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Catching-up and falling behind: Russian economic growth, 1690s-1880s

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Abstract

This paper provides decadal estimates of GDP per capita for the Russian Empire from the 1690s to the 1880s. GDP per capita in the 1880s was barely 3 per cent higher than in the 1690s, but this was not the result of continuous stagnation. Rather, positive growth during the first half of the eighteenth century was followed by negative growth between the 1760s and 1800s and stagnation from the 1800s to the 1880s. The main driver of this variation in GDP per capita was the relationship between population and land, with land per capita increasing to the 1760s, then declining to the 1800s and staying stable during the nineteenth century. This suggests that serfdom may not have been as strong a barrier to eighteenth century growth as has often been suggested, nor its abolition in 1861 as significant for subsequent growth. Although large-scale industry grew more rapidly than the rest of the economy, particularly after Peter the Great's reforms in the early eighteenth century, this had only a minor effect on the economy as a whole, as it was starting from a very low base and still only accounted for 10 per cent of GDP by the 1880s. Russian economic growth before the 1760s resulted in catching-up on northwest Europe, but this was followed by a period of relative decline, leaving mid-nineteenth century Russia further behind than at the beginning of the eighteenth century.

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CATCHING-UP AND FALLING BEHIND: RUSSIAN ECONOMIC GROWTH, 1690s-1880s

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File: Russia 1690s-1880s v7

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I. INTRODUCTION

Russia has been largely absent from recent debates over or the emergence of a GDP per capita gap between northwest Europe and other regions of the continent, known as the European Little Divergence. An important factor here is the absence of GDP data for Russia before 1885, when Gregory's (1982) series begins. In the 1880s, Russia was the sixth largest economy in the world, and is the only one among the ten largest economies that does not have even rough estimates of economic performance for the eighteenth and nineteenth centuries.¹ This paper provides decadal estimates of GDP per capita for the Russian Empire from the 1690s to the 1880s, constructed from the output side using both archival and secondary sources. This enables us to encompass many strands of the existing literature on Russian economic history in a way that ensures consistency with the aggregate evolution of the nation's economic performance, and at the same time to place it in an international comparative perspective.

One familiar strand of Russian economic history concerns an early phase of industrialisation from the early eighteenth century following the reforms of Peter the Great (Lyashchenko, 1949; Blackwell, 1968; Falkus, 1972; Kahan, 1985; Mau and Drobyshevskaya, 2012). Although the rapid growth of large-scale industry during this period has received a great deal of attention, it is important to remember the low base from which this growth was starting, which severely limited the scale of the impact on overall industrial production, let alone the economy as a whole. This is reminiscent of the powerful argument of Crafts and Harley (1992), who explained slow aggregate growth during the British Industrial Revolution, despite the

¹ Estimates of gross domestic product (GDP) and GDP per capita in western Europe 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, 2022). 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, but the largest east European economy of the time has until now not attracted sufficient attention.

rapid growth of modernising industries such as cotton textiles and iron, by the small initial scale of those industries in the early stages of industrialisation. As late as the 1880s, large-scale industry accounted for less than half of industrial net output and only just over 10 per cent of GDP in Russia. Small-scale industry grew much less rapidly than large-scale industry, thus ensuring that overall industrial production also grew relatively slowly.

Our estimates of agricultural production also contain some surprises compared with the existing literature, which emphasises backwardness throughout the eighteenth century and continued stagnation during the nineteenth century until the abolition of serfdom in 1861 (Lyashchenko, 1949; Gerschenkron, 1965; Markevich and Zhuravskaya, 2018). By contrast, we find a phase of substantial per capita agricultural output growth during the first half of the eighteenth century as the cultivated area expanded faster than population and grain yields trended upwards. However, this was followed by a period of increasing population growth during the second half of the eighteenth century so that land per capita declined and grain yields also fell back as the climate became less favourable. Such swings in agricultural output per head suggest that serfdom may not have played as large a role in driving agricultural performance as has often been assumed in the literature (Lyashchenko, 1949). This view is only strengthened by the absence of a noticeable effect on per capita agricultural output following the abolition of serfdom in 1861, at least until after the 1880s.

The most important factor behind the very limited increase in Russian GDP per capita over these two centuries was the failure of Russian agriculture to increase output sufficiently to keep pace with the acceleration of population growth from the 1760s, so that much of the per capita income gain of the previous half century was lost. This is broadly consistent with the views of Baykov (1954: 137-138, 144), who emphasised agrarian over-population in an

economy where abundant resource endowments could not be effectively utilised before the railways permitted effective economic integration from the late nineteenth century.

Although GDP per capita in the 1880s was barely 3 per cent higher than in the 1690s, this was not the result of continuous stagnation, but rather periods of growing followed by periods of shrinking, or growth reversals. Until recently, economic historians have written about phases of growth, without paying any attention to the phases of shrinking. But the alternation of phases of growing and shrinking is the normal pattern of pre-industrial economies, and what matters for development is breaking free from this cyclical pattern by shrinking less (Broadberry and Wallis, 2017; Broadberry and Gardner, 2022). For Russia, the late industrialisation of the 1890s was followed by another phase of shrinking following the Bolshevik Revolution of 1917 and it was only after Stalin's Big Push industrialisation of the 1930s that GDP per capita gains were permanently consolidated (Allen, 2003).

With a continuous series of GDP per capita from the 1690s, it is possible to place Russia's economic performance in an international comparative perspective. In the 1690s, there was a substantial GDP per capita gap between Russia and northwest Europe, with Russia at barely half the Dutch level and less than 60 per cent of the British level. During the first half of the eighteenth century, however, Russia entered a catching-up phase, as per capita GDP grew faster than in Britain and the Netherlands. By the 1760s, Russian GDP per capita had reached over 60 per cent of the Dutch level and nearly 70 of the British level. However, this period of Russian catching-up was followed by a period of falling behind during the second half of the eighteenth century, as GDP per capita declined in Russia while growing rapidly in Britain and merely stagnating in the Netherlands. By the 1800s, Russia had fallen further behind northwest Europe than in the 1690s. As Russia stagnated during the nineteenth century,

growth continued in Britain and the Netherlands, so that by the 1880s GDP per capita in Russia was just over 20 per cent of the British level and less than 30 per cent of the Dutch level. Within the Baltic region, Russia briefly overtook Sweden during the mid-eighteenth century, but then lost its lead during the second half of the eighteenth century before falling behind again during the nineteenth century.

2. RUSSIAN POPULATION

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 km² in 1796 and 18.2 million km² in 1858. The data for the key benchmark years in Table 1 are taken from Mironov (2000: 2), based on population counts or *revizii*. Details of the sources and methods are provided in Appendix 2. 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, with the shading becoming darker the later the date of annexation. From the 1697 boundaries there was considerable expansion of the northern frontier into the Baltic region, the western frontier into Eastern Europe and the southern frontier into the Caucasus and Central Asia, as well as further eastward expansion beyond Siberia into East Asia.

Appendix Table A1.1 presents a decadal index of population from the 1690s to the 1880s, using log-linear interpolation between census years for the eighteenth century and annual data from the *Statisticheskii yezhegodnik* [Statistical Yearbook of Russia] for the nineteenth century. Population within the expanding territory grew at an average annual rate of 1.11 per cent over the whole period between the 1690s and the 1880s. However, there were

significant decadal fluctuations with the peak rate of population growth at 1.46 per cent per annum occurring between the 1760s and 1800s. Although population growth fell back from this peak during the nineteenth century, it remained substantially higher than before the 1760s, so that population growth between the 1800s and 1880s exceeded that between the 1690s and 1800s. As we shall see, this rapid population growth during the second half of the eighteenth century had a significant negative impact on the long run evolution of Russian living standards.

3. RUSSIAN AGRICULTURE

In placing Russia's experience in an international comparative perspective, it will be useful to reconstruct GDP on a similar basis to that used in studies for other countries, 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. We begin with agriculture, which was the largest sector in the Russian economy between the 1690s and 1880s and therefore played a dominant role in determining the path of GDP per capita. Agricultural output for the eighteenth century is derived indirectly from data on the amount of cultivated land and grain yields. For the nineteenth century, however, grain output is estimated directly from harvest data. We have followed a common practice in the economic history of pre-industrial Europe of treating grain production as an indicator of overall agricultural output, as we currently lack data on livestock farming for both the eighteenth and nineteenth centuries. Table 2 suggests that livestock products accounted for about one-third of agricultural output in the 1880s and 1890s, which is also consistent with Goldsmith's (1961: 453) assessment of the situation in 1913.

3.1 Eighteenth century agriculture

Table 3A provides data on the land area in Russia, taken largely from Kahan (1985: 46). While the total land area increased by 19.8 per cent 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. This upward trend in yields is visible in Table 4A, taken from Kahan (1985), based on the work of Indova (1970). However, 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

Rye was the habitual consumption crop in eighteenth century Russia, so the rye yield series has been used in the calculation of agricultural output for this period in Figure 2. 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. Multiplying the ploughland series by the index of rye yields results in an index of grain output. This can then be divided by population to yield a series for output per head. The data are plotted in Figure 2 and also provided in Appendix Table A1.1.

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, which raised grain yields as well as expanding the cultivated area (Nefedov, 2010: 143). The rise in yields may also have been a

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

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 was just balanced by rising grain yields.³ Grain yields then began to fall from the 1760s, 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.

3.2 Nineteenth century agriculture

Agricultural output in the nineteenth century is derived directly from data on the Russian harvest, which is checked for consistency with lower frequency data on the cultivated area and grain yields. Figure 2 and Appendix Table A1.1 set out the data for the Russian grain harvest in index number form. For the nineteenth century, our agricultural output data refer only to the 50 provinces of European Russia, so we derive our estimates of agricultural output per capita using population data for this territory from Rashin (1956). This series is then applied to the population data for the whole Empire to obtain a series for agricultural output in the Empire as a whole. With population growing rapidly, agricultural output also increased, but at a slightly slower rate, so that output per capita declined at an annual rate of -0.2 per cent. However, as Figure 2 shows, the decline was not monotonic, with agricultural output per capita showing two periods of positive growth in the 1840s and the 1870s.

A substantial increase in agricultural output was required as the population and territory of the Russian Empire expanded during the nineteenth century. Tables 3B and 4B provide some

³ Ploughland has been assumed to increase at a constant rate between the 1720s and 1760s.

background data on how this increase in agricultural output was achieved. The increase in grain output depended on the cultivated area and the grain yields achieved. In Table 3B, Lyashchenko's (1956, vol.1) data suggest an increase in the cultivated area of around 53 per cent between 1802 and the 1860s, similar to the 54 per cent increase in the population of European Russia over the same period. However, more of the increase came in the non-black soil regions, so that the share of black soil regions declined from 47.1 to 39.6 per cent, which would be consistent with a small decline in quality-adjusted cultivated land per head.

The evidence on grain yields in Table 4B is described by Lyashchenko (1956, vol.1: 509) as showing “an almost stationary yield” between the 1800s and 1860s. Markevich and Zhuravskaya (2018) use similar data from Mikhajlovskij (1921) for the longer period 1800-1914 to suggest an increasing trend from around the emancipation of the serfs in 1861, although most of the gains occurred only after the 1880s. The negative effects of serfdom on agricultural productivity before 1861 and the delayed effects of emancipation are both easy to understand. Under the 1649 Code of Law (*Sobornoye Ulozhenie*), free peasants with the right to migrate across estates became serfs attached to the land and migration without a passport was made a criminal offence. Landlords demanded seigniorial obligations of labour services (*barshchina*), cash or in-kind payment (*obrok*), or in most cases a combination of both, and also had the right to sell, buy, or lease their serfs (Markevich and Zhuravskaya, 2018: 1081). But it was illegal to buy and sell serfs separately and without land. Economic decision-making of serfs was therefore highly constrained, distorting the allocation of labour, creating disincentives for investment and impeding the adoption of improved agricultural techniques (Bugge and Nafziger, 2021: 3). However, the abolition of serfdom was a drawn-out affair involving both the emancipation of the serfs and land reform (Gerschenkron, 1965: 717-783). Although landlords lost their seigniorial rights over the serfs in 1861, the emancipated serfs had an

obligation to buy out the land from the landlords. The terms of this buyout, including the plots of land, the price and the timing of the transaction, had to be negotiated between the landlords and the emancipated serfs. The time period for the signing of the contracts lasted from 1862 to 1882 (Khristoforov, 2011).

4. RUSSIAN INDUSTRY

We construct an index of industrial production for the period between the 1690s and the 1880s, drawing an important distinction between large-scale industry carried out in manufactories and small-scale or cottage industry. For large-scale industry, which is relatively well documented, we combine indices of gross output for each industry with value added weights. We use 1805 weights for the period from the 1690s to the 1800s, 1848 weights for the 1800s to the 1840s and 1887 weights for the 1840s to the 1880s. 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, bar iron and metalworking. Food and drink industries contain separate series for salt, alcohol and sugar, while textiles are represented by wool, linen and cotton. Although in many cases data are available at annual frequency, for some of the key series there are significant gaps for sizeable periods, so that it makes sense to provide series at decadal rather than annual frequency.

