ISSN 1883-1656

Центр Российских Исследований
RRC Working Paper Series No. 73

An Estimation of Production Indices for Industry and Agriculture in Imperial Russia

Manabu Suhara

March 2018

RUSSIAN RESEARCH CENTER
INSTITUTE OF ECONOMIC RESEARCH
HITOTSUBASHI UNIVERSITY
Kunitachi, Tokyo, JAPAN

An Estimation of Production Indices for Industry and Agriculture in Imperial Russia

Manabu Suhara
Nihon University, Tokyo, Japan

Introduction

Estimation results of production indices for value-added in industry and agriculture in Imperial Russia (1860-1913) are shown in this paper. Section 1 below addresses the construction of a production index for Russian industry. Calculations are made to obtain an agricultural production index in Section 2. Value-added created in industry and agriculture is thought to have jointly accounted in 1913 for nearly three quarters out of the total produced in Russian economy as a whole (value-added in industry accounted for nearly a quarter, whereas that in agriculture was almost a half).[1] The integration of the indices for industry and agriculture can therefore be considered to provide a GDP index for the whole of Imperial Russia. This issue is dealt with in Section 3, the final section. However, the estimation in this paper is only a primary approximation to the issue of the production of value-added in Tsarist Russia in this era and needs further elaboration in future.

1 Production Index for Industry

Let us first try to construct a production index for industry in the Russian Empire for the period after the serf Emancipation. Table 1 below shows most of the existing estimates of industrial production indices for Imperial Russia by order of year of publication (see Table 5 for a summary of estimation results). These are all calculated based on the Laspeyres formula, in which production quantities of representative products are multiplied by weights obtained from the base years and then summed to obtain an index number for a given year. The so-called Kondrat'ev index (Kon"iunkturnyi institut, 1926), placed first in the table, was probably the first attempt to estimate a production index for Russian industry. In order to calculate the index, 21 items, such as coal, crude oil, iron ore, pig iron, steel, cotton yarn, cotton cloth, raw sugar, refined sugar, and tobacco, are utilized. An especially interesting point of this index is that surrogates for value-added in 1900 for every product were calculated and were used as weights for the aggregation. However, the estimation period of the index was not that long: from 1885 to 1913.

Unfortunately, details are not available with regard to Kafengauz's estimates

[1] See Table 10 below. This issue will be discussed in detail later.

(Gregory, 1999), while the calculated growth rate from his index was the highest among the cited estimates (see Table 5). He took into consideration the production of industrial items related to railways (locomotives, passenger cars, and freight cars), which other estimations did not utilize. This could be one of the reasons for the relatively high growth rate he found. Although the estimation was made in the late 1920s, the publication of Kafengauz's book was withheld by the Stalinist regime and his work remained in obscurity until the end of the 20th century.

The estimation by Goldsmith (1961) is an extended version of the Kondrat'ev index. While the estimation period of the latter was relatively short, Goldsmith recalculated the index going back to 1860. Partly because of this, the Goldsmith estimation is currently regarded as the final and most authoritative production index for tsarist Russian industry. However, as Goldsmith's estimation has several unclear and ambiguous points, Suhara (2013) was dissatisfied with his findings and estimated anew an index for Russian industry.

Nutter's estimates (1962) were calculated as an avocation, so to speak, of the original goal of his book, which was the estimation of a production index for Soviet industry. In other words, he applied his methodology of estimation for Soviet industry to the outputs of individual items in Imperial times back to 1860. For that reason, he himself qualified his estimation results and said they should not be regarded as definitive. His estimated index numbers are not shown for all years of the estimation period from 1860 to 1913, but only every 5 years, i.e., 1860, 1865, 1870, and so on.

In Suhara's estimation (2013), the number of sample products slightly increased to 31 relative to existing indices.[2] Suhara's dissatisfaction with the Goldsmith index is based on the following points. (1) Although the Goldsmith index is explained as a backward extension of the Kondrati'ev index, the sources of output data for the extended period (1860-1885) were not specified in his paper, and even when sources were shown, it is not conceivable that the necessary data are available from those mentioned sources only. (2) It is not clearly explained how value-added for each product or each industrial branch is calculated in the three base years of 1887, 1900, and 1908. (3) The explanations are ambiguous as to how the three index series based on the three base years are linked, and so on. Due to these problems, we are not able to follow up the calculation process of the Goldsmith index, and therefore not to judge whether or not it is appropriate.[3]

---

[2] Suhara's estimation (2013) is essentially the same as Suhara (2006) and Suhara (2007), although the final result figures were slightly different.

[3] A footnote to Goldsmith's paper suggests that it was a condensed version of an original paper that was about three times as long as the published one. Unfortunately, the original paper is not available.

Suhara (2013) published a new index (shown in Table 1) because of these problems with the Goldsmith index. However, to our regret, we have difficulty in calling this a value-added production index, as Suhara used labor force instead of value-added weight for each industrial branch at the point of aggregating branch indices to obtain an index for the entire industry. The use of labor force instead of value-added weight was simply a result of the fact that appropriate value-added data were not available to him. As we said before, Goldsmith stated that he had calculated these value-added data for the three years 1887, 1900, and 1908, although he did not make clear how to obtain these data. In the present study, we were narrowly able to calculate value-added by industrial branch for the year 1908 only; in this paper, we present estimated figures utilizing these values as weights. We will next explain the estimation procedure.

The estimation consists of two steps. The first step is an estimation of production indices for the 7 industrial branches that make up total industry, whereas the second step is an estimation of an index for industry as a whole by aggregating the branch indices calculated in the first step. Let us explain the first step in detail. Individual industrial products as a basis of the estimation comprise 30 items in 7 branches (fuels, ferrous metals, nonferrous metals, chemicals, construction materials, textile, food processing), as shown in Table 2.[4] Out of these items, manufacturing products are classified as per the actual classification method at that time, apart from "salt," which was classified as a mining product in those days. Production volumes are shown for the territory of the Russian Empire excluding Finland. Annual outputs for these 30 products are multiplied by their prices in 1908[5] and the resulting production values for products are added by branch to obtain industrial production indices for each branch. The representation ratio, which captures the ratio of production values for sample products against the total value for all industrial products in Russia in 1908, is calculated as 35.1%. In the second step, branch indices calculated in the first step are aggregated with the weight of value-added produced in each branch in 1908 to obtain an index for an entire industry. As these 7 branches did not cover total industry, we assume here that the omitted branches grew at the same rate as the 7 branches as a whole.

Value-added by industrial branch in 1908, which is utilized in the second step of the estimation, is shown in Table 3. As mentioned in the table sources, value-added for branches is obtained basically from Bazarov et al. (1929), which summarized results of the second industrial census conducted in 1908. To be precise, apart from the fuels

[4] Out of 31 items employed in Suhara (2013), "phosphoric fertilizer" was excluded from the estimation, because the 1908 price for it was not available.

[5] Prices in 1908 are shown in Table 2. For the calculation methods for these prices, see Suhara (2006, pp. 53-57).

branch, value-added for each branch was calculated by deducting the raw material and fuel expenses from gross production values. However, as depreciation as a cost item is not deducted, the value obtained can be taken as gross value-added including depreciation (*uslovno chistaia produktsiia* in Russian). In the interests of accuracy, value-added for iron ore, manganese ore, chrome ore, and sulfide iron ore, which belonged to mining industry in those days, is added to value-added for ferrous metallurgy; value-added for gold and platinum is added to nonferrous metallurgy; value-added for asbestos ore is added to the construction materials branch; and value-added for the salt industry is added to the food processing branch. Because the necessary data on material expenses and fuel expenses for the calculation of value-added for these mining products were not available for 1908, I applied the gross value-added ratio (the ratio of gross value-added to gross production value) in 1925/26 for the mining products shown in Bazarov et al. (1930) to gross production values for these products in 1908 to obtain their gross value-added. For the fuels branch as a whole, gross value-added is also not available from Bazarov et al. (1929); this value was determined by applying the gross value-added ratio for 1925/26, which was shown in Bazarov et al. (1930), to the gross production value for the branch as a whole. Further, even though the gross value-added ratio for 1925/26 was not available for gold and platinum, the value-added ratio for the nonferrous metals branch excluding gold and platinum in 1908 was also applied to the production of gold and platinum. The above-mentioned calculation procedures are shown in Table 3. The size of value-added production in an industrial branch in our estimation thus includes not only value-added by sample products, but also that from other products in the branch. This is a procedure generally called “imputation.”

When we construct a production index for an entire industry by aggregating indices for industrial branches with weights, we have to select the formula for averaging. In the case of a long-term index such as ours, the difference in averaging formulas could lead to disparities in calculated figures of indices. While Table 4 displays estimated indices for industrial branches and for industry as a whole, we can see here that there are relatively large differences in index numbers and growth rates for an entire industry between the indices using geometric average and arithmetic averages, even with identical branch indices. Average annual growth rates calculated from values in the first (1860) and last (1913) years are 5.5% using the geometric average and 4.5% with the arithmetic average. If we employ the slope of log-linear regression lines, average growth rates are 6.1% using the geometric average and 4.9% with the

arithmetic average[6]. While we prefer to use the geometric average in order to eliminate arbitrariness, in that growth rates calculated from an aggregated index (e. g., index for an entire industry) using the arithmetic average of individual indices (e. g., industrial branch indices) differ depending on the choice of the reference base year (the year for which the value of an index is put at 100) in those indices, opinions are divided on this issue. This might mean that we have to tolerate a degree of difference of up to 1% in average annual growth rates.

