88.6	86.2	89.9	96.0
1800s	100.0	100.0	100.0	100.0	100.0

Sources: derived from Tables 1, 2 and 3.

TABLE A2: Large-scale industrial production in Russia, 1690s to 1800s: Metals (1800s=100)

	Silver	Gold	Copper	Iron	Pig iron	Metal production
1690s						
1700s	0.2	0.062	3.0	0.8	1.6	1.5
1710s	0.7	0.062	3.0	2.5	3.4	2.7
1720s	0.3	0.062	2.9	5.5	7.6	5.0
1730s	0.1	0.062	8.5	11.3	12.6	9.8
1740s	7.7	3.914	15.4	17.0	17.3	15.4
1750s	27.9	34.664	47.6	21.7	30.4	31.4
1760s	60.6	48.067	96.0	36.9	39.2	53.0
1770s	109.0	100.464	82.8	52.1	54.7	66.6
1780s	77.6	64.881	90.1	61.1	73.9	73.7
1790s	91.7	72.287	63.0	87.6	86.2	81.7
1800s	100.0	100.000	100.0	100.0	100.0	100.0

Sources and notes: Kahan (1985: 83-85, 110, 114), with minor corrections from original sources for copper from Pavlenko (1953: 78; 1962: 239, 462). Additional information from Golitsyn (1807: 9), Zyablovskii (1815, part 4: 204, 218, 230), Strumilin (1954: 180-206, 347, 367; 1966: 509), Danilevskii (1947: 47). Weights from Table 5.

TABLE A3: Large-scale industrial production in Russia, 1690s to 1800s: Food and drink (1800s=100)

	Salt	Alcohol	Food & drink
1690s			
1700s	15.7		8.4
1710s	18.8		10.1
1720s	22.2	10.9	12.0
1730s	26.5	10.8	12.2
1740s	34.1	13.8	15.7
1750s	31.0	19.4	20.5
1760s	33.0	27.6	28.1
1770s	39.7	38.6	38.7
1780s	43.9	50.2	49.6
1790s	57.5	56.4	56.5
1800s	100.0	100.0	100.0

Sources and notes: Kahan (1985: 96-97, 324), with minor corrections from original sources for salt (Troitskii, 1966: 169; Chechulin, 1906: 199-200) and alcohol (Troitskii, 1966: 159; Chechulin, 1906: 167-168). Alcohol tax revenues are deflated by the official prices per unit (vedro) of alcohol. Additional information for the 1800s from Golitsyn (1807: 9), Zyablovskii (1815, part 4: 281-289), Svedeniya (1860: vol. 3, 3-5) and RGIA, F. 17. Op. 1. D. 44, p. 157 ob. Weights from Table 5.

TABLE A4: Large-scale industrial production in Russia, 1690s to 1800s: Textiles (1800s=100)

	Wool	Linen	Textile production
1690s		0.8	0.9
1700s		1.6	1.9
1710s	4.4	3.2	3.8
1720s	8.2	6.3	7.2
1730s	17.3	14.3	15.7
1740s	18.9	22.2	20.6
1750s	31.7	27.5	29.5
1760s	50.1	45.7	47.8
1770s	84.7	126.3	106.5
1780s	53.0	123.3	89.9
1790s	78.5	201.6	143.0
1800s	100.0	100.0	100.0

Sources and notes: Wool cloth supply from Kahan (1985: 103), interpolated for the 1770s and 1780s using wool cloth demand. Linen output is measured by exports from Kahan (1985: 89), interpolated before the 1750s using the number of linen manufactories from Kahan (1985: 88). Additional information for the 1800s from Zyablovskii (1815, part 5: 10, 33), RGIA. F. 17. Op. 1. D. 44. Weights from Table 5.

TABLE A5: Large-scale industrial production in Russia, 1690s to 1800s: Total (1800s=100)

	Metals	Food	Textiles & other	Total factory industry
1690s			0.9	1.9
1700s	1.5	8.4	1.9	3.7
1710s	2.7	10.1	3.8	5.4
1720s	5.0	12.0	7.2	8.1
1730s	9.8	12.2	15.7	13.2
1740s	15.4	15.7	20.6	17.8
1750s	31.4	20.5	29.5	27.3
1760s	53.0	28.1	47.8	43.2
1770s	66.6	38.7	106.5	76.3
1780s	73.6	49.6	89.9	73.8
1790s	81.7	56.5	143.0	101.8
1800s	100.0	100.0	100.0	100.0

Sources and notes: see Tables A2-A4. Weights from Table 5. Other large-scale industries are assumed to grow at the same rate as textiles.