For small-scale industry, the time path of output depends heavily on assumptions about productivity. In contrast to large-scale industry, there is no suggestion of rapid productivity growth or economic development in Russian cottage industry over this period, so our central assumption is that output grew in line with population. In Appendix 2 we consider the sensitivity of our results to alternative assumptions.

The data series for large-scale industry are set out in Appendix Tables A1.2 to A1.5, together with sources and brief notes, while the data for small-scale industry and total industry are given in Appendix Table A1.6. The starting point for large-scale industry has been the series for the eighteenth century 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. Blackwell (1968) provides a similar overview of large-scale industry for the first six decades of the nineteenth century, but with a much less comprehensive statistical database, so that it has been necessary to draw on a wider range of sources for individual industries.⁴ 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 was a leading producer and exporter of both ferrous and non-ferrous metals during the eighteenth century, producing a third of the world's iron and exporting more than any other country, while establishing itself as Europe's leading producer of precious metals (Blackwell, 1968: 56; Blanchard, 1989: 63). During the nineteenth century, Russia lost its position in ferrous metals, but continued to play an important role in non-ferrous metals. Appendix Table A1.2 sets out the data for the metal industries, while Figures 3 and 4 plot the series for non-ferrous and ferrous metals, respectively.

⁴ Writing during the Soviet era, Blackwell (1968: 7) notes that he was denied access to Russian archives.

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. Under Peter, the Russian state set up and operated manufactories to meet Russia's military needs, involving the production of metals, armaments and even woollen cloth for military uniforms (Falkus, 1972: 21). Many of these enterprises were later sold to private entrepreneurs from 1720 and private enterprise was heavily involved in further expansion during the post-Petrine period, but the state continued to play an important role through subsidies, tax exemptions, monopolies and other concessions. Perhaps the most important role of the state throughout the eighteenth century, however, was as the main buyer of the output of these manufactories (Kahan, 1985: 80). In addition, the state also helped to solve the problem of securing a labour force for the manufactories by supplying state serfs and drafting criminals and beggars (Mavor, 1965: 124-127).

Non-ferrous metals

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 metal industries is shown in Figure 3 while the decadal data are provided together with brief notes and sources in Appendix Table A1.2. 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.

During the nineteenth century, gold production increased very rapidly at 8.5 per cent per annum between the 1800s and 1840s as Russia became the world's leading gold producer and was second only to Mexico in the combined production of silver and gold (Blanchard, 1989: 63). Between the 1840s and 1880s, however, the growth rate of gold production slowed down to 1.9 per cent, in the face of competition from the newly discovered rich gold fields of California and Australia (Blackwell, 1968, 61). By contrast, silver production declined slowly at an average annual rate of -1.0 per cent across the eight decades, as gold came to dominate world specie markets (Blanchard, 1989: 61-62). Copper production increased slowly to the 1850s, then declined so that it showed no growth over the nineteenth century as a whole.

Ferrous metals

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 4 while metalworking is also shown for the nineteenth century. The decadal data are provided together with brief notes and sources in Appendix Table A1.2. The iron industry grew faster than the copper industry during the eighteenth century at 4 to 5 per cent 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).

Between the 1800s and the 1880s, pig iron and bar iron production grew in parallel at the relatively modest rate of 1.4 per cent per annum, with more of the growth concentrated in the period after the 1840s. The iron industry remained concentrated in the Urals, accounting for around three-quarters of production during the first half of the nineteenth century (Falkus, 1972: 40). Growth was substantially slower than in the eighteenth century as a result of strong competition from Britain and the continued reliance on serf labour (Falkus, 1972: 32, 37; Blackwell, 1968: 56-57). Metalworking is assumed to grow in line with bar iron production before the 1840s and steel production between the 1840s and the 1880s, since these were the most important inputs. This is a standard way of measuring the growth of metalworking in historical national accounting, as output is very heterogeneous in this industry, making it difficult to obtain meaningful physical indicators or unit prices (Hoffmann, 1965: 236-238; Lewis, 198: 253). It is also consistent with accounts of the emergence of Russia's machine building enterprises out of mechanical workshops at metallurgical plants and foundries (Yatsunsky, 1974: 124). Metalworking thus grew slowly between the 1800s and the 1840s, before accelerating to an annual growth rate of 10.1 per cent between the 1840s and the 1880s, consistent with Blackwell's (1968: 64) account of the pace of change in the machine industry.

4.2 Large-scale industry: Food and drink

Output of the major large-scale food and drink industries is shown in Figure 5 while the decadal data are provided together with brief notes and sources in Appendix Table A1.3. For the eighteenth century, Kahan (1985) provides data on salt and alcohol, which were controlled by the state. 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. Salt output grew at an annual rate of 1.85 per cent during the eighteenth century as a whole. 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 (2012: 310), obtaining similar results.⁵ 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).

In the nineteenth century, as during the eighteenth century, the food and drink sector of large-scale industry was dominated by the staples of salt and alcohol. In addition, beet sugar emerged as an important new industry that developed behind tariff protection. Salt production grew a little more slowly than population, at an annual rate of 1.0 per cent, while alcohol grew somewhat faster than population at 2.0 per cent. The state continued to control the alcohol market, as it had done during the eighteenth century. Between 1795 and 1863, the sale of vodka was in the hands of middlemen known as *otkupshchiki* (tax farmers), who sometimes enjoyed monopolies over several provinces. This produced high prices for consumers, lower alcohol tax revenues for the government and large fortunes for corrupt officials (Blackwell, 1968: 55-56). Following the introduction of tariff protection in 1822, sugar beet refining initially operated on a small scale, dominated by manorial factories using serf labour, particularly in the

⁵ 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.

Ukraine (Yatsunsky, 1974: 119-120). After 1840, however, production became concentrated in larger units using steam-powered machinery (Falkus, 1972: 40; Blackwell, 1968: 54). From 1840 to 1880, the industry grew at the rapid rate of 10.7 per cent per annum. Although this may at first sight appear to be an example of the state successfully stimulating an infant industry that modernised, it should be noted that concerns about the viability of cane sugar refiners in St Petersburg led the state to introduce a domestic excise on beet sugar in the mid-nineteenth century that kept prices high and restricted the sugar market to the upper classes (Blackwell, 1968: 54-55). A heavy reliance on serf labour may also have impeded the productivity of the industry (Blackwell, 1968: 55).

4.3 Large-scale industry: Textiles and other industries

Output of the major large-scale textile industries is shown in Figure 6 while the decadal data are provided together with brief notes and sources in Appendix Table A1.4. Government played an important role in the wool industry during the eighteenth century 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 (Kahan, 1985: 103). 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 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 during the eighteenth century, and linen output 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.

Performance in the textile industries during the nineteenth century ranged from the very dynamic (cotton) through the slow-growing (wool) to the declining (linen). The output of the cotton industry is tracked using imports of raw cotton, the principal input, a common way of measuring the output of the cotton industry at this time (Robson, 1957). The cotton industry developed very rapidly from a low level in the 1810s, growing at an annual rate of 13.0 per cent between the 1800s and 1840s, slowing down to a still impressive 5.7 per cent between the 1840s and 1880s. Although the Russian cotton industry was able to grow rapidly, it developed against the backdrop of the growing dominance of the English cotton industry, the scale of which outshone its Russian counterpart by a factor of more than 10 to 1 in terms of the numbers of spindles and looms (Blackwell, 1968: 43). Given the English dominance in spinning, the Russian cotton industry at first developed by weaving cloth from imported yarn and finishing the cloth by dyeing and printing, employing free labour but with relatively low levels of mechanisation before the late nineteenth century. In wool textiles, output grew at 2.5 per cent per annum between the 1800s and 1880s, but with much of the growth concentrated in the period before the 1840s. Indeed, from the 1840s output only just kept pace with population growth. After the Napoleonic wars, attempts to diversify away from production for military needs met with some success, but the industry remained dominated by technically conservative gentry-owned rural estate factories using serf labour rather than by technically modern urban factories owned by middle class industrialists employing free labour (Blackwell, 1968: 49). Although the total value of linen production exceeded that of cotton and wool combined, most

of this was produced by peasants working from home, and linen was only a small part of factory industry (Blackwell, 1968: 51). We have used data on the volume of exports to estimate the trend of output in the large-scale or factory linen industry, which declined by -0.7 per cent per annum between the 1800s and the 1880s. The main reason for the decline of linen was competition from cotton cloth.

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 and 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 index of large-scale industrial production has been constructed using the net output weights shown in Table 5, derived from material on industry from the Russian State Historical Archive (*Rossiskii Gosudarstvennyi Istoricheskii Arkhiv*) at St Petersburg and additional secondary sources. Data are available on production volumes and unit prices, which can be used to derive gross output for benchmark years circa 1805, 1848 and 1887 (Rybakov, 1976). To arrive at net output weights, we have used the ratio of net output to gross output for individual industries from the 1908 Production Census (Ministerstvo trgovli i promyshlennosti, 1913), as these ratios tend to be fairly stable over time and across countries in the nineteenth century (Lewis, 1978; Flux, 1924).

Although the metal industries have received much attention in the literature, they accounted for only around one-fifth of net output in large-scale industry in 1805, with food and drink playing a much larger role. Within metals, the most significant changes over the

nineteenth century were the declining share of iron production, the growing importance of gold during the first half of the century and the emerging importance of metalworking. The share of metals as a whole declined sharply in the second half of the nineteenth century as the result of declining relative prices despite continued rapid real growth.

Food and drink accounted for the biggest share of net output in large-scale industry throughout the nineteenth century. It was dominated by alcohol production, with salt remaining much smaller, but the second half of the nineteenth century saw the rapid growth of a sugar beet industry concentrated in large-scale enterprise. The increasing share of food and drink between the 1840s and 1880s was driven by an increase in relative prices in a sector largely shielded from international competition.

Textiles increased their share of value added during the first half of the nineteenth century through rapid growth in real terms. The most significant change was the emergence of cotton as the dominant large-scale textile industry in the place of woollen and linen cloth, although linen retained its importance in small-scale enterprise.

Output of large-scale industry by major branch is shown in Figure 7 while the decadal data are provided together with brief notes and sources in Appendix Table A1.5. Growth was rapid in all three component series, although food & drink grew somewhat more slowly than metals or textiles & other during the first half of the nineteenth century. 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 production in metals and mining, where economies of scale were important. However, in industries such as textiles, food & drink and small household goods such as candles, small-scale producers continued to account for the bulk of industrial output during the eighteenth century (Kahan, 1985: 120-124). By the 1880s, Gregory (1882: 73) estimates that after two centuries of rapid growth, large-scale manufactories produced just under half of all industrial net output, as shown in Table 6. As noted above, our central assumption for small-scale industry is that output grew in line with population. Projecting back from the 1880s with this assumption for small-scale industry and the index of output in large-scale from Table A1.5 produces an estimate for the share of large-scale industry of 22.1 per cent of total industrial production in the 1800s, and just 4.2 per cent in the 1710s at the start of Peter the Great's reforms. This is very much in line with the existing literature, which notes that although there had been earlier attempts by Dutch entrepreneurs to establish large-scale industry in Russia during the seventeenth century, not much of it survived by the beginning of the eighteenth century (Falkus, 1972: 21; Kahan, 1985: 124).

4.6 Total industrial production

Figure 8 plots the path of total industrial production constructed using the weights from Tables 5 and 6, while Appendix Table A1.6 provides the data series, together with sources and brief notes. Although large-scale industry grew at the rapid rate of 3.14 per cent per annum between the 1690s and 1880s, small-scale industry is assumed to grow in line with population at a much slower annual rate of 1.11 per cent. Since small-scale industry had a weight of more than half in total industrial production, the overall annual growth rate of industry was 1.43 per cent, or just 0.32 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 base (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 the 1880s, agriculture accounted for 72 per cent of Russian commodity output (Table 8).⁶ The importance of agriculture shows up clearly in Figure 9, 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 2, but with long-term decline avoided by the inclusion of industry. The data series for commodity output are set out in Appendix Table A1.7, together with sources and brief 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 for 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 Appendix Tables A1.8 and A1.9, together with sources and brief notes.

⁶ The share of agriculture in commodity production is obtained as the ratio between the share of agriculture in GDP and the sum of the shares of agriculture and industry in GDP.

6.1 Commerce

The output of the commerce sector is tracked using volume indicators of foreign and domestic trade. For foreign trade, we rely on the value of exports deflated by the general price index for the eighteenth century and the volume of wheat exports for the nineteenth century. 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 (2012). In the absence of aggregate data on the value of exports during the nineteenth century, the volume of wheat exports, the most important export, is used. The volume of domestic trade is tracked using the commodity output index constructed as described in section 5.

Although exports and imports together only amounted to around 15 per cent of GDP in the 1880s, they consisted entirely of marketed output, whereas a large proportion of domestically consumed commodity output was not marketed. We have therefore used weights of 30 per cent for foreign trade and 70 per cent for domestic trade to construct the commerce series in Figure 10. Since foreign trade grew faster than commodity output, the commerce sector grew a bit more rapidly than domestic trade. The overriding impression, however, is of only modest growth of commerce due to the limited degree of integration of the Russian economy before the railway age (Baykov, 1954).