Table 5 presents average annual growth rates of the estimations cited in Table 1 for various periods. Estimated index numbers by Kondrat'ev and Goldsmith are shown in Goldsmith (1961, pp. 462-463) for every year of the estimation period (1860-1913). When we calculate growth rates based on these index numbers, we obtain different figures to those shown in Goldsmith's paper. Since he appears to have made errors in calculation, corrected values are also shown in parentheses in Table 5, along with his original figures. Average annual growth rates are scattered between 4.4% and 5.8% for 1860-1913, and between 4.8% and 6.7% for 1887-1913, due to differences in weights such as labor force or value-added, the weight base years, the weighting system (whether fixed weight or shifting weight), whether imputation is made or not, the averaging formula, and so on, as well as differences in sample products.

One problem common to the estimates displayed in Table 5 is that they are all concerned only with so-called factory industry, and not with total industry including manual industry by handicraftsmen (*kustar*'s), which remained extensively even in the last days of the Russian Empire. Unfortunately, we have hardly any information on such small-scale industry. In his paper, Goldsmith estimated growth rates by deflating nominal production values — including small-scale industry — using an index of wholesale prices, in addition to the construction of the aforementioned Laspeyres index. According to his results based on the deflation method, the entire industry grew at 5 to 5.5% for the period 1860-1883, whereas factory industry grew at 5.5 to 6% for the same period; for the period 1883-1913, he estimated a 4.5 to 5% growth for total industry and a 5 to 5.5% growth for factory industry. To sum up, his estimates for the entire period 1860-1913 were 4.75 to 5.25% for total industry, and 5.25 to 5.75% for factory industry. He also introduces Strumilin's estimation, which is basically consistent with

[6] As shown in Table 4, the value of the geometric average is necessarily smaller than that of the arithmetic average. Hence, for years before the reference base year (the year for which the value of an index is put at 100), growth rates produced by indices with geometric averages are necessarily larger than those produced with arithmetic averages, conversely, for years after the reference base year growth rates of the arithmetic average index are necessarily higher than those of geometric average index. In the case of Table 4, as the reference base year is close to the last year of the estimation period, the growth rate of the geometric average index is higher than that of the arithmetic average index.

above-mentioned figures, that the average annual growth rate for small-scale industry was about two thirds of that for factory industry. If these estimates are basically correct, we may also have to deduct 0.5% or so from the estimated growth rate of 5.5%. To our regret, however, Goldsmith did not mention anything at all about concrete figures for nominal output values, the price index he used, or the sources of these data.

2 Production Index for Agriculture

Next, let us move on to the issue of the construction of a production index for agriculture in the Russian Empire for the same period as our index for industry. As agriculture is divided into crop farming and livestock farming, in the first place we try to estimate an index for crop farming. Our data on agricultural production as a basis of the estimation are yield quantities (gross output quantities) for grain and potatoes from the middle of the 19th century onward, as shown in Table 6. Sufficient data were not available for industrial crops, such as linen, sunflower, and so on. We assume, therefore, that output for these products grew at the same rate as that for grain and potatoes. To our regret, we had to restrict our estimation to within the 50 provinces of European Russia due to the paucity of data for the latter half of the 19th century. In addition, while output figures in Table 6 are based on official statistics compiled by the Ministry of Internal Affairs, as referenced in the table sources, they are thought to hold a downward bias of some 6% or so, according to the studies by Wheatcroft (1974) and others. Here we also have to assume that the degree of bias was constant for 1860-1913. As is clear from the above, the following estimation is tentative in many ways.

At first, in preparations for the estimation of an index for value-added production, let us construct an index for gross output. The gross output index can be obtained by multiplying output figures for individual products shown in Table 6 by their prices in the base year of the index and aggregating the resulting products. While various kinds of data are available on prices for agricultural products in Imperial Russia, we decided to employ Falkus's (1968) price data for 1913, because they included prices for all crops displayed in Table 6. This means that we calculate a production index whose base year is 1913. As is clear from the table, output data for individual crops apart from potatoes are not available for the years before 1870 and 1881-1882; only yield quantities for grains as a whole are known. We calculated the output values for these years employing the weighted average price for 9 grains using their outputs in 1913 as weights (52.3 rubles per ton), and the price for potatoes in 1913. Results of these calculations are shown in the column "Gross Production Index (1)" of Table 7. The same table shows "Gross Production Index (2)" based on only 4 types of crops (wheat, rye, barley and

potatoes) in connection with the estimation of a net production index later. Again in this case, output for grain as a whole was used, rather than for individual crops of wheat, rye, and barley, in order to calculate the index for the period before 1870 and for 1881-1882.

Next we calculate a net production index. Net production here indicates the total quantities, i.e., the gross yield quantities, minus the portions used for seeding or for feed. Strictly, we may also need to deduct the input portions from sectors other than agriculture itself from the gross output in order to gauge the size of value-added in agriculture. However, we do not conceive that the inputs from other sectors were so substantial, especially in imperial days, hence we here regard net production as value-added. In the estimation of a production index, we use data on net output for wheat, rye, barley, and potatoes in 63 provinces for 1885-1913, which Gregory (1982, pp. 232-234) once employed in his estimation for Russia's GNP. Let us assume that the net output ratio (the ratio of net to gross output) is valid for the 50 provinces of European Russia as well; and also that results for the 4 above-mentioned agricultural products (wheat, rye, barley, and potatoes) are applicable to the entire range of crops. The output value for the 4 main products amounted to 77.8% in 1913 of the total for 9 grains and potatoes (4,025 million rubles). If we make these assumptions, we can easily find net output values for the 4 crops in 1885-1913. The question remains to find the net output ratio for 1860-1884. We estimated this in the following way.

(1) There appear to be two distinguishing features in the progress over 1885-1913 of net output ratios for the 4 products (see Figure 1). First, although in the case of potatoes this trend may not be so definite, there is a clear upward tendency in ratios for other crops during this period. The general belief is that there existed a certain degree of improvement in productivity in Russian agriculture from the latter half of the 19th century to the early 20th century. If this is true, we can quite easily conceive that the increase in output available for human beings as food was larger than the growth in the portions for seeding and feed. Second, the net production ratio tended to decrease in poor harvest years. This tendency is also quite likely in view of the fact that a certain amount of farm produce for seed and forage has to be secured even in bad harvest years.

(2) We can hence consider a regression equation for each crop in which its net production ratio in every year is explained by an upward trend with a constant rate and by the harvest level in that year. This is provided by the following simple formula:

$$\ln(Net\ Production\ Rate) = constant + \alpha t + \beta \ln(Harvest\ Level).$$

The harvest level for a certain year is measured as the divergence rate of the harvest in that year from the 5-year (before and after that year) moving average harvest (for the years 1860 and 1912, the 3-year moving average harvest). Results of the regression using data on 1885-1913 (the number of samples is 27) are shown as a footnote 7.[7] We can be said to have obtained tolerable results.

(3) For potatoes, we can calculate the size of net output for every year of the estimation period (1860-1913) with gross output data and estimated net output rates. For the three main grains, however, there are some years for which the gross output data necessary for calculations are lacking (1860-1872, 1880-1884). Concerning these years, we calculated net output rates in the following way. (a) We applied the estimated net production rates for the 3 main grains to the gross output data of total grain to obtain the net output volumes for total grain. (b) Next, we calculated weighted averages of the net output for total grain and the net output for potatoes (see column (5) of Table 7). The weight is the ratio between the average price per ton for total grain in 1913 (52.3 rubles) and the price for potatoes in the same year (16.5 rubles), namely 0.76 : 0.24, to obtain a net production index for crop farming as a whole. These procedures are also shown in Table 7. As may be expected, the average annual growth rate of net production for 53 years is 2.1%, higher than the average rate for gross production calculated based

---

[7] Regression results are as follows (t-values are shown in parentheses):

【Case of wheat】(Adjusted $R^2 = 0.827$)

$$\ln(\textit{Net Production Rate}) = \underset{(-3.590)}{-4.443} + \underset{(6.352)}{0.0042} \times t + \underset{(8.877)}{0.210} \times \ln(\textit{Harvest Level})$$

【Case of rye】(Adjusted $R^2 = 0.689$)

$$\ln(\textit{Net Production Rate}) = \underset{(-1.824)}{-2.021} + \underset{(4.938)}{0.0028} \times t + \underset{(6.426)}{0.236} \times \ln(\textit{Harvest Level})$$

【Case of barley】(Adjusted $R^2 = 0.865$)

$$\ln(\textit{Net Production Rate}) = \underset{(-4.114)}{-3.646} + \underset{(7.908)}{0.0037} \times t + \underset{(9.529)}{0.2222} \times \ln(\textit{Harvest Level})$$

【Case of the 3 main crops】(Adjusted $R^2 = 0.847$)

$$\ln(\textit{Net Production Rate}) = \underset{(-3.682)}{-3.094} + \underset{(7.695)}{0.0032} \times t + \underset{(9.544)}{0.306} \times \ln(\textit{Harvest Level})$$