TABLE A6: Total industrial production in Russia, 1690s to 1800s: Food and drink (1800s=100)

	Large-scale industry	Small-scale industry	Total industry
1690s	1.9	31.8	20.0
1700s	3.7	34.5	22.4
1710s	5.4	37.5	24.9
1720s	8.1	39.5	27.2
1730s	13.2	41.5	30.4
1740s	17.8	43.7	33.6
1750s	27.3	49.4	40.7
1760s	43.2	55.8	50.9
1770s	76.3	61.7	67.4
1780s	73.8	68.2	70.4
1790s	101.8	89.9	94.6
1800s	100.0	100.0	100.0

Sources and notes: Large-scale industry from Table A5, small-scale industry assumed to grow in line with population. Weights from Table 5.

TABLE A7: Commodity production in Russia, 1690s to 1800s (1800s=100)

	Agriculture	Industry	Commodity output	Commodity output per head
1690s	31.7	20.0	28.4	89.5
1700s	34.7	22.4	31.3	90.6
1710s	37.9	24.9	34.3	91.5
1720s	50.8	27.2	44.2	112.0
1730s	48.8	30.4	43.6	105.0
1740s	69.0	33.6	59.1	135.1
1750s	64.0	40.7	57.5	116.4
1760s	85.7	50.9	75.9	136.2
1770s	88.8	67.4	82.8	134.2
1780s	80.0	70.4	77.3	113.3
1790s	86.2	94.6	88.6	98.5
1800s	100.0	100.0	100.0	100.0

Sources and notes: Agriculture from Table A1 and industry from Table A6. Weights from Hermann (1790).

TABLE A8: Commerce in Russia, 1690s to 1800s (1800s=100)

	Foreign trade	Domestic trade	Commerce
1690s		28.4	22.3
1700s	9.2	31.3	24.6
1710s	9.7	34.3	26.8
1720s	16.7	44.2	35.8
1730s	17.2	43.6	35.6
1740s	18.4	59.1	46.7
1750s	24.3	57.5	47.4
1760s	36.3	75.9	63.9
1770s	49.2	82.8	72.6
1780s	54.5	77.3	70.4
1790s	96.4	88.6	91.0
1800s	100.0	100.0	100.0

Sources and notes: Foreign trade: Kahan (1985: 164-165); checked against and augmented by data from Repin (1985: 502, 521, 538-541, 561, 563), Strumilin (1954: 234), Semenov (1859, vol. 3, 221), Chulkov (1788: vol. 7 bk 1, table 8-14) and Troitskii (1966: 185), Storch (1801: 174/15). Data for the 1800s from Valetov (2017). Domestic trade: commodity output from Table A7. Weights from Table 5

TABLE A9: Services in Russia, 1690s to 1800s (1800s=100)

	Commerce	Government	Other domestic services	Total services
1690s	22.3	4.8	31.8	23.1
1700s	24.6	7.2	34.5	25.6
1710s	26.8	10.6	37.5	28.5
1720s	35.8	12.3	39.5	32.3
1730s	35.6	12.5	41.5	33.3
1740s	46.7	12.2	43.7	37.4
1750s	47.4	18.4	49.4	41.8
1760s	63.9	25.5	55.8	51.1
1770s	72.6	31.9	61.7	57.9
1780s	70.4	37.4	68.2	61.8
1790s	91.0	42.9	89.9	79.5
1800s	100.0	100.0	100.0	100.0

Sources and notes: Commerce: Table A8. Government: Kahan (1985: 346), Chechulin (1906: 254, 256), Strumilin (1966: 307), Mironov (2012b: 200), Troitskii (1966: 219, 226), Ministerstvo finansov (1902), Kulomzin (1880: XXXII). Other domestic services: assumed to grow in line with population. Weights from Table 5.