6.2 Government and other domestic services

The government provided services of civil administration and defence, with the necessary expenditure financed by raising revenue. However, the government revenue and expenditure

accounts are complicated by the heavy involvement of the state in production and distribution, where output has already been accounted for. For the nineteenth century we have used the ordinary expenditure of the government provided on a consistent basis by Tabata and Tabata (2019). This current price series is deflated using the price index from Mironov (2012) to provide an index of real government services. For the eighteenth century, the accounting data have not yet been consolidated and since the coverage of the revenue and expenditure accounts became more complete over time, their use would give a misleading impression of very rapid growth during the eighteenth century, which does not reflect the reality of the provision of government services. We have assumed that the provision of civil administration grew in line with population, but have made a significant cyclical adjustment for defence spending based on military personnel for census years from Kahan (1985: 8).

The real government services series is set out in Table A1.9 of Appendix 1 together with brief sources and notes, and plotted in Figure 11. Government services grew in line with population during the eighteenth century, but there is also a cyclical element of military expenditure between wars and peacetime, the details of which are set out in Appendix 2. There was a major spike at the time of the Napoleonic wars in the early nineteenth century, with high levels of military expenditure continuing through the 1820s and 1830s as a result of empire building in the Middle East and police actions in eastern Europe (Blackwell, 1968: 182-183). Over the whole period between the 1690s and the 1880s, government grew at an annual rate of 1.37 per cent, or 0.26 per cent on a per capita basis. 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).

6.3 Total service sector output

As for industrial production, service sector provision is tracked using a volume index derived from indices for each sector, with net output weights for the 1880s from Table 7. These weights for 1883-87 from Gregory (1982: 73) suggest that commerce was the largest sector and government the smallest. However, it must be borne in mind that a large part of government revenue and expenditure was a result of state industrial production, which has already been accounted for within the industrial sector. Hence the 1880s value of net output of government services in Table 7, at 143 million silver roubles, is substantially lower than the level of government revenue, at 732 million silver roubles.

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 8. The value of total net output in Table 8 is taken from Gregory (1982: 58), based on current price net national product (NNP), and is divided between the three sectors using the sectoral shares for 1883-1887 from Gregory (1982: 73). The resulting series for GDP is shown in Figure 12 together with the component sectoral outputs, which are also provided together with sources and brief notes in Appendix Table A1.10. Agriculture emerges as the slowest growing sector, while the fastest growing sector was industry but with services also growing substantially faster than agriculture.

Figure 13 shows the impact of this output growth on GDP per capita, while annual growth rates for the component series are provided in Table 9. Although GDP grew at 1.13 per cent per annum between the 1690s and the 1880s, most of this was extensive growth as population grew by 1.11 per cent per annum, so that GDP per capita grew by just 0.02 per cent

per annum. This resulted in an increase in living standards of around 3 per cent over the one hundred and ninety-year period as a whole.

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 (2012: 310). With real GDP increasing by a factor of 9 between the 1690s and the 1880s and the price level increasing by a factor of 5, nominal GDP increased by a factor of 45, as shown in Figure 14. 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 Appendix Table A1.11, by benchmarking the 1880s figure on the 1885 value from Table 8.

9. RUSSIA'S LONG RUN ECONOMIC PERFORMANCE

9.1 Russian GDP per capita from the 1690s to the 2000s

It is now possible to provide a single series for Russian GDP per capita covering the period from the 1690s to the 2000s, by combining the estimates for the period 1690s-1880s from this paper with those of Maddison (2010) for the period 1880s-2000s. The Maddison series incorporates the estimates of Gregory (1982) for the period 1885-1913, Markevich and Harrison (2011) for 1913-1928, Moorsteen and Powell (1966) for 1928-1950 and CIA estimates for the postwar period. The complete series from the 1690s to the 2000s in 1990 international dollars is plotted in Figure 15.

The Russian economy experienced a phase of growth in the first half of the eighteenth century via state-led industrialisation under Peter the Great. However, this petered out from the 1740s and went into reverse as agricultural output failed to keep up with rapid population

growth from the 1760s. By the 1800s, GDP per capita was little higher than it had been in the 1690s. There then followed a long period of stagnation between the 1800s and 1880s, with the abolition of serfdom in 1861 apparently having no significant effect on GDP per capita, at least in the short run. By contrast, the period between the 1880s and 1900s saw a return to strong growth as the state protected heavy industry and played a more active role in the construction and operation of railways. These policies were pursued most systematically between 1893 and 1903 by Sergei Witte, the Minister of Finance, who also encouraged foreign investment in Russia (Falkus, 1972: 69-74). The decade of the 1910s saw the twin setbacks of defeat in World War I and the Bolshevik revolution of 1917, followed in the 1920s by difficulties of adjusting to changing economic systems (Davies, 1994).

Russia experienced a period of rapid growth during the 1930s through a policy of state-led industrialisation, which provided the materials for Russia to fight off successfully the German invasion during World War II (Allen, 2003). Although the setback of the 1940s seems modest in Figure 15, it involved a more than 25 per cent decline in Russian GDP between 1940 and 1942 before recovery by 1945 and a return to rapid postwar growth in the second half of the decade (Harrison, 1998: 283). Russia, in common with most of the rest of the world, experienced rapid growth during the 1950s and 1960s, but growth slowed down sharply in the 1980s, contributing to the demise of the socialist system. The transition to a market economy in the 1990s saw a peak-to-trough decline of 45 per cent in GDP per capita on an annual basis, and full recovery had still not been achieved by the time of the global financial crisis of 2008 (Dennison and Klein, 2021).

9.2 A benchmark comparison of GDP per capita for Russia and Britain in 1795/96

Our estimates of Russian GDP per capita in Figure 15 are based on time series projection of real GDP from a 1990 benchmark. This provides a basis for comparisons of GDP per capita across both time and space in 1990 international prices, as in Maddison (2010). However, this exercise is inevitably fraught with index number problems, and perhaps more importantly, dependent on accurately estimating the path of GDP per capita over several centuries from historical data subject to measurement error. It is therefore useful to construct another benchmark for an earlier year as a cross-check. Here, we have chosen to provide a benchmark in the 1790s through a direct comparison between Russia and Britain. This can be done by comparing the new nominal GDP per capita estimates for Russia with the estimates for Britain from Broadberry et al. (2015), which requires constructing a purchasing power parity (PPP) for the two nations. This is done in Table 10 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.

Table 10 presents the prices and weights of individual products in sections dealing with food and other commodities. For food, British prices are taken from Clark (2004) while Russian prices are taken from the Russian State Archive of Ancient Acts⁷ and the Moscow Gazette (*Moskovskie vedomosti*). British 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 items in household expenditure. Feinstein's weights are for broad categories of expenditure, and within those categories we have taken unweighted averages of individual items. The earliest Russian weights are for the mid-nineteenth century, taken from

⁷ 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.

Mironov (2012: 255, 261). PPPs for individual products are obtained as the ratio between the Russian price and the British price. For other goods, prices for candles and soap are taken from the same sources as for food, while prices for cloth and iron are taken from Harley (1998) and Gayer et al. (1953) for Britain and from Semenov (1859) for Russia. Within the category of other goods, we have taken unweighted averages of individual items, as within the sub-categories of food. The weights used to aggregate food and other goods are the shares of agriculture and industry in commodity output, derived from Broadberry et al. (2015: 194) for Britain and Table 8 for Russia.

Table 11 shows the sectoral and aggregate PPPs calculated at both Russian and British weights, together with the geometric means that we use as the compromise estimates. The market exchange rate was £1 = 5.65 silver roubles (Denzel, 2010: 359, 368), so a PPP of £1 = 3.23 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 is £1 = 5.44 roubles. This reflects technological progress in Britain during the Industrial Revolution, which particularly affected the price of cloth and iron. The aggregate PPP is a weighted average of the PPPs for food and other goods, taking account of the different shares of agriculture and non-agriculture in commodity output in Britain and Russia. The aggregate PPP for 1795/96 works out at £1 = 3.97 roubles, which implies that the exchange rate for the silver rouble deviated from purchasing power parity by 42 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 12, we see

that at the silver exchange rate, Russian GDP per capita was 30.8 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 44.2 per cent of the British level. The time series projection for both countries from their 1990 benchmark levels in 1990 international dollars yields a result that for the 1790s, Russian GDP per capita was 45.4 per cent of the British level, well within any reasonable error bounds.

9.3 Russia in international comparative perspective, 1690s-1880s

Figure 16 places Russia's long run economic performance in an international comparative perspective for the main period covered by this study, 1690s-1880s. Beginning with the long eighteenth century, the spurt of Russian economic growth between the 1710s and the 1760s, initiated by the reforms of Peter the Great, represented a period of strong catching-up on the West. During this period, Russia 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 already caught up with Sweden, although this owed as much to Swedish decline as to Russian growth. During the rest of the eighteenth century, however, although Russia remained on a par with Sweden, the absolute fall of Russian GDP per capita led to a growing gap with the rest of western Europe as Britain and the Netherlands forged ahead while Italy stagnated. Turning to the nineteenth century, Russian stagnation between the 1800s and 1880s led to further Russian falling behind as growth accelerated in Britain and the Netherlands. During this phase, Sweden also pulled decisively ahead of Russia. These findings are broadly consistent with the views of Mau and Drobyshevskaya (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.

10. CONCLUSIONS

This paper presents a quantitative overview of economic growth in Russia from the 1690s to the 1880s, using a historical national accounting approach. As well as providing the first reconstruction of GDP from the output side for Russia during this period, it also creates a link to estimates of GDP for the period since 1885, so that Russia's economic performance from the late seventeenth century to the twenty-first can be assessed within the standard international comparative framework of GDP per capita.

Previous work on the eighteenth century 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 45 per cent between the 1690s and 1760s, this was followed by a period of strong negative per capita income growth as population growth outstripped the ability of agriculture to maintain per capita food supply, so that by the 1800s, GDP per capita was little higher than it had been a century earlier. The existing literature on the nineteenth century focuses on the period since the 1861 abolition of serfdom, offering little quantitative evaluation of economic developments during the first half of the century. We show that GDP per capita stagnated from the 1800s to the 1880s. To the extent that the abolition of serfdom succeeded in stimulating the economy, the positive effects on per capita incomes were delayed until after the 1880s.

One reason for the limited increase in GDP per capita over this period of almost two centuries is that although large-scale industry, the modernising part of the economy, grew quite rapidly, it was a very small part of the economy at the end of the seventeenth century, and took

a very long time to have a significant effect on the economy as a whole. More important, however, was the inability of Russian agriculture to increase output sufficiently to keep up with the rapidly growing population from the 1760s.

Although Russia began to close the gap with northwest Europe between the 1690s and the 1760s, the rest of the period from the 1760s to the 1880s 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. However, this potential would not be realised in a sustained way before the railways led to the integration of the economy, allowing the effective utilisation of Russia's abundant resources from the late nineteenth century in a way first highlighted by Baykov (1954).

TABLE 1: Population of the Russian Empire, 1646-1914**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
1762	23.2	18.1
1796	37.4	23.8
1815	46.3	28.6
1858	74.5	40.8
1897	128.9	52.0
1914	178.4	73.0

B. Population growth (% per year)

	Expanding territory	Constant territory
1646-1678	1.48	0.99
1678-1719	0.81	0.85
1719-1762	0.93	0.67
1762-1796	1.41	0.81
1796-1815	1.13	0.97
1815-1858	1.11	0.83
1858-1897	1.42	0.62
1897-1914	1.93	2.02
1646-1914	1.22	0.88

Sources and notes: Derived from Mironov (2000: 4).

TABLE 2: Composition of output in Russian agriculture, 1885-1897 (%)

	1885	1897
Grain production	44.4	41.8
Meat & dairy products	32.3	33.8
Other agriculture, forestry & fisheries	23.3	24.4
TOTAL AGRICULTURE	100.0	100.0

Sources and notes: 1885: shares of consumption of farm products in kind from Gregory (1982: 58). 1897: shares of gross regional product from Markevich (2019).

TABLE 3: Land area for agricultural cultivation in Russia, 1690s-1860s***A. Land area, 1696-1796 (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

B. Cultivated land area, 1802-1860s (million dessyatin)

Provinces	1802		1860s	
	million dessyatin	%	million dessyatin	%
21 black soil regions	17.9	47.1	23.0	39.7
24 non-black soil regions	20.1	52.9	35.0	60.3
45 provinces	38.0	100.0	58.0	100.0

Sources and notes: Part A: Kahan (1985: 46). Part B: Lyashchenko (1956, vol.1: 507).

TABLE 4: Grain yields per seed in Russia, 1710s-1860s***A. Yields by crop, 1710s-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			

B. Average yields across all crops, 1800s-1860s

	Yield per seed
1800s	3.5
1810s	3.5
1820s	3.4
1830s	3.4
1840s	3.6
1850s	3.6
1860s	3.7

Sources and notes: Part A: Kahan (1985: 49), with additional information for 1800s from Mikhajlovskij (1921: 4). Part B: *Sources and notes:* Lyashchenko (1949: 324), Shtukenberg (1858), Kovalchenko (1967: 386).