【Case of potatoes】(Adjusted $R^2 = 0.557$)

$$\ln(\textit{Net Production Rate}) = \underset{(0.414)}{0.361} + \underset{(3.727)}{0.0017} \times t + \underset{(4.032)}{0.162} \times \ln(\textit{Harvest Level}).$$

All t-values for coefficients except for the y-intercepts for rye and potatoes are significant at the 1% level.

on output data for all grain and potatoes (1.8%) and the average rate based on output data on the 3 main crops and potatoes (1.9%).[8]

Next, let us turn to a production index for livestock farming. The number of livestock animals purportedly counted in the winter season for the 50 provinces of European Russia is shown on the left-hand side of Table 8. Based on these figures, we will construct a net production index for livestock farming. The Soviet economic statistician Vainshtein (1969, p. 62) introduces Prokopovich's estimation of Russian national income. Vainshtein states that Prokopovich estimated income (value-added) from horse breeding in European Russia in 1900 and 1913 at 10.8 million rubles and 20.93 million rubles, respectively; income from cattle breeding at 610.0 million and 1167.3 million rubles; income from pig breeding at 94.0 million and 284.1 million rubles; and income from sheep breeding at 116.7 million and 257.4 million rubles, respectively. Between these Prokopovich income estimates and the livestock counts presented in Table 8, we expect a linear relation, similar, for instance, to the capital coefficient that often appears in economic literature; in other words, value-added production will also increase in proportion to livestock count. Annual livestock income may be obtained through multiplying the income per head of 4 types of livestock (i.e., the income-livestock coefficient) by the annual livestock counts. The index derived from this should be the livestock net output (value-added production) index. In fact, largely the same index is obtained regardless of whether the calculation uses income-livestock coefficients from 1913 income or from 1900 income. Table 8 displays the livestock sector index using 1913 income-livestock coefficients.

Finally, we attempt calculation of a net agricultural production index by combining the net crop farming output and net livestock output indices. Although estimated production indices for the two sectors of agriculture are actually those for the 50 provinces of European Russia, let us regard them here as indices for Imperial Russia as a whole. One issue is the weight for the two indices when constructing weighted averages; for this, let us employ the revised versions of the Prokopovich estimates found in Falkus (1968) (see Table 10). Falkus estimates the gross national income (including depreciation) for the 50 provinces of European Russia in 1913 as 13,723.5 million rubles, 6,540.4 rubles of which (47.7%) are agricultural sector income. The details of this agricultural sector income are: 4,313.0 million rubles for crop farming; 1,729.7 million rubles for livestock; 497.7 million rubles for other types of agriculture (e.g., hay, straw, gapes, horticulture, beekeeping) (Falkus, 1968, pp. 65, 67). The ratio of crop farming income to livestock sector income, ignoring the other types of agriculture, will be used as

[8] These average annual rates are calculated using log-linear regression.

the weight when averaging the two production indices. The specific process is as follows: revise the crop farming sector and livestock sector indices taking for example the 1913 index value as 100, then calculate the geometric mean for this using a weight of 43.130 : 17.297. The result is an index for the entire agricultural sector. For years that do not have livestock sector index values, the crop farming sector index values alone are used as the values for that year. In other words, the crop farming sector index is used to create two index values for a certain year from the combined index values for the previous year and for the following year, and the geometric averages of these indices become the combined index for the year in question. The combined index in Table 9 is the net agricultural production index for Imperial Russia calculated in this manner; Figure 2 is a graph of the crop farming, livestock farming, and combined indices. The average annual growth rate for agriculture is calculated to be 1.7%, based on the log-linear regression.

3 GDP index

Let us attempt to create an index for GDP (regarded here as being the same as national income) measured from the value-added generation side using our industrial and agricultural production indices. As we seem unable at the moment to obtain reliable measurements of value-added in sectors other than industry and agriculture for Imperial Russia, we here assume that production in these sectors grew at the same rate as that of production in industry and agriculture as a whole. Table 10 presents a summary of existing estimates of Russian national income for 1913. As is clear from this table, industry and agriculture are thought to have jointly accounted for some 70 to 75% of national income in 1913. Among these estimates, we choose Falkus's estimates of the production ratio between industry and agriculture to unify our two production indicators into a GDP index, taking into consideration that our industrial output index pertains to the entire Russian Empire, and that it is also concerned with gross production including depreciation. In addition, considering also that our industrial production index fails to take small-scale industry into account, we decided to estimate two cases, i.e., one case in which we assume production in small-scale industry grew at the same rate as the relatively high rate of the factory industry, and another in which we assume production in small-scale industry grew at the same rate as the relatively low rate of that for agriculture and industry (actually, factory industry) as a whole. In the former case, we use a 23.7 : 48.3 production ratio between industry and agriculture (see Table 10) as a weight, whereas in the latter we use a 16.7 : 48.3 ratio between them. Let us call the GDP index that is constructed in the former case the maximum index

and that in the latter case the minimum index. The actual growth rate will probably have been located somewhere in the middle between the two. Table 11 displays obtained index values including those of the average of the maximum and minimum indices. Average annual growth rate for 1860-1913 is 2.8% based on the "average" GDP index.

In order to consider the validity of the "average" GDP index, we show several hypothetical figures. First of all, we suppose our production indices for agriculture and factory industry are appropriate. Then the average growth rate of 3.1% is needed for sectors other than agriculture and factory industry as a whole (namely, small-scale industry, forestry, fishing and hunting, construction, trade, transport and others, see Table 10), so as to agree the values of calculated GDP index with those of the "average" index. If we assume annual growth rates for small-scale industry to be, after Strumilin, as two thirds of those for factory industry (in this case average annual growth rate for small-scale industry is calculated as 3.7%), above-mentioned other sectors apart from small-scale industry must have grown at the average rate of 2.9%. In other sectors are included forestry, fishing, and hunting, whose growth rates are believed to have been relatively low (these sectors jointly accounted for 6.9% of national income in 1913), and also construction and transport, whose growth rates are thought to be relatively high (shares of national income were 5.9% and 6.1% in 1913, respectively). In any event we have to estimate value-added production in sectors other than agriculture and industry as accurately as possible, to judge properly the appropriateness of our "average" GDP index.

Table 12 summarizes average annual rates of growth calculated from our estimates in this paper in two ways, namely, based on index numbers of the first and last years and on log-linear regression, whereas Table 13 compares our GDP index with other estimates in terms of average annual growth rate. As is shown in Table 13, our GDP index indicates somewhat higher annual growth rate than do the existing estimates, apart from during the period 1900-1913. Out of these estimations shown in this table, it is only Gregory's estimation that can be compared with our index on an annual basis.[9] Figure 3 presents a graph in which annual growth rates calculated from his GDP estimates are compared with our rates. While our index is estimated from the production side, his estimates are calculated from the expenditure side. As is seen in the table, the basic configurations of both indices are similar, although differences arise in some cases. Specifically, the degree of growth or decline, or even the positive or negative direction, differs in some years. Close examination is needed in such cases, although a

[9] Gregory estimated Russian GNP for every year of the period 1885 to 1913. The differences between GNP and GDP are negligible in this case.

certain degree of disparities might be inevitable based on the differences in estimation methodology.

Finally, let us compare our GDP growth rates in Russia with the rates in other countries for the period 1860 to 1913 (see Table 14). Goldsmith commented that his estimate of a 2.5% growth rate for Russia "was not conspicuously high or low in international comparison" (Goldsmith, 1961, p. 474). Judging at the present time, when more than half a century has passed since Goldsmith's evaluation, we can say that Russia attained fairly good results, although they were not sufficient to reach those of the USA. Still, another appraisal must be necessary when we consider the situation from the viewpoint of per capita growth, as the rate of population growth was substantially higher during this period in Russia, as is shown in Table 14. In any event, it goes without saying that all estimates in this paper contain numerous assumptions and inferences and need further investigation and examination.

【References】

Bazarov, V. A., V. E. Varzar, V. G. Goman, L. B. Kafengauz, V. I. Mezhlauk, M. L. Rukhimovich, S. P. Sereda, S. G. Strumilin and A. B. Shtern (eds.) (1929) *Dinamika rossiiskoi i sovetskoi promyshlennosti v sviazi s razvitiem narodnogo khoziaistva za sorok let (1887-1926 gg.), chast' vtoraia (promyshlennost' 1908 g.)*, Moscow, Leningrad.

———— (1930) *Dinamika rossiiskoi i sovetskoi promyshlennosti v sviazi s razvitiem narodnogo khoziaistva za sorok let (1887-1926 gg.), chast' tret'ia (promyshlennost' 1912, 1913, 1915, 1920 i 1925/26 gg.)*, Moscow, Leningrad.

Falkus, Malcolm E. (1968) "Russia's National Income, 1913: A Revaluation," *Economica*, Vol. 35, Feb, pp. 52-73.

Goldsmith, Raymond W. (1961) "The Economic Growth of Tsarist Russia 1860-1913," *Economic Development and Cultural Change*, Vol. 9, No. 3, pp. 441-475.

Gregory, Paul (1982), *Russian National Income, 1885-1913*, Cambridge University Press.