TABLE A10: GDP and GDP per capita in Russia, 1690s to 1800s (1800s=100)

	Agriculture	Industry	Services	GDP	Population	GDP p.c.
1690s	31.7	20.0	23.1	27.0	31.8	85.2
1700s	34.7	22.4	25.6	29.8	34.5	86.3
1710s	37.9	24.9	28.5	32.8	37.5	87.4
1720s	50.8	27.2	32.3	41.1	39.5	104.1
1730s	48.8	30.4	33.3	40.9	41.5	98.6
1740s	69.0	33.6	37.4	53.4	43.7	122.1
1750s	64.0	40.7	41.8	53.4	49.4	108.1
1760s	85.7	50.9	51.1	69.4	55.8	124.5
1770s	88.8	67.4	57.9	76.2	61.7	123.6
1780s	80.0	70.4	61.8	73.2	68.2	107.3
1790s	86.2	94.6	79.5	86.1	89.9	95.8
1800s	100.0	100.0	100.0	100.0	100.0	100.0

Sources and notes: Agriculture and Industry: Table A6. Services: Table A9. Population: Table A1. Weights for GDP: Table 5.

TABLE A11: Nominal and real GDP in Russia, 1690s to 1800s

	(1790s=100)	(1790s=100)	(1790s=1000)	(m roubles)
	Real GDP	Price index	Nominal GDP	Nominal GDP
1690s	27.0	27.0	7.3	166
1700s	29.8	27.0	8.1	183
1710s	32.8	33.0	10.8	246
1720s	41.1	40.3	16.6	376
1730s	40.9	43.0	17.6	400
1740s	53.4	43.9	23.5	533
1750s	53.4	50.3	26.8	609
1760s	69.4	51.9	36.0	818
1770s	76.2	57.5	43.9	996
1780s	73.2	73.0	53.4	1,213
1790s	86.1	83.5	71.9	1,633
1800s	100.0	100.0	100.0	2,271

Sources and notes: Real GDP: Table A10. Price index: Mironov (2012a: 310). Nominal GDP is obtained in index number form by reflating real GDP with the general price index, and in million roubles by setting the level for the 1800s on the 1805 benchmark in Table 10.

REFERENCES

Primary sources

Rossiskii Gosudarstvennyi Istoricheskii Arkhiv (RGIA: Russian State Historical Archive, St Petersburg). F. 17. The Department of Manufacture of Ministry of Domestic Affairs. Op. 1. D. 44 Vedomosti po fabrikam i zavodam po vsem guberniyam [The list of manufactures and factories in Russia].

Moscow Vedomosti [Moscow Gazette], 1796, 1805.

Rossisikii Gosudarstvennyi Arkhiv Drevnikh Aktov (RGADA: Russian State Archive of Ancient Acts, Moscow) F. 248. Senate. Op. 112. D. 222. Vedomosti na tseny i furazh.

Rossisikii Gosudarstvennyi Arkhiv Drevnikh Aktov (RGADA: Russian State Archive of Ancient Acts, Moscow) F. 248. Senate. D. 3577. Vedomosti ob uroahayakh.

Rossisikii Gosudarstvennyi Arkhiv Drevnikh Aktov (RGADA: Russian State Archive of Ancient Acts) F. 1204. Trinity Lavra of St. Serguis. Op. 1. D. 19315, 19341, 19342. Books of Revenues and Expenditures.

Rossisikii Gosudarstvennyi Arkhiv Drevnikh Aktov (RGADA: Russian State Archive of Ancient Acts, Moscow) F. 1239. Op. 1. D. 5134, Op. 3, D. 5920, 59239, 59132, 58964, 59213, 59130. Governors' reports.

Secondary sources

Álvarez-Nogal, C. and Prados de la Escosura, L. (2013), "The Rise and Fall of Spain (1270-1850)", *Economic History Review*, 66, 1-37.

Blanchard, I. (1989), *Russia's 'Age of Silver': Precious-metal Production and Economic Growth in the Eighteenth Century*, London: Routledge.

Broadberry, S., Campbell, B., Klein, A., Overton, M. and van Leeuwen, B. (2015), *British Economic Growth, 1270-1870*, Cambridge: Cambridge University Press.

Broadberry, S. and Wallis, J. (2017), "Growing, Shrinking and Long Run Economic Performance: Historical Perspectives on Economic Development", National Bureau of Economic Research Working Paper No. 23343, http://www.nber.org/papers/w23343.