TABLE 5: Large-scale industry net output weights, 1690s-1880s (%)

	c.1805	c.1848	1887
Silver	1.7	0.4	0.1
Gold	0.6	9.3	5.4
Copper	3.8	1.2	0.4
Pig iron	8.1	2.9	0.4
Bar iron	6.6	2.9	2.4
Metalworking		4.9	5.2
Metals	20.7	21.6	14.0
Salt	2.1	2.1	1.4
Alcohol	36.0	33.4	34.9
Sugar		1.4	8.1
Food & drink	38.1	36.8	44.5
Woollen cloth & goods	3.7	14.6	3.9
Linen cloth & goods	5.6	1.4	8.0
Cotton cloth & goods		10.1	15.4
Textiles	9.4	26.2	27.2
Other industries	31.8	15.4	14.3
Total large-scale industry	100.0	100.0	100.0

Sources and notes: Derived for circa 1805 from RGIA (Russian State Historical Archive - St Petersburg) F. 16. Op. 1. D. 3, for circa 1848 from Semenov (1859), Tengoborskii (1855), Istoriko-Statisticheskoe obzor (1886), and for 1887 from Svod (1889). 1805 weights are used for 1690s-1800s, 1848 weights for 1800s-1840s and 1887 weights for 1840s-1880s.

TABLE 6: Shares of large- and small-scale industry in total industry, 1880s

	Net output weights (%)
Large-scale industry	46.5
Small-scale industry	53.5
Total industry	100.0

Sources and notes: Derived from Gregory (1982: 73)

TABLE 7: Service sector net output weights, 1880s

	Net output (m roubles)	Weights (%)
Commerce	812	56.4
Government	143	9.9
Rent & domestic services	485	33.7
TOTAL SERVICES	1,440	100.0

Sources and notes: Weights derived from Gregory (1982: 73). Current price value of total services derived from Gregory's (1982: 58) current price value of NNP in the 1880s.

TABLE 8: GDP by major sector, 1880s

	Net output (m roubles)	Weights (%)
Agriculture	3,826	56.6
Industry	1,494	22.1
Services	1,440	21.3
TOTAL GDP	6,760	100.0

Sources and notes: Sectoral shares for the 1880s from Gregory (1982: 73). Current price NNP from Gregory (1982: 87).

TABLE 9: Annual growth rate of Russian GDP, population and GDP per capita, 1800s-1880s (per cent per annum)

	GDP	Population	GDP p.c.
1690s-1760s	1.34	0.80	0.54
1760s-1800s	0.64	1.46	-0.82
1800s-1840s	1.31	1.28	0.03
1840s-1880s	1.07	1.13	-0.06
1690s-1800s	1.08	1.04	0.04
1800s-1880s	1.19	1.21	-0.02
1690s-1880s	1.13	1.11	0.02

Sources and notes: Derived from Appendix Table A1.11.

TABLE 10: Prices and weights for a Russia/GB PPP in 1795/96

	Units	Russian price (Rbs)	Russian weights (%)	British price (£)	British weights (%)	PPP (Rbs per £)
Wheat	kg	0.097	11.6	0.018	10.6	5.45
Wheat flour	kg	0.093	11.6	0.027	10.6	3.50
Rye	kg	0.044	11.6	0.012	10.6	3.75
Oats	kg	0.019	11.6	0.010	10.6	1.95
Barley	kg	0.024	11.6	0.010	10.6	2.37
GRAIN & FLOUR			58.0		53.0	
Peas	kg	0.048	3.0	0.010	2.5	4.83
Potatoes	kg	0.006	3.0	0.004	2.5	1.59
VEGETABLES			6.0		5.0	
Beef	kg	0.139	16.0	0.056	15.0	2.49
MEAT			16.0		15.0	
Butter	kg	0.408	5.0	0.073	4.0	5.59
Eggs	dozen	0.090	5.0	0.031	4.0	2.92
DAIRY & EGGS			10.0		8.0	
Sugar	kg	0.306	3.5	0.092	2.5	3.32
Ginger	kg	3.659	3.5	0.234	2.5	15.65
SUGAR & SPICES			7.0		5.0	
Hops	kg	0.391	1.5	0.120	7.5	3.26
Tobacco	kg	0.588	1.5	0.349	7.5	1.68
DRINK & TOBACCO			3.0		15.0	4.83
TOTAL FOOD			100.0		100.0	
Cloth	yards	0.527	25.0	0.050	25.0	10.54
Bar iron	cwt	4.745	25.0	0.845	25.0	5.62
Tallow candles	kg	0.366	25.0	0.087	25.0	4.23
Soap	kg	0.306	25.0	0.090	25.0	3.40
OTHER GOODS			100.0		100.0	
Food			72.0		51.0	
Other goods			28.0		49.0	
TOTAL GOODS			100.0		100.0	

Sources and notes: British prices for food, candles and soap from Clark (2004). Russian prices for food, candles and soap from *Moskovskie Vedomosti*, 1796, RGADA. F. 248. Op. 112. D. 222, F. 1204. Op. 1. D. 19315, 19341, 19342 (annual average, our calculations). 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). British weights derived from Feinstein (1995: 22), with equal weights within each category. Russian weights derived from Mironov (2012: 255, 261), with equal weights within each category. British weights for total goods from Feinstein (1995: 22). Russian weights for total goods derived from the ratio between agricultural and industrial output in Table 8. PPPs for individual products obtained as the ratio between the Russian price in Rbs and the British price in £.

TABLE 11: Sectoral and aggregate Russia/GB PPPs for 1795/96

	PPP British weights (Rbs per £)	PPP Russian weights (£ per Rb)	PPP Russian weights (Rbs per £)	PPP geometric mean (Rbs per £)
Grain & flour	3.40	0.33	2.99	3.19
Vegetables	3.21	0.42	2.39	2.77
Meat	2.49	0.40	2.49	2.49
Dairy & eggs	4.26	0.26	3.84	4.04
Sugar & spice	9.48	0.18	5.48	7.21
Drink & tobacco	2.47	0.45	2.22	2.34
TOTAL FOOD	3.49	0.34	2.98	3.23
Cloth	10.54	0.09	10.54	10.54
Bar iron	5.62	0.18	5.62	5.62
Tallow candles	4.23	0.24	4.23	4.23
Soap	3.40	0.29	3.40	3.40
OTHER GOODS	5.95	0.20	4.98	5.44
Food	3.49	0.34	2.98	3.23
Other commodities	5.95	0.20	4.98	5.44
AGGREGATE PPP	4.69	0.30	3.36	3.97
Market exchange rate				5.65

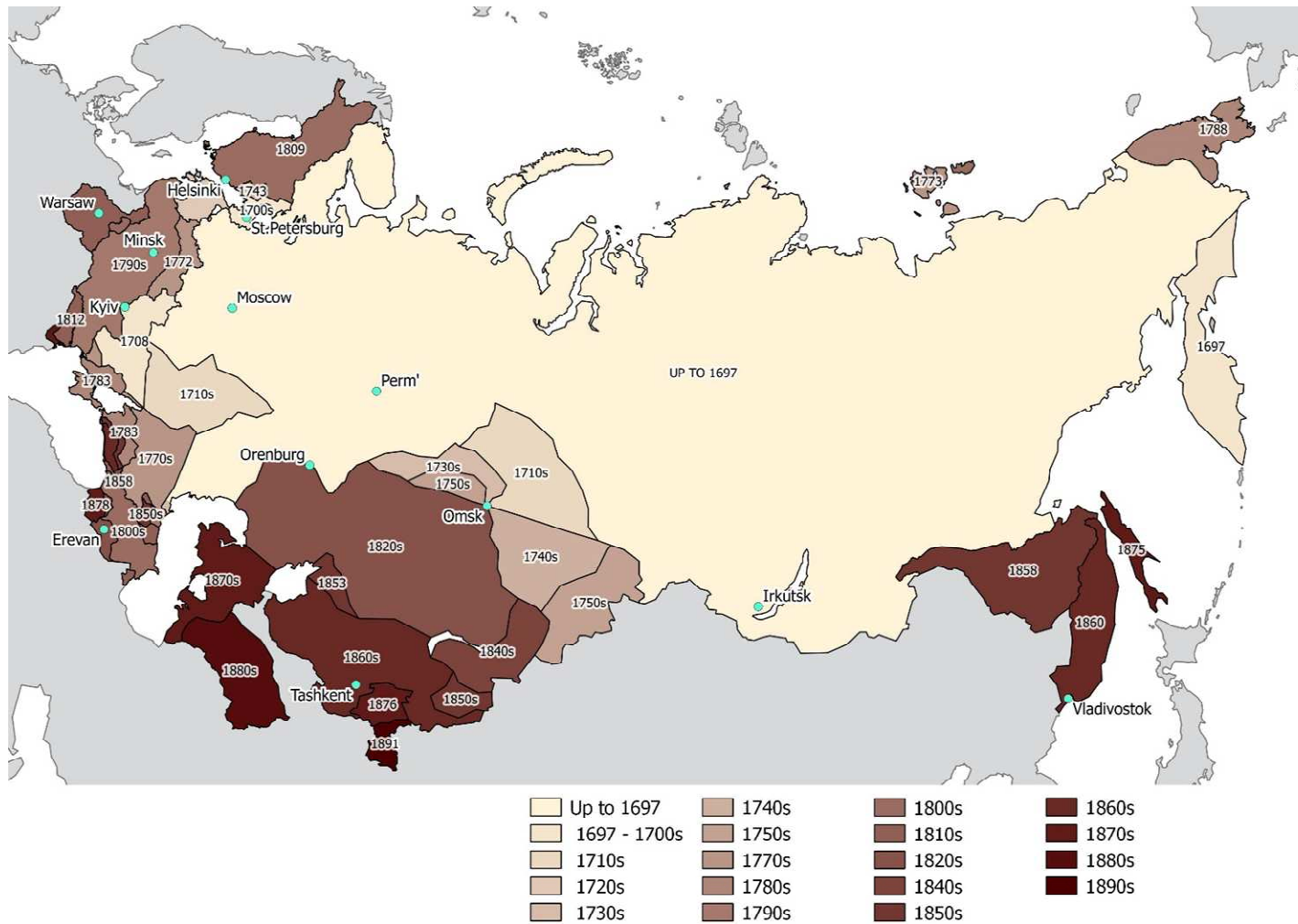
Sources and notes: The sectoral and aggregate PPPs at British weights are calculated with the Rbs per £ PPPs from Table 10 while the sectoral and aggregate PPPs at Russian weights are calculated using the £ per Rb PPPs for consistency. We use the geometric mean as the compromise estimate. The market exchange rate for the silver rouble is from Denzel (2010: 359, 368).

TABLE 12: A benchmark estimate of Russia/GB GDP per capita circa 1796

<i>Russia</i>	
Nominal GDP (million Rbs)	1,373
Population (millions)	37.4
Nominal GDP per capita (Rbs)	36.71
<i>Great Britain</i>	
Nominal GDP (£ million)	209.18
Population (millions)	10.0
Nominal GDP per capita (£)	20.92
<i>Exchange rates</i>	
Silver exchange rate (Rbs per £)	5.65
PPP (Rbs per £)	3.97
<i>Comparative Russia/GB GDP per capita (%)</i>	
At silver exchange rate	31.1
At PPP	44.2
<i>GDP in 1990 international dollars</i>	
GB	2,028
Russia	896

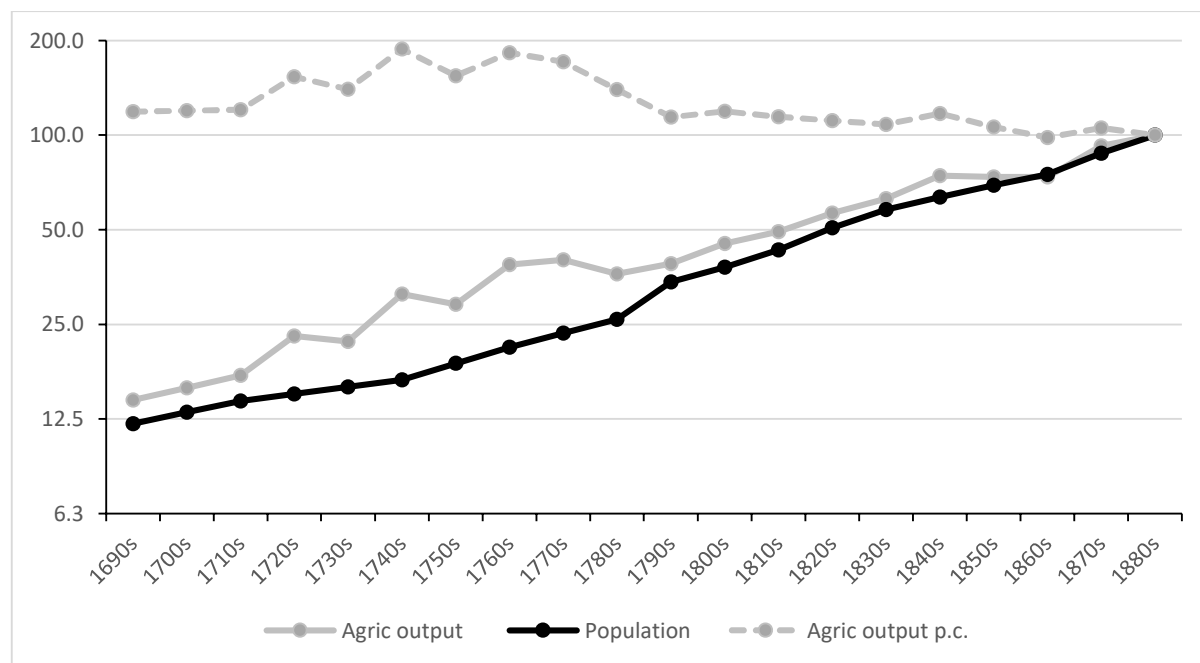
Sources and notes: Nominal GDP from Table A1.10 for Russia and from Broadberry et al. (2015) for GB. Population from Table 1 for Russia and from Broadberry et al. (2015) for GB. Silver exchange rate from Denzel (2010). PPP from Table 9. GDP for GB in 1990 international dollars from Broadberry et al. (2015).