————— (1999), "Poisk istiny v istoricheskikh dannykh: eshche odna otsenka promyshlennogo proizvodstva v Rossii, 1887-1913 gg.," in book *Ekonomicheskaia istoriia Ezhegodnik 1999*, ROSSPEN, Moscow, pp. 471-500.

Kon"iunkturnyi institut (1926) "Indeksy fizicheskogo ob"ema promyshlennogo proizvodstvo, ischilennye Kon"iunkturnym institutom," *Ekonomichesii biulleten' Kon""iunkturnogo instituta*, No. 2, pp. 12-20.

Maddison, Angus (2003) *The World Economy: Historical Statistics*, Development Centre Studies, OECD.

Mitchell, B. R. (ed.) (2007) *International Historical Statistics: Europe 1750-2005*, Sixth Edition, Palgrave Macmillan.

Nifontov, A. S. (1974) *Zernovoe proizvodstvo Rossii vo vtoroi polovine XIX veka: po materialam ezhegodnoi statistiki urozhaef evropeiskoi Rossii*, Izdatel'stvo Nauka, Moscow.

Nutter, G. Warren (1962) *Growth of Industrial Production in the Soviet Union*, Princeton University Press, Princeton, New Jersey.

Suhara, Manabu (2006) "Russian Industrial Growth: An Estimation of a Production Index, 1860-1913," Research Institute of Economic Science, College of Economics, Nihon University, *Working Paper Series*, No. 05-03, March, pp. 1-66, http://www.eco.nihon-u.ac.jp/center/economic/publication/pdf/05-03suhara.pdf.

———— (2007) "Otsenka indeksa promyshlennogo proizvodstva Rossii: 1860-1913," *Voprosy statistiki*, No. 2, pp. 41-49.

———— (2013) *Soren Kogyo no Kenkyu* (*A Study of Soviet Industry*), Ochanomizu Shobo, Tokyo (in Japanese).

Tsentral'nyi statistichekii komitet Ministerstva Vnutrennikh del, *Statisticheskii vremennik Rossiiskoi Imperii*, St. Petersburg.

———— *Statistika Rossiiskoi Impereii*, St. Petersburg.

Vainshtein, Al'b L. (1969) *Narodnyi dokhod Rossii i SSSR: istoriia, metodologiia ischisleniia, dinamika*, Nauka, Moscow.

Wheatcroft, Stephen G. (1974) "The Reliability of Russian Prewar Grain Output Statistics," *Soviet Studies*, Vol. 26, No. 2, pp. 157-180.

Table 1　Estimations of Industrial Production Index for Imperial Russia

Index (Publication Year)	Estimation Period	Covered Area	Number of Items	Weight	Weight Base Year	Averaging Fomula
Kondrat'ev (1926)	1885－1913	Imperial Russia	21	Surrogates for value added	1900	Geometric mean
Kafengauz (1929?, 1994)	1887－1913	USSR at the end of the 1920s	29	Labor force, Gross output value	1887	Arithmetic mean
Goldsmith (1961)	1860－1913	Imperial Russia	20	Value added	1887, 1900, 1908	Arithmetic mean
Nutter (1962)	1860－1913 (every 5 years)	Imperial Russia	26	Value added	1913	Arithmetic mean
Suhara (2013)	1860－1913	Imperial Russia	31	Gross output value, Labor force	1887, 1890, 1900, 1908, 1912	Geometric mean

Source:　Suhara (2013, p. 481).

Table 2　Output of Main Industrial Products for Imperial Russia: 1860-1913

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Fuels		Ferrous Metals				Nonferrous Metals				Chemicals					
	Crude Petroleum	Coal	Pig Iron	Iron	Steel	Rails	Copper	Lead	Zinc	Gold	Phosphoric Fertilizer	Sulfuric Acid	Soda Ash	White Lead	Zinc Oxide	Matches
	mill.m.t.	mill.m.t.	th.m.t.	th.m.t.	th.m.t.	th.m.t.	th.m.t.	th.m.t.	th.m.t.	metric ton	th.m.t.	th.m.t.	th.m.t.	th.m.t.	th.m.t.	billions
prices in 1908	13.6	4.73	26.6	93.5	58.4	61.4	798.4	185.5	231.0	1460.2/kg	–	30.3	76.3	228.9	254.0	39.7/mill.
1860	0.004	0.30	335	210.4	2	10.7	5.20	1.09	1.84	24.4	0	5.1	0	0	0	
1861	0.004	0.38	319	194.2	2	5.7	4.93	0.81	2.54	23.8			0			
1862	0.004	0.35	250	172.5	2		4.75	0.88	2.58	23.9			0			
1863	0.01	0.36	279	197.4	2	12.3	4.82	1.17	2.47	23.9			0			
1864	0.01	0.40	300	182.0	4	22.6	4.51	1.35	2.94	22.9			0			
1865	0.01	0.38	299	175.5	4	23.1	4.15	1.63	3.09	25.8	0	6.5	0.35	0	0	
1866	0.01	0.45	304	185.7	4	14.2	4.42	1.71	3.14	27.2						
1867	0.02	0.44	288	187.7	6	7.1	4.24	1.74	2.95	27.0						
1868	0.03	0.45	324	222.7	10	23.6	4.39	1.64	3.25	28.0						
1869	0.04	0.60	329	235.9	8	42.3	4.26	1.07	3.63	33.2			1.28			
1870	0.03	0.69	360	248.5	9	40.7	5.05	1.65	3.78	35.4	0	7.9	1.32	0	0	
1871	0.03	0.83	359	255.5	7	38.5	4.52	1.77	2.73	39.3			0.77			
1872	0.03	1.09	399	268.1	9	30.5	3.72	1.22	3.03	41.4						
1873	0.07	1.17	385	255.8	9	26.3	3.66	0.94	3.38	33.2						
1874	0.09	1.29	380	299.3	9	48.9	3.27	1.34	4.13	33.2						
1875	0.13	1.70	427	303.8	13	43.8	3.65	1.08	3.99	32.7	0	15.5	0.63	0	0	
1876	0.19	1.82	442	292.7	18	43.9	3.87	1.17	4.62	33.6						
1877	0.25	1.79	400	266.6	44	41.7	3.50	1.20	4.73	41.2			0.56			
1878	0.33	2.52	417	273.5	64	72.4	3.52	1.40	4.65	42.1			0.54			
1879	0.40	2.92	433	280.1	210	153.9	3.12	1.36	4.32	43.1			0.40			
1880	0.35	3.29	448	292.1	307	202.6	3.20	1.15	4.39	43.3	0	23.0	0.89			
1881	0.66	3.49	469	292.2	293	207.4	3.46	0.99	4.55	36.8			0.67			
1882	0.83	3.78	463	297.3	248	162.6	3.59	0.57	4.47	36.1			0.81			
1883	0.99	3.98	483	322.8	222	116.5	4.36	0.54	3.67	34.9			1.00			
1884	1.48	3.93	510	362.2	207	92.0	6.22	0.63	4.32	35.7						
1885	1.91	4.27	504	362.3	193	94.7	4.72	0.71	4.59	33.0	0	36.7	5.00			
1886	1.90	4.58	516	363.0	242	112.9	4.57	0.78	4.20	33.4						
1887	2.36	4.53	598	369.4	226	87.9	4.99	0.99	3.62	34.9			11.1			
1888	3.01	5.19	647	364.5	222	64.3	4.60	0.80	3.87	35.2	0.86	43.5	18.0	3.10	1.01	59.3
1889	3.28	6.21	726	427.8	259	95.7	4.80	0.58	3.69	37.2			18.6			139.7
1890	3.78	6.01	916	433.2	378	173.0	5.73	0.84	3.77	39.4	1.36	40.0	20.1	3.05	0.90	142.9
1891	4.53	6.23	983	448.0	434	171.1	5.46	0.56	3.68	39.1			19.6		0.84	144.7
1892	4.69	6.95	1050	497.4	515	197.3	5.32	0.88	4.37	43.0	1.07	36.5	27.7	3.01	0.23	146.6
1893	5.53	7.61	1125	499.0	631	237.3	5.46	0.84	4.50	44.9	6.94	44.3	46.1	3.58	0.25	137.0
1894	4.92	8.76	1309	502.6	703	250.0	5.41	0.74	5.01	42.9			45.9			157.5
1895	6.745	9.10	1429	440.4	879	302.2	5.85	0.41	5.03	41.1	18.7	52.0	47.8	5.77		167.1
1896	6.80	9.38	1595	498.0	1022	366.6	5.83	0.26	6.26	37.2			58.6			166.7
1897	7.28	11.20	1849	512.2	1225	398.8	6.94	0.45	5.88	38.2		59.8	61.1	7.95	0.29	182.3
1898	8.33	12.31	2216	481.5	1619	468.4	7.29	0.24	5.66	38.8						183.2
1899	8.96	13.97	2682	519.7	1897	464.0	7.53	0.32	6.33	38.9			69.8			186.3
1900	10.38	16.16	2916	489.4	2216	496.1	8.26	0.22	5.96	38.8	48.1	105.7	86.2	8.32		208.8
1901	11.56	16.53	2837	382.3	2228	481.5	8.47	0.16	6.10	39.1						231.6
1902	11.08	16.47	2569	310.7	2184	419.5	8.82	0.23	8.27	34.9						233.9
1903	10.42	17.86	2464	279.0	2434	337.9	9.23	0.11	9.89	34.7						237.3
1904	10.89	19.61	2954	261.3	2766	420.1	9.84	0.09	10.61	33.9						236.2
1905	7.56	18.67	2717	160.3	2266	383.1	8.51	0.78	7.91	33.5	80.5	177.7	86.9	8.76		224.1
1906	8.17	21.73	2691	157.4	2496	299.5	9.35	1.01	10.09	36.8						245.4
1907	8.66	26.00	2822	155.5	2671	330.9	13.29	0.50	10.12	37.8						251.7
1908	8.74	25.91	2814	142.0	2698	361.2	16.23	0.52	9.96	42.4			109.1	9.03	2.12	275.5
1909	9.30	26.82	2872	117.9	2940	500.0	18.44	1.06	9.61	48.7						273.8
1910	9.63	25.43	3041	55.3	3314	505.2	22.69	1.31	10.84	53.9	112.9	249.7	132.2	12.15	2.85	295.5
1911	9.18	28.42	3595	44.2	3949	507.9	26.44	1.24	12.21	52.0	123.3	275.3	148.2	11.25	3.74	306.2
1912	9.29	31.13	4199		4503	623.9	32.66	1.62	20.32	47.8	150.1	283.7	164.2	11.08	3.78	311.2
1913	9.23	36.05	4636		4918	640.9	33.10	1.53	19.36	49.2	115.0	292.2	160.0	18.00		322.5