Buyst, E. (2011), "Towards Estimates of Long Term Growth in the Southern Low Countries, ca.1500–1846", Paper for the "Quantifying Long Run Economic Development" conference at the University of Warwick in Venice, March 22–24, http://www2.warwick.ac.uk/fac/soc/economics/events/seminars-workshops-conferences/conferences/venice3/programme/buyst.pdf.

Campbell, B.M.S. (2000), *English Seigniorial Agriculture, 1250-1450*, Cambridge: Cambridge University Press.

Chechulin, N.D. (1906), *Ocherki po istorii Russkikh finansov v tsarstvovanie Ekateriny II* [Essays on the history of Russian finance under Catherine the Great], St Petersburg: Senatskaya tipographiya.

Chulkov, M.D (1788). *Istoricheskoe opisanie rossiiskoi kommertstii pri vsekhportakh I granitsakh* [Historical description of Russian commerce at all ports and borders] (7 volumes in 21 books), St Petersburg: Imp. Academii Nauk.

Clark, G. (2004), "The Price History of English Agriculture, 1209-1914", *Research in Economic History*, 22, 41-124.

Crafts, N.F.R. (1985), *British Economic Growth during the Industrial Revolution*, Oxford: Clarendon Press.

Crafts, N.F.R. and Harley, C.K. (1992), "Output Growth and the Industrial Revolution: A Restatement of the Crafts-Harley View", *Economic History Review*, 45, 703-730.

Danilevskii, V.V. (1949) *Russkaya tekhnika* [Russian engineering]. Leningrad: Leningradskoe gazetno-zhurnalnoe izdatelstvo.

Deane, P. and Cole, W.A. (1962), *British Economic Growth, 1688-1959: Trends and Structure*, Cambridge: Cambridge University Press.
Denzel, M. (2010), *Handbook of World Exchange Rates, 1590-1914*, Abingdon: Routledge.
Falkus, M.E. (1972), *The Industrialisation of Russia, 1700-1914*, London: Macmillan.
Feinstein, C.H. (1995), "Changes in Nominal Wages, the Cost of Living and Real Wages in the United Kingdom over Two Centuries", in Scholliers, P. and Zamagni, V. (eds.), *Labour's Reward: Real Wages and Economic Change in 19th- and 20th-Century Europe*, Aldershot: Elgar, 3-36.
Gayer, A.D., Rostow, W.W. and Schwartz, A.J. (1953), *The Growth and Fluctuation of the British Economy*, 1790-1850, (2 volumes), Oxford: Clarendon Press.
Gerschenkron, A. (1962), *Economic Backwardness in Historical Perspective*, New York: Praeger.
Golitsyn, I.A. (1807), *Statisticheskaya tablitsa Vserossiyskoi imperii ili fizicheskoye, politicheskoye nachertaniye Rossii, s XIX stolitiya* [Statistical table of the All-Russian Empire, or the physical, political statistical outline of Russia, from the 19th century], Moscow: A. Reshetnikov, https://www.prlib.ru/item/453899.
Gregory, P. R. (1982), *Russian National Income, 1885–1913*, Cambridge: Cambridge University Press.
Harley, C.K. (1998), "Cotton Textile Prices and the Industrial Revolution", *Economic History Review*, 51, 49-83.
Hermann, B.F.J. (1790), *Statistische Schilderung von Russland in Rucksicht auf Bevölkerung, Landesbeschaffenheit, Naturprodukte, Landwirtschaft, Bergbau, Manufakturen und Handel*, St Petersburg: Christian Zornow.
Kahan, Arcadius (1985), *The Plow, the Hammer and the Knout: An Economic History of Eighteenth-Century Russia*, Chicago: University of Chicago Press.
Konotopov, M. V, et al. (1992), *Istoriya otechestvenno tekstilnoi promyshlennosti* [History of the domestic textile industry], Moscow: Legprombytizdat.
Krantz, O. (2017), "Swedish GDP 1300-1560: A Tentative Estimate", Lund Papers in Economic History; No. 152, Department of Economic History, Lund University, http://portal.research.lu.se/portal/files/21081639/LUP_152.pdf.
Kulomzin A.N. (1880), "Finansovye document tsarstvovaniya imperatritsy Ekateriny II [The financial documents of the reign of Catherine II ", *Sbornik russkogo geograficheskogo obsestva*. Issue 28.
Luterbacher, J., Dietrich, D., Xoplaki, E., Grosjean, M. and Wanner, H. (2004), "European Seasonal and Annual Temperature Variability, Trends and Extremes Since 1500", *Science*, 303, 5 March, 1499-1503.
Lyashchenko, P.I. (1949), *History of the National Economy of Russia to the 1917 Revolution*, New York: Macmillan.
Mau, V. and Drobyshevskaya, T., (2012) "Modernization and the Russian Economy: Three Hundred Years of Catching Up (June 1, 2012)". Available at SSRN: https://ssrn.com/abstract=2135459 or http://dx.doi.org/10.2139/ssrn.2135459.
Maddison, A. (1995), *Monitoring the World Economy*, Paris: Organisation for Economic Co-operation and Development.
Maddison, A. (2010), "Statistics on World Population, GDP and Per Capita GDP, 1-2008 AD", Groningen Growth and Development Centre, http://www.ggdc.net/MADDISON/oriindex.htm.
Malanima, P. (2011), "The Long Decline of a Leading Economy: GDP in Central and Northern Italy, 1300-1913", *European Review of Economic History*, 15, 169-219.
Malinowski, M. and van Zanden, J.L. (2017), "Income and its Distribution in Preindustrial Poland", *Cliometrica*, 11, 375-404.