FIGURE 1: The territorial expansion of Russia, 1690s-1890s



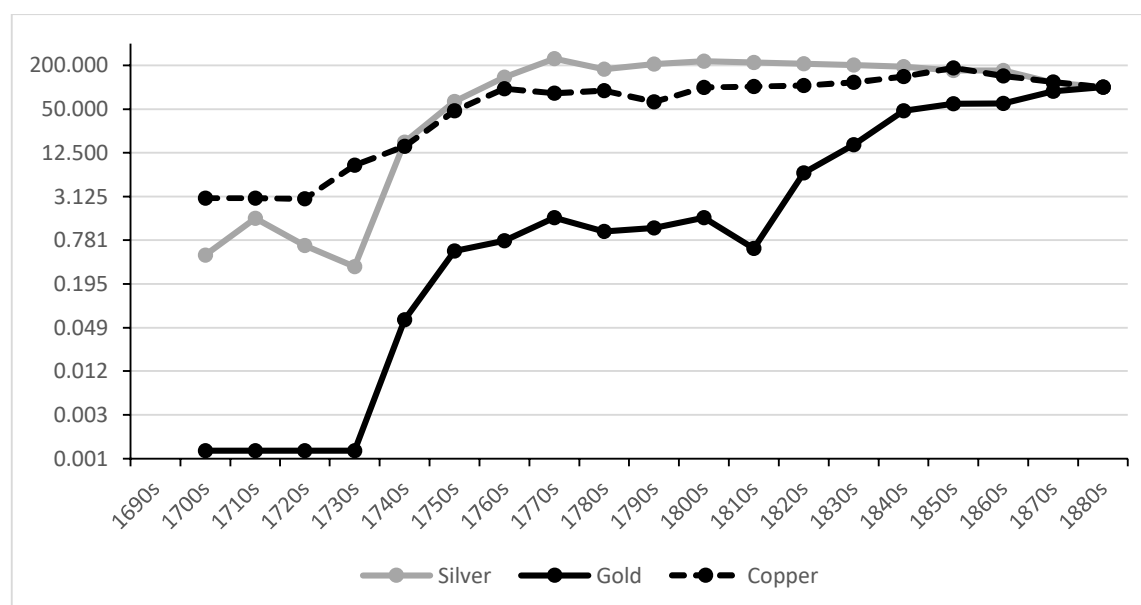
Source: Redrawn based on a map from Chepelkin and Dyakova (1995).

FIGURE 2: Population, agricultural output and output per capita in Russia, 1690s-1880s (1880s=100)



Source: Appendix Table A1.1.

FIGURE 3: Large-scale industrial production in Russia: Non-ferrous metals, 1690s-1880s (1880s=100)



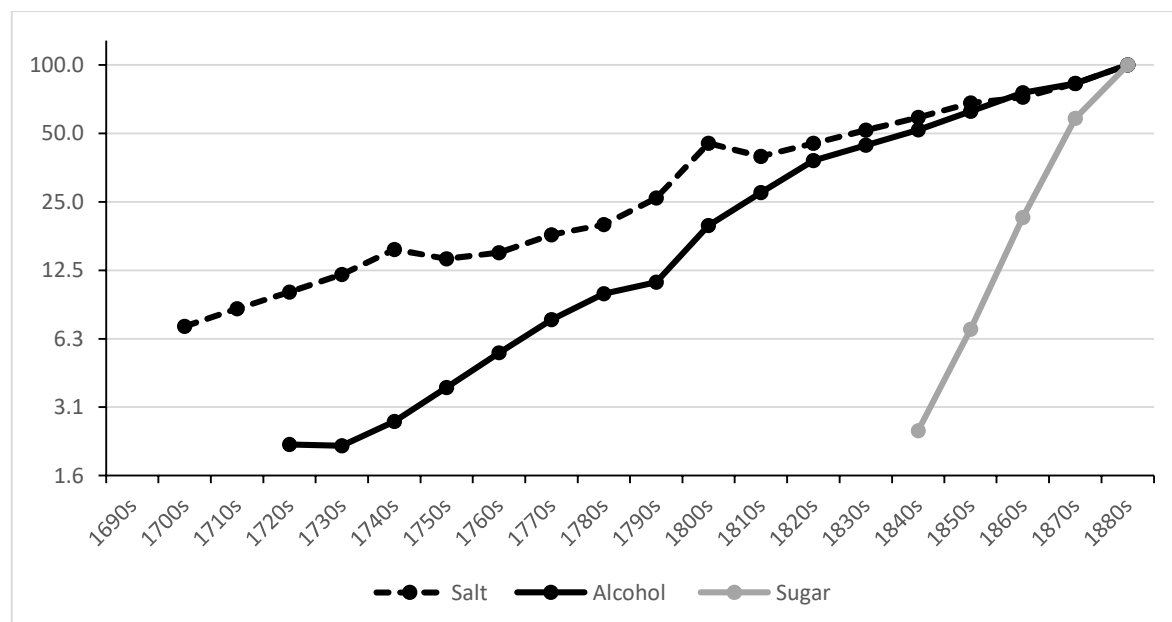
Source: Appendix Table A1.2.

FIGURE 4: Large-scale industrial production in Russia: Ferrous metals, 1690s-1880s (1880s=100)



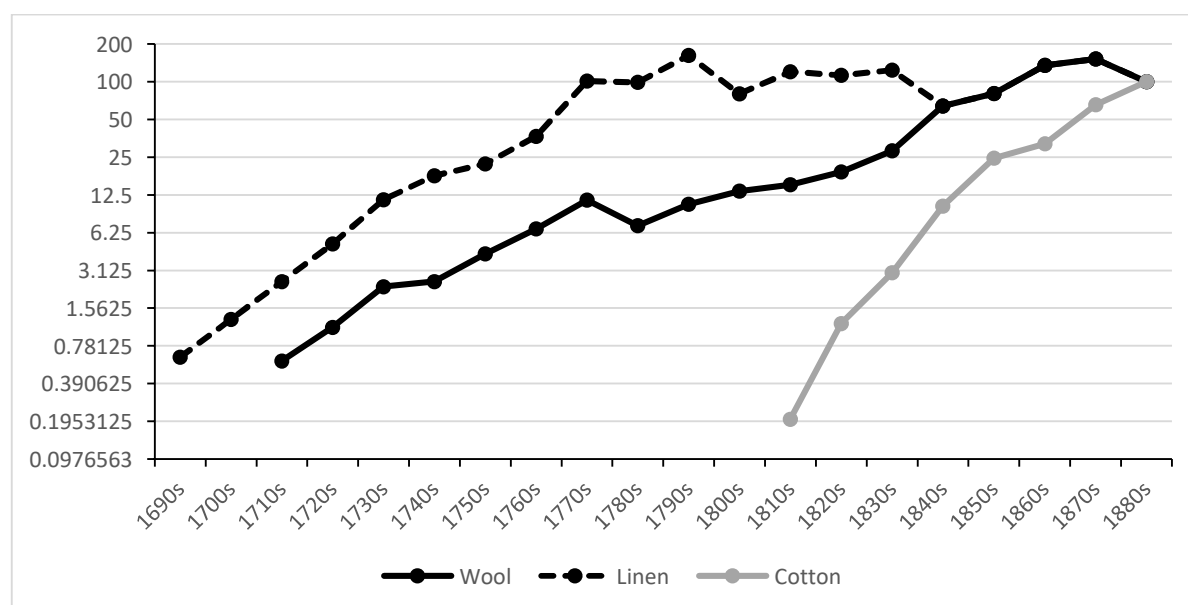
Source: Appendix Table A1.2.

FIGURE 5: Large-scale industrial production in Russia: Food and drink, 1690s-1880s (1880s=100)



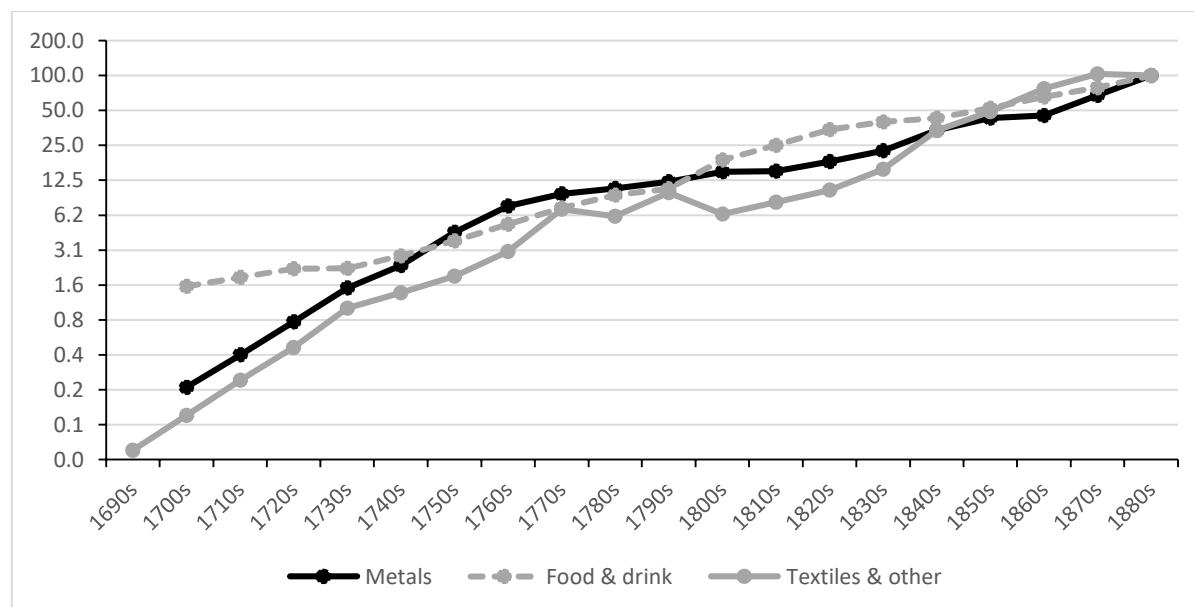
Source: Appendix Table A1.3.

FIGURE 6: Large-scale industrial production in Russia: Textiles, 1690s-1880s (1880s=100)



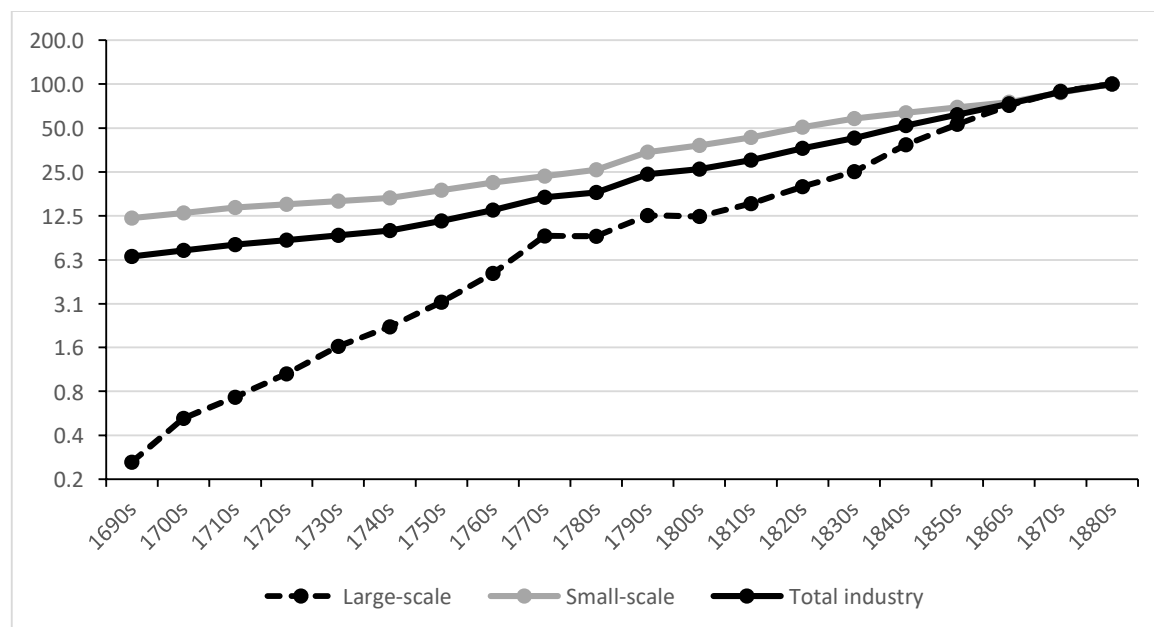
Source: Appendix Table A1.4.