Note:　Output for products with (*) refers to that for fiscal year (September of the previous year to August of the current year). Prices in 1908 are shown in rubles per metric ton.

Source:　Suhara (2013, pp. 519, 545-548).

Table 2 (continued)

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	Construction Materials			Textile Industry		Processed Food									
	Cement	Bricks	Window Glass	Ginned Cotton Consumption	Woolen Yarn	Raw Sugar Consumption*	Refined Sugar*	Vegetable Oil	Flour	Starch & Syrup	Crude Alcohol*	Beer	Salt	Cigarettes	Makhorka
	th.m.t.	millions	mill.m^2	th.m.t.	th.m.t.	th.m.t.	th.m.t.	th.m.t.	mill.m.t.	th.m.t.	th.kiloliter	th.kiloliter	th.m.t.	billions	h.20-kg crates
prices in 1908	17.8	13.0/th.	0.51/m^2	786.3	2579.8	129.1	223.0	263.4	98.5	118.4	106.8/kilol.	72.5kilol.	5.24	1.47/th.	l.22/20kgcrate
1860				46.5		57.3					350.7		429.7	0.34	
1861				43.3		57.3					350.7		431.8	0.36	
1862				13.9		47.5					350.7		749.2	0.41	
1863				17.7		35.9					350.7		506.6	0.50	
1864				26.8		53.0					384.8		363.0	0.52	
1865				26.0		72.9					314.3		501.9	0.51	
1866				48.3		55.2					286.1		646.6	0.66	
1867				54.0		104.5					385.9		724.5	0.71	
1868				41.9		122.7					320.6		602.8	0.81	
1869				52.5		82.8					369.6		651.6	1.07	
1870				45.9		105.4					385.1		475.3	1.14	
1871				68.2		122.7					344.2		456.7	1.40	
1872				59.0		89.6					404.3		650.5	1.57	
1873				57.8		122.1					405.6		755.5	1.64	
1874				76.4		128.3					386.4		725.5	1.86	
1875				85.4		132.0					387.0		585.4	2.02	
1876				77.1		155.7					339.8		683.7	1.84	
1877				72.6		207.5					325.8		474.3	2.50	
1878				117.6		173.7					342.2		781.7	2.02	
1879				105.6		181.8					438.3		817.9	2.24	
1880				94.1		205.5					402.4		779.3	2.24	
1881				148.6		203.1					381.0		831.1	2.19	964.9
1882				127.0		261.1					400.7		1667	2.43	1305
1883				146.6		287.3					397.3		1138	2.66	2188
1884				120.8		308.9					413.4		1024	2.90	2237
1885				124.0		343.3					413.7		1133	3.13	2112
1886				137.4		475.7					386.5		1197	3.25	2182
1887				184.4		425.1	280.7		2.45		367.3	355.5	1157	3.34	2184
1888				136.9		389.0	279.7	60.3	2.43	88	434.9		1113	3.47	2135
1889				170.8		465.1	292.9				403.3		1394	3.69	2111
1890	173.1	833	3.1	136.4	13.4	403.1	302.1	44.6	2.47	106	386.8	396.2	1390	3.74	2093
1891		764		151.6		466.4	306.1	47.1	2.37	110	385.3		1351	3.82	2125
1892		744		163.7		485.7	311.4	54.6	2.33	131	336.4		1459	4.25	1878
1893	137	760		186.7	17.9	399.5	321.9	63.3	2.66	133	340.5	344.8	1351	4.58	2095
1894				190.3		578.5	359.0				379.3		1354	4.98	2062
1895		1617		201.4	28.5	528.6	351.4	81.4	3.89	110	371.1		1540	5.70	2326
1896				224.2		679.5	367.3		4.45		393.1	536.4	1347	5.93	2277
1897		2474		224.5		634.6	381.3		5.12	87.4	380.1	565.7	1562	6.09	2257
1898				233.3		654.4	429.1				365.5	537.4	1505	5.71	2304
1899				264.2		682.7	445.3				360.2	591.3	1681	7.70	2340
1900	803	1768	14.3	262.2	54.9	794.1	471.0	126.7	3.71	89.4	413.0	587.2	1968	8.62	2484
1901				264.1		806.6	506.4				425.3	574.4	1706	9.67	2623
1902				285.5		959.4	562.6				385.3	570.6	1847	10.76	2372
1903				294.8		1053	556.6				360.9	668.2	1659	9.94	2956
1904				298.8		1041	574.2				404.9	667.4	1908	11.82	3089
1905	865	1531	15.8	273.3	64.9	854	611.7	195.2	4.86	100	419.0	729.1	1844	11.77	2984
1906				296.1		872	641.1				452.6	879.6	1790	15.05	3225
1907				319.3		1279	676.7				485.5	930.0	1872	14.36	3098
1908	902	1388	16.8	346.5	70.2	1257	672.8	236.5	5.25	106.6	522.6	876.0	1847	14.60	3537
1909				348.5		1129	709.7		5.55		560.1	925.3	2243	20.39	3626
1910	1210	1763	23.8	361.8	73.8	1033	811.5	226.6	4.86	130.6	523.7	1019.8	2051	16.73	3698
1911	1484	2114	25.3	350.5	75.4	1882	801.5	252.1	5.35	131.4	606.7	1099.0	2011	19.84	3699
1912	1757	2341	27.2	420.9	82.0	1848	852.1	262.3	5.39	130.7	547.4	1066.6	1858	22.53	4262
1913	2131	3090		424.2	110.2	1235	934.7	325.0		125	606.3	1161.2	1981	25.89	4390

Table 3　Production of Value-Added by Industrial Branch in 1908（thousand rubles）

Industrial Branch	Items	Gross Production	Material Expenses	Fuel Expenses	Value-Added Ratio (%)	Value-Added	Value-Added Share (%)
Fuels		271,995			79.4	215,982	14.4
Ferrous Metals	Ferrous Metals (except for ores)	202,364	62,045	51,472		88,847	
	Iron Ores	17,574			74.5	13,092	
	Manganese Ores	4,424			76.8	3,399	
	Chrome Ores	234			80.4	188	
	Sulfide Iron Ores	752			80.4	605	
						106,131	7.1
Nonferrous Metals	Nonferrous Metals (except for Gold & Platinum)	19,354	8,174	2,856		8,325	
	Gold and Platinum	61,913			43.0	26,630	
						34,955	2.3
Chemicals		319,504	205,758	15,710		98,037	6.6
Construction Materials	Construction Materials (except for Asbestos Ores)	97,760	19,549	16,186		62,024	
	Asbestos Ores	902			65.3	589	
						62,613	4.2
Textile		1,365,603	898,632	45,669		421,302	28.2
Food Processing	Food (except for Sallt)	1,576,591	977,515	48,338		550,738	
	Salt	9,679			67.2	6,504	
						557,242	37.2

Note：　Value-added in this table includes depreciation.

Source：Bazarov et al. (1929, pp. 76-89, 106-108); Bazarov et al. (1930, pp. 206-207).