Markevich, A. (2019), "A Regional Perspective on the Economic Development of the Late Russian Empire". Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2555273

Markevich, A. and Harrison, M. (2011), "Great War, Civil War, and Recovery: Russia's National Income, 1913 to 1928", *Journal of Economic History*, 71, 672-703.

Mellor, R.E.H. (1982), *The Soviet Union and its Geographical Problems*, London: Macmillan.

Mikhailovskii, V.G., (1921), "Urozhai v Rossii" [Harvests in Russia], *Bulleten' Tsentral'nogo statisticheskogo upravleniya*, 50, 4-5.

Milov, L.V. (2006), "Istoria Rosssii s drevneishihk vremen do nachala XXI veka" [The History of Russia from ancient times to the beginning of the 21st century] Vol. 2. Moscow: MGU.

Ministerstvo finansov. 1802-1902. [The Ministry of Finance], Saint-Petersburg, 1902. On-line access http://www.hist.msu.ru/Dynamics/13_stt.htm.

Mironov, B. (2000), *The Social History of Imperial Russia, 1700-1917, Volume 1*, Boulder, CO: Westview.

Mironov, B. (2012a), *The Standard of Living and Revolutions in Imperial Russia, 1700-1917*, Abingdon: Routledge.

Mironov, B. (2012b). *Blagososotoyaniye naseleniya i revolyutsii v imperskoy Rossii: XVIII - nachalo XX veka*. [The welfare of the population and revolutions in imperial Russia: XVIII - early XX century.] M.: Ves' Mir.

Nefedov, S.A. (2010), *Istoria Rossii. Faktornyi analiz. Ot okonchaniia Smuty do Fevral'skoi revolutsii* [History of Russia. Factor Analysis. From Time of Trouble till February Revolution]. Vol. 2. Moscow: Izdatel'skii Dom "Territoria budutshego".

Palma, N. and Reis, J. (2019), "From Convergence to Divergence: Portuguese Economic Growth, 1527-1850", *Journal of Economic History*, 79, 477-506.

Pavlenko, N.I. (1953), *Razvitie mettalurgicheskoi promyshlennosti Rossii v pervoi polovine XVIII veka. Promyshlennyay politika I upravlenie*, [The development of the metallurgical industry of Russia in the first half of the 17th century. Industrial policy and management], Moscow: AN SSSR.

Pavlenko, N.I. (1962), *Istoriya metallurgii v Rossii XVIII veka. Zavody I zavodovladeltsy*, [The history of metallurgy in 18th century Russia. Factories and plant owners], Moscow: Izdatelstvo Academii nauk.

Pfister, U. (2011), "Economic Growth in Germany, 1500–1850", paper for the "Quantifying Long Run Economic Development" conference at the University of Warwick in Venice, March, 22–24, https://warwick.ac.uk/fac/soc/economics/seminars/seminars/conferences/venice3/programme/pfister_growth_venice_2011.pdf.

Prokhorov, M. F. (1997), *Krepostnoye krest'yanstvo Rossii v 1750-kh - nachala 1770kh godov*. [Serf peasantry of Russia in the 1750s - early 1770s.] Doctoral Thesis. Moscow.