FIGURE 7: Large-scale industrial production in Russia, 1690s-1880s: Major branches (1880s=100)



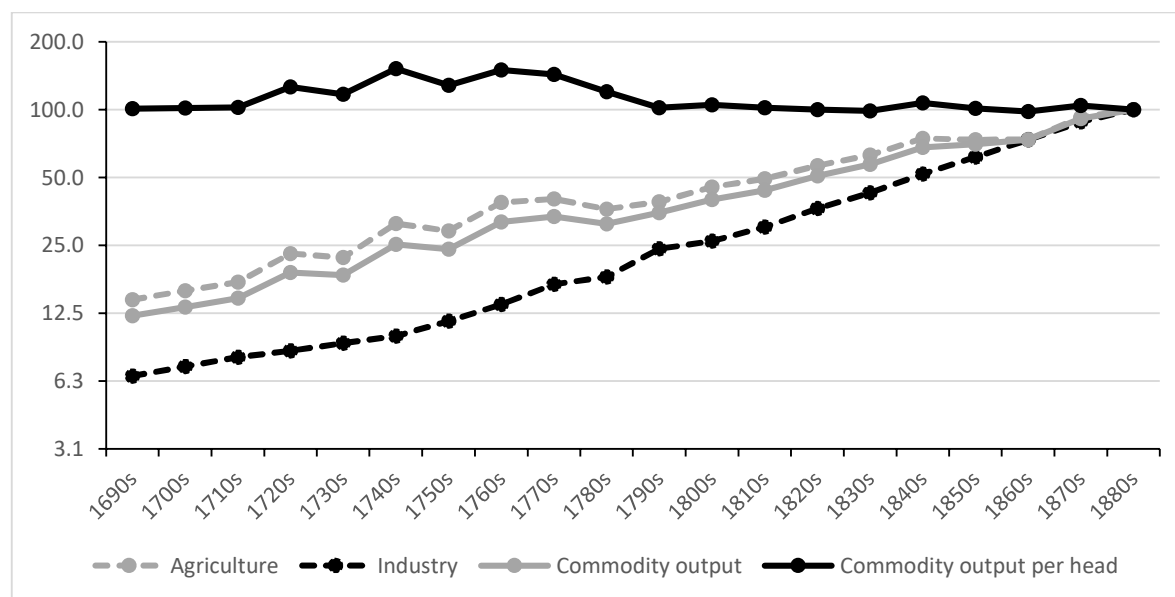
Source: Appendix Table A1.5.

FIGURE 8: Total industrial production in Russia, 1690s-1880s (1880s=100)



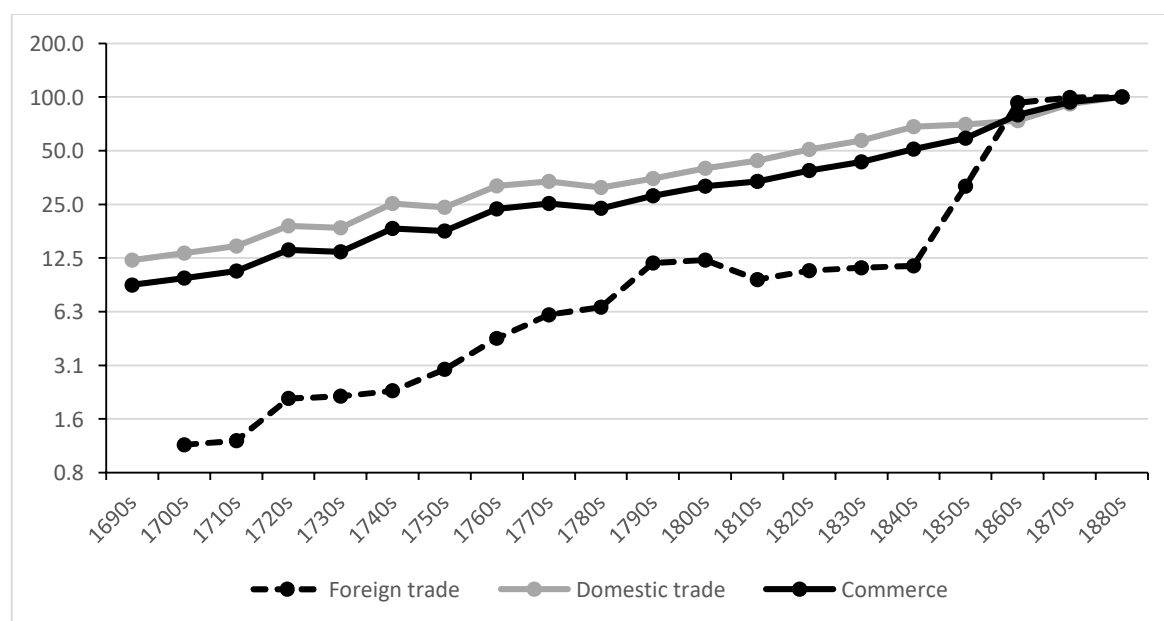
Source: Appendix Table A1.6.

FIGURE 9: Commodity production in Russia, 1690s-1880s (1880s=100)



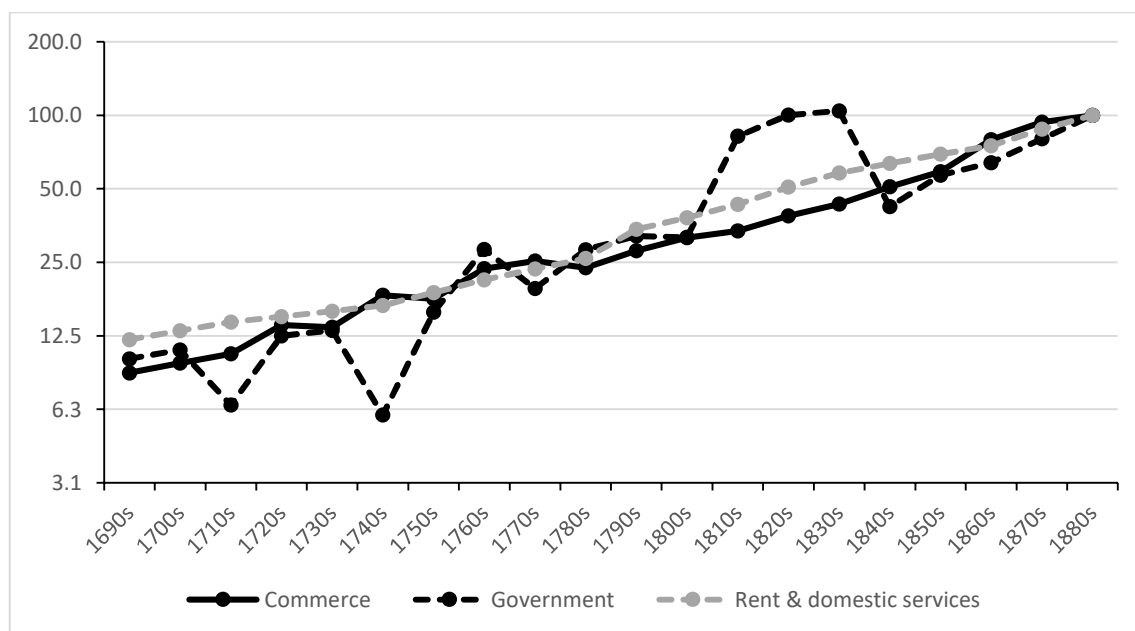
Source: Appendix Table A1.7.

FIGURE 10: Commerce in Russia, 1690s-1880s (1880s=100)



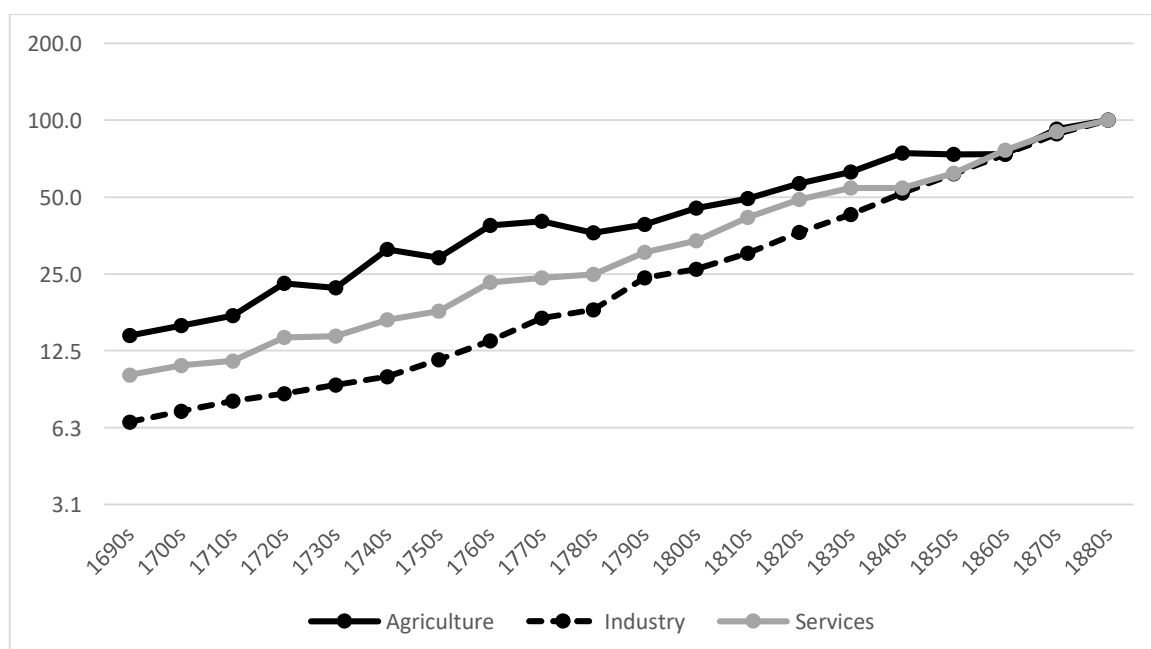
Source: Appendix Table A1.8.

FIGURE 11: Government and other services in Russia, 1690s-1880s (1880s=100)



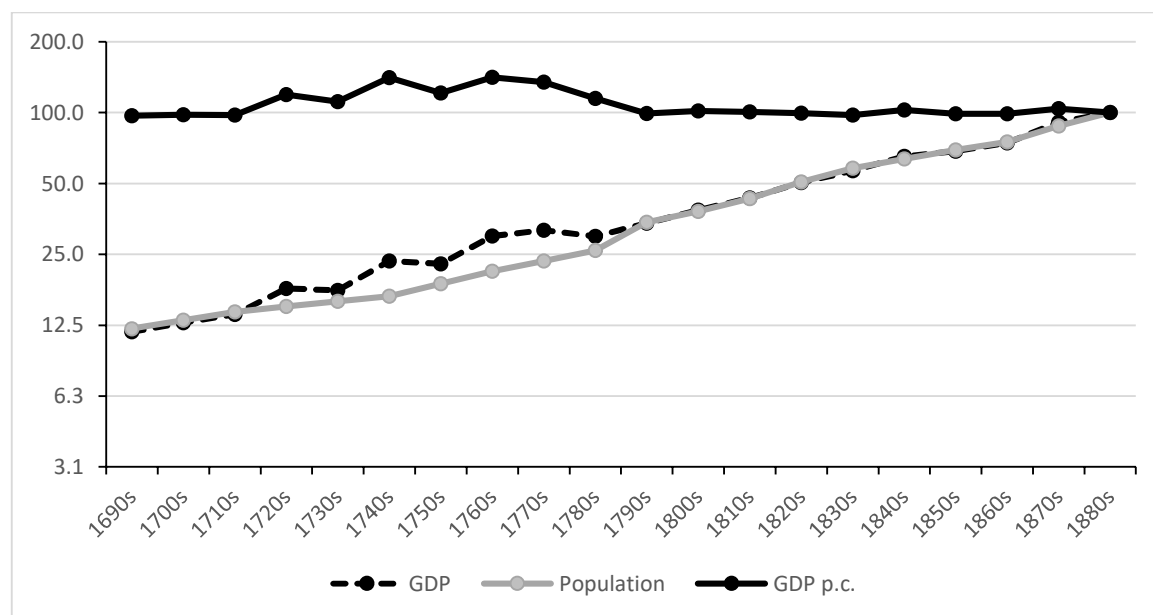
Source: Appendix Table A1.9.