Table 4　Production Indices for Imperial Russian Industry: 1860-1913 (Value for 1908 = 100)

	Industrial Branches							Total Industry (geometric mean)	Total Industry (arithmetic mean)
	Fuels	Ferrous Metals	Nonferrous Metals	Chemicals	Construction Materials	Textile	Food Processing		
1860	0.6	10.9	52.3	0.9		10.7	19.5	7.7	12.9
1861	0.8	10.1	51.0			9.9	19.5	7.9	12.7
1862	0.7	8.7	51.1			3.2	19.7	5.4	10.6
1863	0.7	10.0	51.2			4.1	18.7	5.8	10.6
1864	0.8	9.9	49.1			6.1	20.8	7.0	12.0
1865	0.8	9.7	54.4	1.3		6.0	19.0	6.8	11.4
1866	1.0	9.9	57.3			11.1	17.2	8.2	12.3
1867	1.0	9.7	56.7			12.4	24.4	9.8	15.5
1868	1.0	11.7	58.8			9.6	22.3	9.0	14.0
1869	1.4	12.6	68.5			12.0	22.6	10.3	15.2
1870	1.5	13.4	73.6	2.0		10.5	24.2	10.3	15.6
1871	1.8	13.5	80.2			15.6	23.4	11.9	17.0
1872	2.3	14.2	83.3			13.5	24.8	12.2	17.2
1873	2.7	13.5	67.8			13.3	26.9	12.7	17.5
1874	3.0	15.5	67.7			17.5	26.4	14.2	18.8
1875	4.1	16.1	67.0	3.0		19.6	26.4	15.5	19.6
1876	4.6	16.0	69.2			17.7	25.7	15.3	19.0
1877	4.9	15.2	83.2			16.7	27.8	15.7	19.8
1878	6.8	16.7	84.9			27.0	27.1	19.2	23.0
1879	8.0	22.2	86.3			24.2	31.9	20.8	24.7
1880	8.4	26.0	86.7	5.2		21.6	31.5	20.6	24.2
1881	10.6	26.0	74.7			34.1	30.6	24.6	27.7
1882	12.1	24.1	73.4			29.1	36.5	25.6	28.6
1883	13.4	23.6	71.7			33.6	37.2	27.3	30.3
1884	16.0	24.3	75.3			27.7	38.9	27.1	29.8
1885	19.1	24.0	68.8	10.1		28.4	41.0	29.0	31.3
1886	19.7	25.7	69.3			31.5	47.0	32.4	34.9
1887	22.2	25.8	72.4	17.1		42.3	43.5	35.6	37.4
1888	27.1	25.5	72.6	21.2		31.4	44.1	34.2	35.5
1889	30.7	30.0	76.5	25.8		39.2	46.7	39.1	40.0
1890	33.1	36.4	81.7	32.9	36.2	31.3	44.6	37.6	38.4
1891	37.7	38.8	80.8	32.3	33.3	34.7	44.4	39.3	39.9
1892	40.0	43.5	88.3	34.5	32.4	37.4	44.4	41.1	41.6
1893	46.1	47.8	92.0	39.4	33.2	42.5	46.8	45.1	45.6
1894	44.9	51.6	88.3	43.6		45.8	60.2	51.9	52.7
1895	55.8	55.6	85.3	46.6	82.2	51.1	62.2	57.5	58.1
1896	56.7	63.9	78.3	50.7		61.1	71.0	65.1	65.9
1897	62.9	72.1	81.2	54.9	125.7	61.2	77.0	69.7	70.9
1898	71.1	84.8	82.6	57.0		63.6	68.9	69.4	70.0
1899	77.9	96.8	83.3	59.9		72.0	72.5	75.4	76.2
1900	90.1	105.7	83.7	71.3	104.4	76.7	68.9	77.9	78.8
1901	97.5	101.1	84.5	81.8		79.3	73.6	82.1	82.7
1902	94.7	93.6	77.6	82.6		85.7	80.3	85.8	86.1
1903	93.7	95.0	78.1	83.7		88.5	83.3	88.0	88.2
1904	99.8	108.4	77.4	83.4		89.7	85.8	91.0	91.4
1905	79.2	90.8	74.7	81.8	101.6	84.3	86.6	85.1	85.2
1906	88.6	93.5	82.5	89.3		88.3	89.6	89.5	89.6
1907	99.7	99.3	88.3	91.6		95.3	104.5	99.7	99.8
1908	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1909	104.9	108.2	114.2	103.3		100.7	104.1	104.2	104.3
1910	104.1	116.0	128.9	115.8	132.7	104.7	98.0	105.0	105.4
1911	107.4	135.0	129.5	124.4	156.6	103.7	115.1	114.2	114.9
1912	113.3	156.0	130.5	130.2	177.1	119.6	115.9	122.4	123.3
1913	122.6	169.9	133.3	137.3	224.2	136.2	111.6	129.2	131.2

Source : The author's estimates.

Table 5　Comparison of Estimated Average Annual Rates of Growth

	Kondrat'ev geomean	Kondrat'ev arithmean	Kafengauz	Goldsmith imputed	Goldsmiith unadjusted	Nutter	Suhara 2013	Suhara geomean 2018	Suhara arithmean 2018
1860–1887	7.6 (6.0)	5.4 (4.2)		5.1 (4.3)	4.6 (4.0)	4.6	4.2	5.8	4.0
1887–1913	5.6	5.3 (5.1)	6.7	5.0	4.8	6.6	5.2	5.1	4.9
1860–1913	6.7 (5.8)	5.2 (4.6)		5.3 (4.7)	4.9 (4.4)	5.6	4.7	5.5	4.5

Note: Calculated based on the following sources. Figures in parentheses are corrected rates by Suhara. Estimates by Nutter are not average annual rates for 1860-87 and 1887-1913, but for 1860-1885 and 1885-1913, respectively.

Source: Goldsmith (1961, pp. 462-463, 465); Gregory (1999, p. 493); Nutter (1962, p. 345); Suhara (2013, p. 532).

Table 6　Total Output of Grain and Potatoes, 1858-1913

(50 Provinces of European Russia, thousand tons)

	Wheat			Rye			Oats	Barley	Emmer	Buckwheat	Corn	Peas	Millet	Total Grains	Potatoes
	Winter Wheat	Spring Wheat	Total	Winter Rye	Spring Rye	Total									
Prices in 1913	66.8	64.1	64.8			50.7	44.0	48.2	42.9	48.8	42.6	68.4	42.1	52.3	16.5
1858														235,300	3,226
1859														170,300	3,604
1860														221,900	3,150
1861														214,200	3,619
1862														209,500	3,195
1863														245,200	4,271
1864														195,000	3,635
1865														179,700	3,604
1866														220,600	3,392
1867														192,900	3,423
1868														209,200	3,604
1869														204,600	4,483
1870														283,700	5,179
1871			4,629			13,297	5,783	1,916		1,057				223,324	4,634
1872			3,895			12,555	8,101	2,295		1,554				246,053	6,633
1873			3,757			13,990	6,809	2,245		1,349				239,920	5,679
1874			6,150			16,025	7,005	2,213		1,327				271,052	5,830
1875			3,488			12,209	5,880	1,886		833				208,494	5,664
1876			3,768			11,928	7,674	2,515		1,502				240,028	6,785
1877			6,117			14,153	7,290	2,534		1,513				267,146	6,512
1878			4,592			16,188	7,899	2,400		1,553				276,961	6,936
1879			3,988			12,307	7,687	2,353		1,206				239,668	5,982
1880			3,576			11,113	7,149	2,168		1,318				221,855	7,118
1881														296,100	8,208
1882														257,900	8,284
1883	1,416	4,444	5,860			13,156	8,920	2,925	242	1,463	515	540	1,352	34,973	6,750
1884	2,063	4,847	6,910			16,507	7,764	2,891	214	1,274	430	415	1,200	37,606	7,520
1885	1,995	2,606	4,601			16,814	6,043	2,158	152	794	456	293	609	31,920	6,194
1886	1,040	3,183	4,223			15,885	8,848	2,875	195	1,470	600	519	1,664	36,281	7,117
1887	2,555	4,646	7,201			17,839	9,606	3,616	165	1,148	342	517	1,362	41,796	8,014
1888	3,184	4,847	8,031			18,046	8,778	3,952	230	1,017	738	477	1,513	42,782	8,363
1889	1,078	3,533	4,612	13,011	211	13,221	7,602	2,491	185	1,192	300	407	867	30,878	7,706
1890	2,053	3,393	5,446	15,947	182	16,130	8,356	3,447	196	836	641	411	1,375	36,838	8,369
1891	1,532	2,837	4,369	11,746	192	11,937	6,600	2,959	110	761	765	334	933	28,768	7,327
1892	1,770	4,511	6,281	13,970	161	14,132	6,783	3,690	143	880	572	429	1,549	34,459	11,742
1893	2,134	7,492	9,626	17,186	233	17,419	10,207	6,473	231	969	1,034	620	2,179	48,758	14,637
1894	2,793	6,451	9,244	20,393	183	20,576	10,194	5,162	231	810	492	734	1,188	48,630	13,570
1895	2,757	5,197	7,954	18,068	168	18,237	9,782	4,577	236	793	633	711	1,131	44,056	14,899
1896	2,150	6,026	8,176	17,676	130	17,805	9,710	4,538	341	868	436	609	2,064	44,547	17,025
1897	1,395	5,097	4,780	14,823	104	14,927	7,944	4,428	233	868	1,155	515	1,199	36,050	15,996
1898	2,594	6,502	9,096	20,246	145	20,391	8,127	5,545	90	867	1,004	508	1,662	47,291	16,992
1899	2,079	5,888	7,967	21,566	120	21,686	12,187	3,916	281	1,079	575	578	1,900	50,168	17,818
1900	2,051	6,636	8,687	20,936	117	21,052	10,799	4,076	243	808	649	565	1,438	48,317	16,887
1901	3,306	5,403	8,708	17,157	120	17,278	7,658	4,124	108	693	1,544	345	1,347	41,805	15,429
1902	3,988	8,619	12,607	20,469	119	20,588	11,726	5,985	221	1,238	1,026	576	2,581	56,549	19,688
1903	3,484	8,888	12,372	20,264	140	20,404	9,440	6,307	142	767	1,026	469	1,613	52,540	18,379
1904	3,392	10,758	14,151	22,542	146	22,688	14,603	6,330	472	910	481	689	1,223	61,546	19,191
1905	3,573	8,710	12,283	15,871	123	15,994	11,141	6,101	317	894	572	469	1,279	49,048	18,683
1906	4,140	5,243	9,383	14,006	109	14,115	7,909	5,318	68	880	1,507	426	1,317	40,924	17,151
1907	2,328	6,936	9,264	17,514	96	17,609	10,593	6,048	108	924	1,064	477	1,810	47,898	18,920
1908	1,986	8,437	10,424	16,999	114	17,113	10,792	6,481	165	891	1,261	482	1,599	49,208	18,573
1909	3,187	12,783	15,970	19,763	127	19,890	13,941	8,325	334	1,036	742	662	2,131	63,031	20,818
1910	3,759	11,265	15,024	18,940	118	19,058	12,624	8,030	234	1,116	1,602	637	2,175	60,501	24,443
1911	3,099	6,327	9,426	16,219	92	16,311	10,026	6,988	52	998	1,723	553	1,310	47,387	23,163
1912	3,642	9,214	12,856	22,976	98	23,074	12,523	7,722	110	1,158	1,598	737	2,123	61,900	25,195
1913	4,498	13,363	17,862	22,007	160	22,167	14,383	9,528	159	1,066	1,519	733	2,073	69,489	23,786