Repin N.N. (1985), *Vneshnyaya torgovlya Rossii cherez Arkhangelsk I Peterburg v 1700-nachale 60-kh godov XVIII vv*, [Foreign trade of Russia through Arkhangelsk and St. Petersburg in the 1700s and early 1760s], Moscow.

Ridolfi, L. (2016), "The French economy in the longue durée. A study on real wages, working days and economic performance from Louis IX to the Revolution (1250-1789), PhD thesis, IMT School for Advanced Studies, Lucca.

Schön, L. and Krantz, O. (2012), "The Swedish Economy in the Early Modern Period: Constructing Historical National Accounts", *European Review of Economic History*, 16, 529-549.

Rubinshtein, N.L. (1957) *Sel'skoe khozyaistvo Rossii vo vtoroi polovine XVIII v.* [Russian Agriculture in the second half of the 18th century], Moscow: Gospolitizdat.

Rybakov, U. Ya. (1976), *Promyshlennaya statistika Rossii XIX v.* [Industrial statistics of Russia in the 19th century.], Moscow: Nauka.

Semenov, A. (1859), *Izuchenie istoricheskikh svedenii o rossiskoi vneshnei torgovle i promyshlennosti s poloviny 17-go stoletiya po 1858*, [The study of historical information about Russian foreign trade and industry from the middle of the 17th century to 1858], Vol. 3, St Petersburg.

Storch, H.F (1801), *Tableau historique et statistique de l'empire de Russie à la fin du dix-huitième siècle, Vol. 2*, Basle: Chez J. Decker.

Strumilin, S.G. (1954), *Istoriia chernoi metallurgi v SSSR*, [History of ferrous metallurgy in the USSR] vol. 1, Moscow: Nauka.

Strumilin, S.G. (1966), *Ocherki ekonomicheskoi istorii Rossii I SSSR*, [Essays on the economic history of Russia and the USSR], Moscow: Nauka.

Svedeniya (1860), *Svedeniya o piteynykh sborakh v Rossii / sostavleno v Gosudarstvennoy kantselyarii po Otdeleniyu gosudarstvennoy ekonomii*, [Information about drinking fees in Russia], Sankt-Peterburg, vol. 3.

Troitskii, S.M. (1966), *Finansovaya politika russkogo absolutizma v XVIII veke*, [The financial policy of Russian absolutism in the 17th century], Moscow: Nauka.

Tsvetkov, M.A. (1957), *Izmenenie lesistosti Evropeiskoi Rossii s kontsa XVII stoletiia po 1914 g.* [Changing the forest cover of European Russia from the end of the 17th century to 1914], Moscow: Izd-vo AN SSSR.

Valetov, T. Ya. (2017), "Proekt: Statistika vneshnei torgovli Rossiicloi imperii: kharakteristika istochmina i tsifrovogo resursa" [Project: Foreign trade statistics of the Russian Empire: Characteristics of the source and digital platform], *Istoricheskaya informatika*, 1. 5-14. On-line access: http://e-notabene.ru/istinf/article_22195.html.

Veselovskii, K.I., (1857), *Khozyaistvenno-statisticheskii atlas Evropeiskoi Rossii* [Economic-statistical map of European Russia], St. Petersburg: Department Sel'skogo Khozyaistva Ministerstva Gosudarstvennykh imushchestv.

Volkov M, Ya. (1979), *Ocherki istorii promyslov Rossii, Vtoraya polovina XVII – pervaya polovina XVIII veka. Vinokurennoe proizvodstvo*, [Essays on the history of crafts in Russia, from the second half of the 17th to the first half of the 18th century. Distillery production]. Moscow: Nauka.

van Zanden, J.L. and van Leeuwen, B. (2012), "Persistent but not Consistent: The Growth of National Income in Holland, 1347-1807", *Explorations in Economic History*, 49, 119-130.

Zyablovskii, E. (1815), *Statisticheskoe opisanie Rossiiskoi Imperii v nyneshnem eya sostoyanii s predvaritel'nymi ponaytiami o Statistike i obtshim obozreniem Evropy v statisticheskom vide* [Statistical description of the Russian Empire in its current state and statistical overview of Europe]. 2nd edition. St Petersburg: V Morskoi Tipografii.