FIGURE 12: GDP by major branches in Russia, 1690s-1880s (1880s=100)



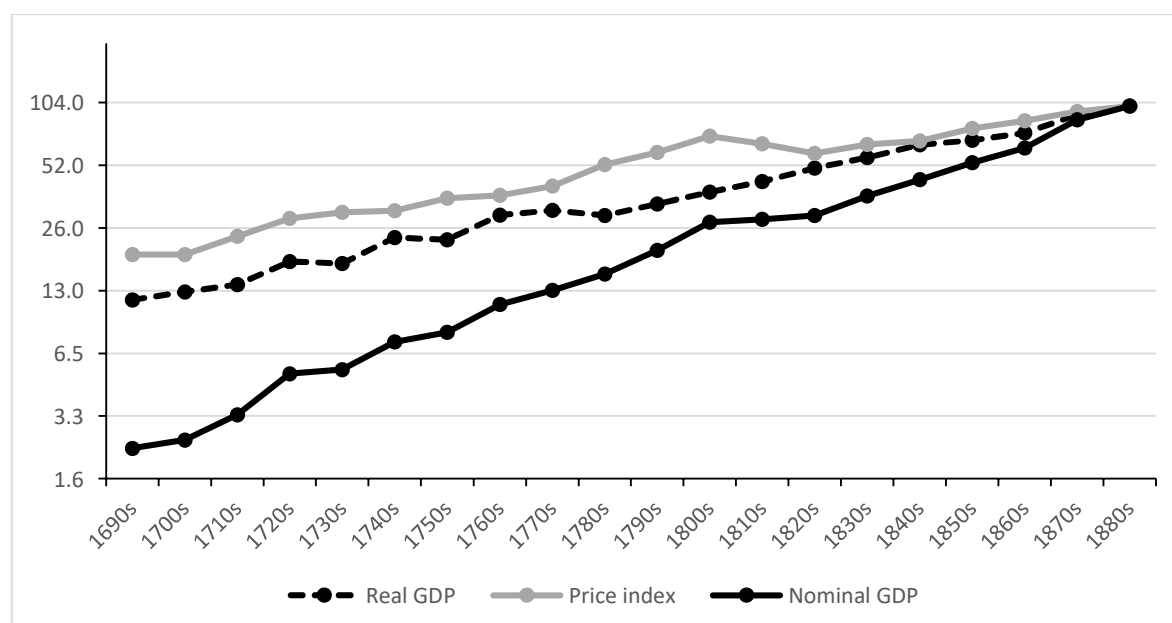
Source: Appendix Table A1.10.

FIGURE 13: GDP per capita in Russia, 1690s-1880s (1880s=100)



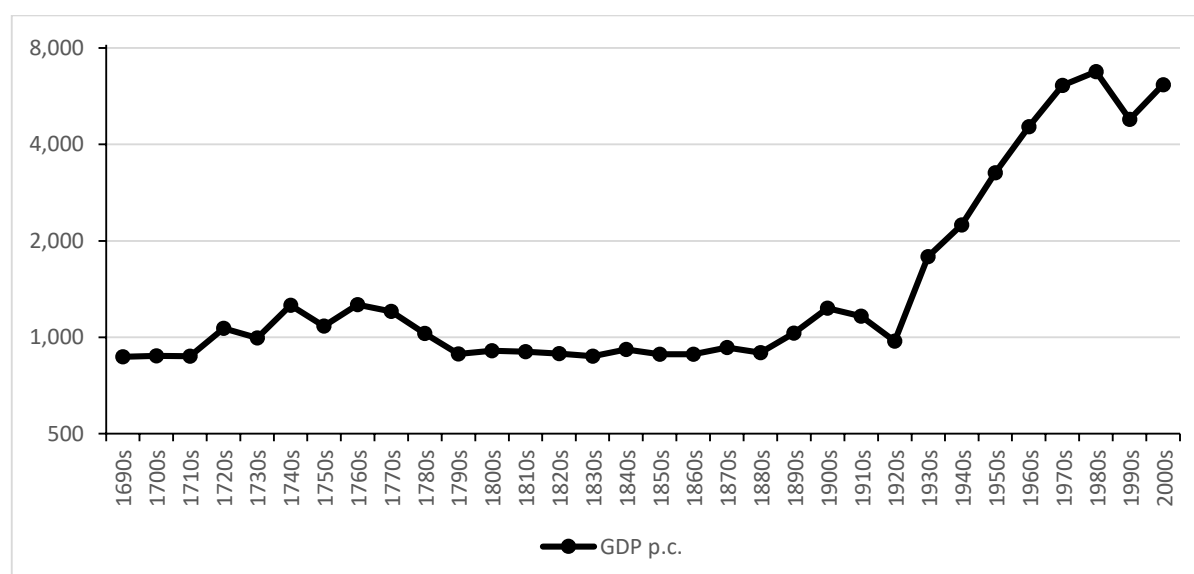
Source: Appendix Table A1.10.

FIGURE 14: Nominal and real GDP in Russia, 1690s-1880s (1880s=100)



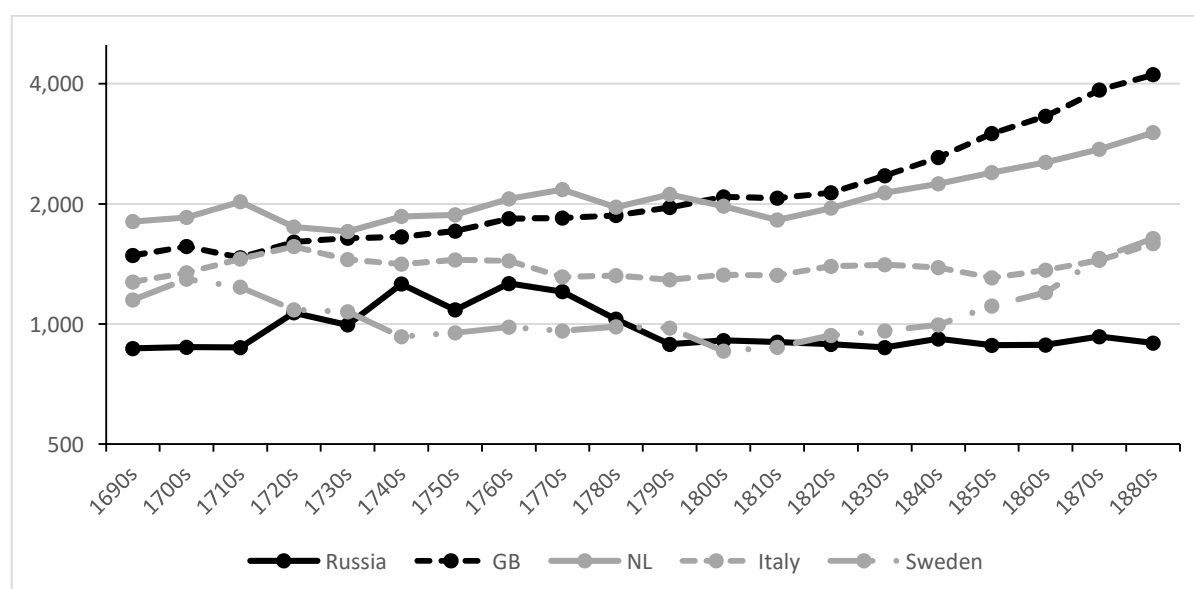
Source: Appendix Table A1.11.

FIGURE 15: Russian GDP per capita, 1690s-2000s (1990 international dollars)



Sources: 1690s-1880s: Table A1.10. 1880s-1910s: Gregory (1982). 1910s-1920s: Markevich and Harrison (2011). 1920s-2000s: Maddison (2010). The series in index number form are spliced together and converted to 1990 international dollars based on Maddison's (1995) benchmark for 1990.

FIGURE 16: GDP per capita in Russia and other European economies, 1690s-1880s (1990 international dollars)



Sources and notes: Russia: Appendix Table A1.10, benchmarked on GDP per capita in 1990 international dollars from Maddison (2010). GB: Broadberry et al. (2015); NL: van Zanden and van Leeuwen (2012); Italy: Malanima (2011); Sweden: Schön and Krantz (2012); Krantz (2017).

APPENDIX 1: DATA SERIES

TABLE A1.1: Agricultural output, population and agricultural output per head in Russia, 1690s-1880s (1800s=100)

	Agricultural output	Population	Agricultural output per head
1690s	14.4	12.1	118.9
1700s	15.7	13.1	119.7
1710s	17.2	14.3	120.5
1720s	23.0	15.0	153.3
1730s	22.1	15.8	139.8
1740s	31.2	16.6	187.9
1750s	29.0	18.8	154.3
1760s	38.8	21.2	183.0
1770s	40.2	23.5	171.4
1780s	36.2	25.9	139.6
1790s	39.0	34.2	114.3
1800s	45.3	38.0	119.1
1810s	49.3	43.1	114.3
1820s	56.5	50.8	111.2
1830s	62.8	58.0	108.2
1840s	74.4	63.5	117.0
1850s	73.6	69.3	106.2
1860s	73.7	75.0	98.3
1870s	92.4	87.6	105.4
1880s	100.0	100.0	100.0

Notes and sources: 1690s-1800s: Agricultural output derived from Tables 3A and 4A as the product of ploughland and rye yields, with log-linear interpolation between benchmarks. Population derived from Mironov (2000: 4) and Kahan (1985: 8) with log-linear interpolation between benchmarks. Agricultural output per head derived by dividing agricultural output by population

1800s-1880s: Crop production for 50 European provinces taken from Zverinskiy (1884), Bezobrazov (1872), Urozhay (1885), Livron (1874), Nifontov (1974), Pokrovskii (1902). Agricultural output per head derived by dividing crop production for 50 European provinces by population for the same territory from Rashin (1956). Population for the Russian Empire derived from annual data in Statisticheskii yezhegodnik (1916). Agricultural output derived by multiplying population for the Russian Empire by agricultural output per head in the 50 European provinces.

TABLE A1.2: Large-scale industrial production in Russia, 1690s-1880s: Metals (1880s=100)

	Silver	Gold	Copper	Pig iron	Bar iron	Metal-working	Total Metals
1690s							
1700s	0.5	0.001	3.0	0.3	0.5		0.2
1710s	1.6	0.001	3.0	0.9	1.0		0.4
1720s	0.7	0.001	2.9	1.9	2.3		0.8
1730s	0.3	0.001	8.5	3.9	3.8		1.5
1740s	17.5	0.1	15.4	5.8	5.1		2.3
1750s	63.4	0.6	47.5	7.4	9.0		4.4
1760s	137.9	0.8	95.8	12.6	11.7		7.5
1770s	247.9	1.6	82.6	17.8	16.3		9.5
1780s	176.6	1.0	89.8	20.8	22.0		10.6
1790s	208.6	1.2	62.9	29.9	25.7		12.2
1800s	227.4	1.60	99.7	34.1	29.8	1.3	14.8
1810s	218.8	0.60	102.7	32.0	32.4	1.4	15.0
1820s	210.5	6.60	105.8	36.1	35.4	1.5	18.2
1830s	202.5	16.1	116.8	39.1	38.6	1.6	22.5
1840s	191.5	47.3	139.8	42.4	42.1	1.8	33.7
1850s	170.4	59.2	185.0	53.3	58.5	2.7	43.0
1860s	169.7	59.9	142.5	67.5	64.0	8.4	45.3
1870s	115.7	88.2	118.3	89.2	89.2	28.9	67.6
1880s	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources and notes: 1690s-1800s: 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 (1949: 47). Weights for c. 1805 from Table 5.

1800s-1880s: Silver: Statisticheskiiye tablitsy (1852: 9); Zyablovskii (1815, part 4: 230); Keppen (1879: 60); Istoriko-statisticheskiiy obzor (1883: table 2 in appendix). Gold: Zyablovskii (1815, part 4: 209, 230); Hermann (1808: 39); Danilevskii (1949: 254); Keppen (1879: 26-27); Istoriko-statisticheskiiy obzor (1883: 128-129 + table 1 in appendix). Copper: Pavlenko (1953: 78); Pavlenko (1962: 239, 462); Strumilin (1954: 347) reference 34; Statisticheskiiye tablitsy (1852: 9); Zyablovskii (1815, part 4: 204, 230); Keppen (1879: 62); Istoriko-statisticheskiiy obzor (1883: table 7 in appendix). Metalworking: Strumilin (1954: 180-206, 367); Strumilin (1966: 509); Statisticheskiiye tablitsy (1852: 9); Zyablovskii (1815, part 4: 230); Pavlenko (1962: 460); Keppen (1879: 64); Istoriko-statisticheskiiy obzor (1883: table 8 in appendix). Weights for c. 1848 and c. 1887 from Table 5.