Note: The unit for "total grains" until 1882 is thousand *chetvert*'s. Note that the 1883 grains total of 34,973 thousand tons is equivalent to 280,419 thousand *chetvert*'s. Conversion coefficients in unit from *chetvert*'s to tons are calculated using production data of output in 1890-93, for which data both in *chetvert*'s and tons are available for each product. Prices in 1913 are shown in rubles per metric ton.

Source: Nifontov (1974, pp. 117, 183, 185), for 1858-82; *Statistika Russiiskoi Imperii*, various issues, for 1883-1913; Falkus (1968, p. 64), for prices.

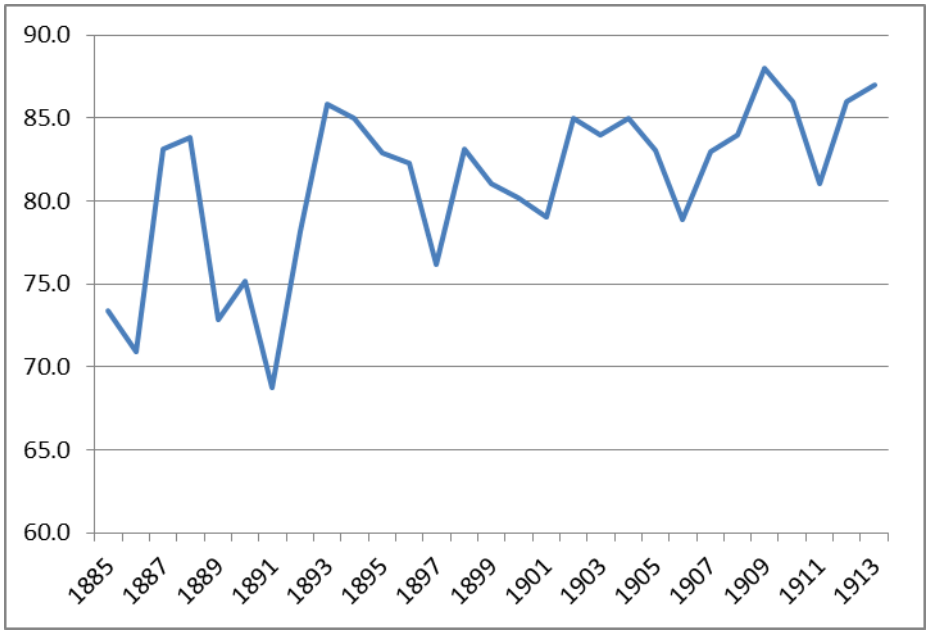
Table 7　Gross and Net Production Index for Imperial Russian Crop Farming

	Gross Production Index		Net Production Ratio (%)					Net Production				Net Production Value					
	(1) Based on all grains and potatoes	(2) Based on 3 main grains and potatoes	Three Main Products	Wheat	Rye	Barley	Potatoes	(3) Grains, 1000 chetvelt's	(4) Potatoes, 1000 chetvelt's	(5) Weighted Average of (3) and (4)	Index 1860=100	(6) Wheat, million rubles	(7) Rye, million rubles	(8) Barley, million rubles	(9) Potatoes, million rubles	(10) Total of (6) (7) (8) and (9)	Net Production Index 1860=100
1860	100.0	100.0	72.3				73.6	160,485	15,304	125,687	100						100
1861	97.1	97.1	71.8				74.6	153,772	17,841	121,190	96.4						96.4
1862	94.6	94.6	71.2				73.3	149,268	15,458	117,195	93.2						93.2
1863	111.2	111.2	75.0				76.6	183,820	21,603	144,939	115.3						115.3
1864	88.7	88.7	71.1				74.9	138,592	17,979	109,682	87.3						87.3
1865	81.9	81.9	70.2				74.8	126,131	17,799	100,165	79.7						79.7
1866	99.7	99.7	74.6				74.6	164,637	16,717	129,182	102.8						102.8
1867	87.6	87.6	72.3				74.3	139,527	16,792	110,109	87.6						87.6
1868	94.9	94.9	72.3				74.1	151,199	17,628	119,184	94.8						94.8
1869	93.6	93.6	72.1				76.1	147,492	22,532	117,540	93.5						93.5
1870	128.9	128.9	77.4				76.3	219,548	26,096	173,180	137.8						137.8
1871	102.0	102.0	72.8				74.1	162,661	22,671	129,107	102.7						102.7
1872	108.5	98.9	73.8	72.1	73.6	76.0	78.0	181,690	34,177	146,333	116.4	182.0	468.3	84.1	85.3	819.8	116.4
1873	107.0	103.0		70.9	75.3	76.2	76.0					172.5	533.8	82.6	71.2	860.0	122.1
1874	125.8	126.2		79.6	78.3	75.3	75.6					317.1	636.1	80.4	72.6	1106.3	157.1
1875	93.5	91.8		69.4	73.3	72.6	75.4					156.9	453.2	66.1	70.4	746.6	106.0
1876	105.1	96.5		70.4	72.5	77.5	77.3					171.8	438.3	94.0	86.4	790.5	112.3
1877	122.3	119.9		79.8	76.7	77.7	76.8					316.2	550.0	95.0	82.5	1043.7	148.2
1878	124.7	120.3		75.4	79.7	76.7	77.2					224.2	653.8	88.7	88.2	1055.0	149.8
1879	105.0	97.7	74.6	74.8	74.8	77.2	75.0	178,773	29,613	143,021	113.8	193.3	466.6	87.6	73.9	821.4	116.7
1880	98.2	90.7	73.6				76.6	163,260	36,014	132,760	105.6						108.3
1881	130.0	120.1	79.1				78.6	234,239	42,611	188,308	149.8						153.6
1882	114.2	105.5	76.0				78.3	196,061	42,853	159,338	126.8						130.0
1883	122.2	112.9	77.5				76.2	217,286	33,974	173,348	137.9						141.4
1884	133.2	134.6	78.7	79.5	78.3	79.8	78.1	231,136	38,773	185,028	147.2	356.0	655.1	111.3	96.8	1219.1	150.9
1885	112.3	118.1		73.4	79.6	71.9	77.4					218.8	678.0	74.8	79.1	1050.7	130.1
1886	125.2	116.0		71.0	78.4	78.6	79.1					194.2	631.0	109.0	92.8	1027.0	127.1
1887	147.1	146.0		83.2	80.6	82.1	80.1					388.0	728.3	143.1	105.9	1365.4	169.0
1888	151.5	153.6		83.9	79.6	81.0	76.2					436.4	728.0	154.4	105.1	1423.8	176.3
1889	109.6	105.7		72.8	74.0	74.0	77.3					217.6	495.7	88.9	98.2	900.3	111.5
1890	129.9	128.4		75.1	77.6	79.9	76.9					265.1	634.6	132.8	106.1	1138.6	140.9
1891	102.2	100.2		68.8	70.0	77.4	71.7					194.7	423.6	110.5	86.7	815.5	101.0
1892	127.0	130.0		78.2	76.8	78.4	78.1					318.3	550.0	139.4	151.1	1158.9	143.5
1893	177.6	179.0		85.9	81.2	87.6	80.7					535.6	716.6	273.4	194.7	1720.3	213.0
1894	177.0	183.9		85.0	83.1	85.1	78.5					509.0	865.9	212.0	175.6	1762.5	218.2
1895	162.5	165.9		82.9	81.6	83.2	80.6					427.4	753.7	183.7	197.8	1562.7	193.4
1896	165.9	168.0		82.3	80.9	82.2	79.5					435.9	729.8	179.9	223.2	1568.9	194.2
1897	141.8	143.8		76.2	76.5	81.4	78.7					235.9	578.6	173.9	207.5	1195.9	148.0
1898	176.2	188.8		83.2	80.1	84.9	79.0					490.1	828.1	227.1	221.2	1766.6	218.7
1899	184.0	182.4		81.0	82.9	79.3	79.0					418.3	911.4	149.8	232.1	1711.6	211.9
1900	178.4	183.0		80.2	82.9	82.9	83.0					451.3	884.1	163.1	231.0	1729.5	214.1
1901	156.5	164.9		79.0	79.0	78.9	79.0					446.0	692.0	157.0	200.9	1496.0	185.2
1902	210.6	215.3		85.0	83.0	86.1	80.0					694.3	865.7	248.6	259.6	2068.2	256.0
1903	197.2	212.5		84.0	82.0	86.0	80.0					673.1	847.6	261.6	242.4	2024.7	250.6
1904	227.4	233.7		85.0	85.0	85.0	80.0					779.4	977.6	259.7	253.1	2269.8	281.0
1905	185.6	192.1		83.0	81.0	84.0	81.0					660.8	656.3	247.2	249.5	1813.7	224.5
1906	156.0	162.4		78.9	79.0	80.0	79.0					479.5	565.0	205.1	223.3	1472.9	182.3
1907	179.0	182.3		82.9	80.0	84.0	80.0					497.9	713.8	245.1	249.5	1706.3	211.2
1908	183.7	187.8		84.0	81.1	85.0	80.0					567.3	702.9	265.8	245.0	1780.9	220.5
1909	234.9	242.2		88.0	83.0	90.0	82.0					910.6	836.7	361.2	281.4	2389.8	295.8
1910	229.9	237.3		86.0	84.0	87.9	82.0					836.9	811.4	340.6	330.6	2319.5	287.1
1911	182.3	187.7		81.0	80.0	83.1	80.3					494.9	661.4	279.9	306.4	1742.6	215.7
1912	233.7	242.7		86.0	85.0	87.0	80.0					716.3	994.0	324.0	332.2	2366.4	292.9
1913	260.6	272.3		87.0	85.0	90.0	78.0					1006.7	954.9	413.6	305.8	2681.1	331.9