TABLE A1.3: Large-scale industrial production in Russia, 1690s-1880s: Food and drink (1880s=100)

	Salt	Alcohol	Sugar	Food & drink
1690s				
1700s	7.1			1.5
1710s	8.5			1.8
1720s	10.0	2.1		2.2
1730s	12.0	2.1		2.2
1740s	15.4	2.7		2.8
1750s	14.0	3.8		3.7
1760s	14.9	5.4		5.2
1770s	17.9	7.6		7.2
1780s	19.8	9.9		9.3
1790s	26.0	11.1		10.6
1800s	45.2	19.7		18.7
1810s	39.6	27.5		25.0
1820s	45.2	37.9		34.1
1830s	51.6	44.3		39.8
1840s	58.9	51.7	2.5	43.0
1850s	68.0	62.4	6.9	52.4
1860s	72.0	75.3	21.3	65.3
1870s	82.9	82.8	58.2	78.3
1880s	100.0	100.0	100.0	100.0

Sources and notes: **1690s-1800s:** 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 for c. 1805 from Table 5.

1800s-1880s: Salt: Statisticheskiye tablitsy (1852: 9); Zyablovskii (1815, part 4: 281, 282, 289); Keppen (1879: 56); Istoriko-statisticheskii obzor (1883: 151, 162, table XIII). Alcohol: Svedeniya (1860, vol 3: 3-12; Konotopov and Smetanin (1992: 148); Istoriko-statisticheskii obzor (1886: 4, 8, 63-65); *Obshchaya gosudarstvennaya rospis' dokhodov i raskhodov* [General State List of Income and Expenses], <http://istmat.info/node/47078>; Pokrovskii (1902, vol 1: 103). Sugar: Istoriko-statisticheskii obzor (1886: 12, 14, 24, 25); Obzor (1858); Semenov (1859: vol 3, p. 442). Weights for c. 1848 and c. 1887 from Table 5.

TABLE A1.4: Large-scale industrial production in Russia, 1690s-1880s: Textiles (1880s=100)

	Wool	Linen	Cotton	Textiles
1690s		0.6		0.1
1700s		1.3		0.1
1710s	0.6	2.5		0.2
1720s	1.1	5.1		0.5
1730s	2.3	11.4		1.0
1740s	2.5	17.8		1.3
1750s	4.3	22.0		1.9
1760s	6.7	36.7		3.0
1770s	11.4	101.2		7.0
1780s	7.1	98.8		6.1
1790s	10.5	161.6		9.8
1800s	13.4	80.2		6.4
1810s	15.1	120.3	0.2	8.1
1820s	19.1	112.8	1.2	10.3
1830s	28.1	123.3	3.0	15.6
1840s	63.9	63.9	10.2	33.5
1850s	80.3	80.3	24.6	58.8
1860s	135.1	135.1	32.1	95.2
1870s	151.5	151.5	65.7	118.3
1880s	100.0	100.0	100.0	100.0

Sources and notes: *Sources and notes: 1690s-1800s:* 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 for c. 1805 from Table 5.

1800s-1880s: Wool: Zyablovskii (1815, part 5: 10); RGIA F. 17. op. 1. d. 44; Istoriko-statisticheskii obzor (1886: 137, 138, 158, 161, 165); Konotopov et al. (1992: 113-114). Linen: Zyablovskii (1815, part 5: 33); Istoriko-statisticheskii obzor (1886: 48); Semenov (1859). Cotton: Istoriko-statisticheskii obzor (1886: 75, 85); Semenov (1859, vol 3: 440). Weights for c. 1848 and c. 1887 from Table 5.

TABLE A1.5: Large-scale industrial production in Russia, 1690s-1880s: Major branches

	Metals	Food & drink	Textiles & other	Total large-scale industry
1690s			0.1	0.3
1700s	0.2	1.5	0.1	0.5
1710s	0.4	1.8	0.2	0.7
1720s	0.8	2.2	0.5	1.0
1730s	1.5	2.2	1.0	1.6
1740s	2.3	2.8	1.3	2.2
1750s	4.4	3.7	1.9	3.2
1760s	7.5	5.2	3.0	5.0
1770s	9.5	7.2	7.0	9.1
1780s	10.6	9.3	6.1	9.1
1790s	12.2	10.6	9.8	12.6
1800s	14.8	18.7	6.4	12.4
1810s	15.0	25.0	8.1	15.2
1820s	18.2	34.1	10.3	19.8
1830s	22.5	39.8	15.6	25.1
1840s	33.7	43.0	33.5	38.4
1850s	43.0	52.4	58.8	52.9
1860s	45.3	65.3	95.2	71.6
1870s	67.6	78.3	118.3	89.3
1880s	100.0	100.0	100.0	100.0

Sources and notes: **1690s-1800s:** Tables A1.2, A1.3, A1.4. Weights for c. 1805 from Table 5.
1800s-1880s: Tables A1.2, A1.3, A1.4. Weights for c. 1848 and c. 1887 from Table 5.

TABLE A1.6: Total industrial production in Russia, 1690s-1880s (1880s=100)

	Large-scale industry	Small-scale industry	Total industrial production
1690s	0.3	12.1	6.6
1700s	0.5	13.1	7.3
1710s	0.7	14.3	8.0
1720s	1.0	15.0	8.5
1730s	1.6	15.8	9.2
1740s	2.2	16.6	9.9
1750s	3.2	18.8	11.5
1760s	5.0	21.2	13.7
1770s	9.1	23.5	16.8
1780s	9.1	25.9	18.1
1790s	12.6	34.2	24.1
1800s	12.4	38.0	26.1
1810s	15.2	43.1	30.1
1820s	19.8	50.8	36.4
1830s	25.1	58.0	42.7
1840s	38.4	63.5	51.9
1850s	52.9	69.3	61.7
1860s	71.6	75.0	73.4
1870s	89.3	87.6	88.4
1880s	100.0	100.0	100.0

Sources and notes: Large-scale industry derived from Table A1.2 to A1.4 using weights from Table 5. Other large-scale industries are assumed to grow at the same rate as textiles. Small-scale industry assumed to grow at the same rate as population. Weights for aggregating large-scale and small-scale industry from Table 6.

TABLE A1.7: Commodity production in Russia, 1690s-1880s (1880s=100)

	Agriculture	Industry	Commodity output	Commodity output per head
1690s	14.4	6.6	12.2	100.8
1700s	15.7	7.3	13.3	101.6
1710s	17.2	8.0	14.6	102.3
1720s	23.0	8.5	18.9	126.2
1730s	22.1	9.2	18.5	116.9
1740s	31.2	9.9	25.2	151.8
1750s	29.0	11.5	24.1	128.2
1760s	38.8	13.7	31.7	149.7
1770s	40.2	16.8	33.6	143.3
1780s	36.2	18.1	31.1	120.0
1790s	39.0	24.1	34.9	102.0
1800s	45.3	26.1	39.9	104.9
1810s	49.3	30.1	43.9	101.8
1820s	56.5	36.4	50.8	100.1
1830s	62.8	42.7	57.2	98.5
1840s	74.4	51.9	68.0	107.1
1850s	73.6	61.7	70.3	101.4
1860s	73.7	73.4	73.6	98.2
1870s	92.4	88.4	91.3	104.2
1880s	100.0	100.0	100.0	100.0

Sources and notes: Agriculture from Table A1.1. Industry from Table A1.6. Weights for 1880s from Table 8.

TABLE A1.8: Commerce in Russia, 1690s-1880s (1800s=100)

	Foreign trade	Domestic trade	Commerce
1690s		12.2	8.8
1700s	1.1	13.3	9.7
1710s	1.2	14.6	10.6
1720s	2.0	18.9	13.9
1730s	2.1	18.5	13.6
1740s	2.2	25.2	18.3
1750s	3.0	24.1	17.7
1760s	4.4	31.7	23.5
1770s	6.0	33.6	25.3
1780s	6.6	31.1	23.8
1790s	11.7	34.9	27.9
1800s	12.2	39.9	31.6
1810s	9.5	43.9	33.6
1820s	10.6	50.8	38.8
1830s	11.0	57.2	43.3
1840s	11.3	68.0	51.0
1850s	31.6	70.3	58.7
1860s	93.0	73.6	79.4
1870s	99.2	91.3	93.6
1880s	100.0	100.0	100.0

Sources and notes: 1690s-1800s: 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 A1.7. Weights for the 1880s are 30% for foreign trade and 70% for domestic trade.

1800s-1880s: Foreign trade: wheat exports from Obzor (1858: appendix); Turchinovic (1854: 63); Semenov (1859: 56-57, 62 and appendices); Pokrovskii (1902, vol.1, appendix IV: 72-73); Kommercheskaya gazeta, 1848; Bliokh (1882: vol. 1, 268); Ostrovskii (2013, appendix table 18). Domestic trade: commodity output from Table A1.7. Weights for the 1880s are 30% for foreign trade and 70% for domestic trade.

TABLE A1.9: Services in Russia, 1690s-1880s (1800s=100)

	Commerce	Government	Rent & domestic services	Total services
1690s	8.8	10.1	12.1	10.0
1700s	9.7	10.9	13.1	11.0
1710s	10.6	6.5	14.3	11.4
1720s	13.9	12.5	15.0	14.1
1730s	13.6	13.2	15.8	14.3
1740s	18.3	5.9	16.6	16.5
1750s	17.7	15.6	18.8	17.9
1760s	23.5	28.2	21.2	23.2
1770s	25.3	19.5	23.5	24.1
1780s	23.8	28.1	25.9	24.9
1790s	27.9	32.1	34.2	30.4
1800s	31.6	31.7	38.0	33.8
1810s	33.6	82.0	43.1	41.6
1820s	38.8	100.1	50.8	48.9
1830s	43.3	104.3	58.0	54.3
1840s	51.0	42.2	63.5	54.4
1850s	58.7	56.8	69.3	62.1
1860s	79.4	64.0	75.0	76.4
1870s	93.6	80.2	87.6	90.3
1880s	100.0	100.0	100.0	100.0

Sources and notes: 1690s-1800s: Commerce: Table A1.7. Government: assumed to grow in line with population. Other domestic services: assumed to grow in line with population, with a cyclical adjustment for military personnel from Kahan (1985: 8). Weights for the 1880s from Table 7.

1800s-1880s: Commerce: Table A1.7. Government: 1803-1885: Nominal ordinary expenditure from Tabata and Tabata (2019), Appendix Table 8.1, deflated by the general price index from Mironov (2012: 310). Rent & domestic services: assumed to grow in line with population. Weights for the 1880s from Table 7.

TABLE A1.10: GDP by major branches and GDP per capita in Russia, 1690s-1880s (1880s=100)

	Agriculture	Industry	Services	GDP	GDP p.c.
1690s	14.4	6.6	10.0	11.7	97.0
1700s	15.7	7.3	11.0	12.8	97.8
1710s	17.2	8.0	11.4	13.9	97.6
1720s	23.0	8.5	14.1	17.9	119.3
1730s	22.1	9.2	14.3	17.6	111.2
1740s	31.2	9.9	16.5	23.4	140.7
1750s	29.0	11.5	17.9	22.8	121.2
1760s	38.8	13.7	23.2	29.9	141.1
1770s	40.2	16.8	24.1	31.6	134.7
1780s	36.2	18.1	24.9	29.8	114.9
1790s	39.0	24.1	30.4	33.9	99.3
1800s	45.3	26.1	33.8	38.6	101.5
1810s	49.3	30.1	41.6	43.4	100.7
1820s	56.5	36.4	48.9	50.4	99.3
1830s	62.8	42.7	54.3	56.6	97.5
1840s	74.4	51.9	54.4	65.1	102.5
1850s	73.6	61.7	62.1	68.5	98.8
1860s	73.7	73.4	76.4	74.2	98.9
1870s	92.4	88.4	90.3	91.0	103.9
1880s	100.0	100.0	100.0	100.0	100.0

Sources and notes: Agriculture: Table A1.1. Industry: Table A1.6. Services: Table A1.8. Weights for 1880s GDP: Table 8.

TABLE A1.11: Nominal and real GDP in Russia, 1690s-1880s (1880s=100)

	(1800s=100) Real GDP	(1800s=100) Price index	(1800s=1000) Nominal GDP	(m roubles) Nominal GDP
1690s	11.7	19.4	2.3	153
1700s	12.8	19.4	2.5	168
1710s	13.9	23.7	3.3	223
1720s	17.9	28.9	5.2	350
1730s	17.6	30.8	5.4	366
1740s	23.4	31.5	7.4	498
1750s	22.8	36.1	8.2	555
1760s	29.9	37.2	11.1	753
1770s	31.6	41.3	13.0	881
1780s	29.8	52.3	15.6	1,055
1790s	33.9	59.9	20.3	1,373
1800s	38.6	71.7	27.7	1,871
1810s	43.4	65.8	28.6	1,932
1820s	50.4	59.3	29.9	2,019
1830s	56.6	65.4	37.0	2,502
1840s	65.1	68.0	44.3	2,994
1850s	68.5	78.0	53.5	3,614
1860s	74.2	84.8	63.0	4,256
1870s	91.0	94.2	85.8	5,798
1880s	100.0	100.0	100.0	6,760

Sources and notes: Real GDP: Table A1.10. Price index: Mironov (2012: 310). Nominal GDP is obtained in index number form by reflatting real GDP with the price index, and in million roubles by setting the level for the 1880s on Gregory's (1982: 73) benchmark in Table 8.

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