Note: Net production ratios for 1860-1884 (indicated by a single underline) are estimates by the author.

Source: See the text.

Figure 1　Net Production Ratio (%): The Case of Wheat



Source: Calculated based on Gregory (1982, p. 232).

Table 8 Calculations of Value-added Production Index for Livestock Farming (50 Provinces of European Russia)

	Livestock Animal Number (millions)				National Income from Livestock Farming (million rubles)				Total	Index
	Cattle	Pigs	Sheep	Horses	Cattle	Pigs	Sheep	Horses	Income	1864=100
1864	21.0	9.4	43.3	14.7	767.3	197.6	269.0	13.5	1247.4	100
1866	21.0	9.4	44.2	15.5	766.0	197.7	274.8	14.2	1252.8	100.4
1870	21.4	9.1	45.3	15.6	780.6	191.4	281.6	14.3	1268.0	101.7
1877	27.3	10.8	51.8	17.6	995.9	227.2	322.1	16.1	1561.2	125.2
1882	23.8	9.2	47.5	20.0	868.2	193.5	295.3	18.3	1375.4	110.3
1883	23.6	9.4	46.7	17.9	860.9	197.7	290.4	16.4	1365.4	109.5
1888	24.6	9.2	44.5	19.7	897.4	193.5	276.7	18.1	1385.6	111.1
1890	25.5	9.6	46.1	19.8	930.2	202.0	286.6	18.2	1436.9	115.2
1891	25.3	9.6	39.8	17.3	922.9	202.0	247.5	15.9	1388.2	111.3
1892	24.0	8.8	40.0	16.6	875.5	185.1	248.7	15.2	1324.5	106.2
1894	24.1	8.8	37.3	16.7	879.1	185.1	231.9	15.3	1311.5	105.1
1895	24.5	9.2	38.2	17.0	893.7	193.5	237.5	15.6	1340.3	107.5
1896	29.5	13.3	46.4	18.8	1076.1	279.8	288.5	17.2	1661.6	133.2
1897	30.7	12.9	45.8	18.8	1119.9	271.4	284.8	17.2	1693.2	135.7
1898	30.2	12.0	46.3	19.1	1101.6	252.4	287.9	17.5	1659.5	133.0
1899	30.9	11.6	45.5	19.6	1127.2	244.0	282.9	18.0	1672.1	134.0
1900	31.7	11.8	47.6	19.7	1156.4	248.2	295.9	18.1	1718.6	137.8
1901	31.9	12.1	38.8	20.2	1163.7	254.5	241.2	18.5	1678.0	134.5
1902	32.2	11.6	47.8	20.5	1174.6	244.0	297.2	18.8	1734.6	139.1
1903	31.8	11.4	46.9	20.3	1160.0	239.8	291.6	18.6	1710.0	137.1
1904	31.9	12.0	46.5	20.7	1163.7	252.4	289.1	19.0	1724.2	138.2
1905	31.2	11.5	45.4	20.8	1138.1	241.9	282.3	19.1	1681.4	134.8
1906	30.5	11.9	42.2	20.5	1112.6	250.3	262.4	18.8	1644.1	131.8
1907	29.7	11.6	40.7	20.5	1083.4	244.0	253.0	18.8	1599.3	128.2
1908	29.7	11.4	39.9	20.6	1083.4	239.8	248.1	18.9	1590.2	127.5
1909	30.5	11.3	39.9	21.3	1112.6	237.7	248.1	19.5	1617.9	129.7
1910	31.3	12.0	40.7	21.9	1141.8	252.4	253.0	20.1	1667.3	133.7
1911	31.0	12.7	40.2	21.8	1130.8	267.2	249.9	20.0	1667.9	133.7
1912	31.0	12.6	39.6	22.1	1130.8	265.1	246.2	20.3	1662.4	133.3
1913	32.0	13.5	41.4	22.8	1167.3	284.0	257.4	20.9	1729.6	138.7

Note: See the text for the estimation method.

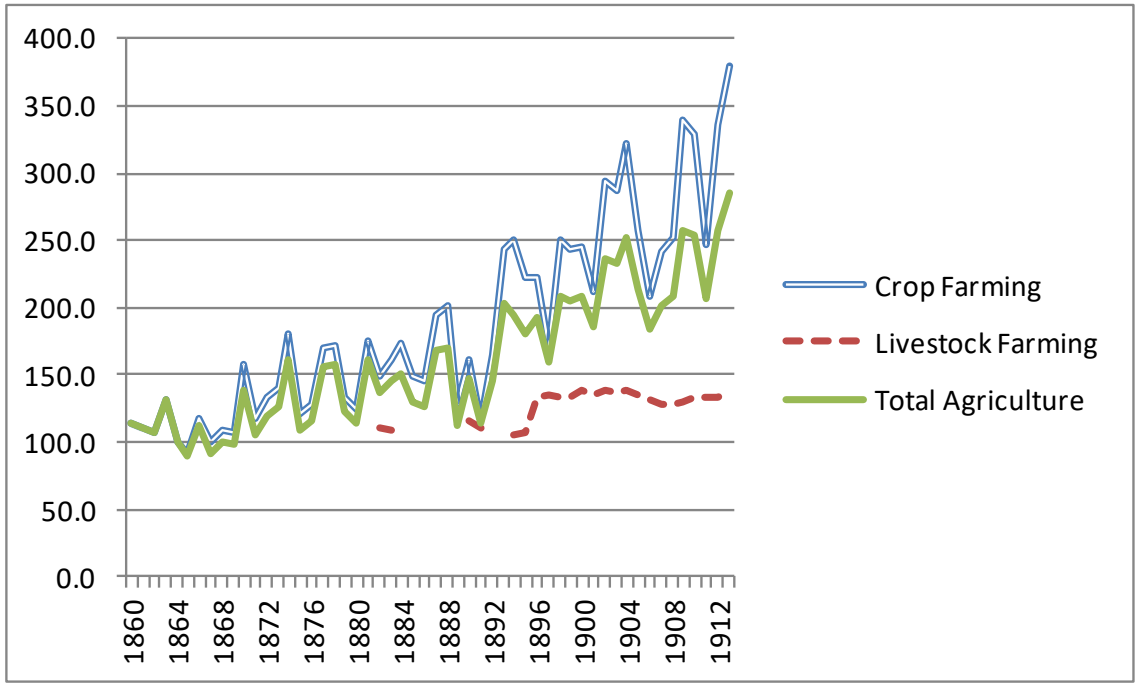
Source: *Statisticheskii Vremennik Rossiiskoi Imperii*, 1866 edition, otdel vtoroi, pp. 242-243, for the numbers for 1864; Mitchell (2007, p.394), for the numbers for other years.

Table 9　Net Production Index for Agriculture

	Crop Farming	Crop Farming 1864=100	Livestock Farming	Total Agriculture 1864=100	Total Agriculture		Crop Farming	Crop Farming 1864=100	Livestock Farming	Total Agriculture 1864=100	Total Agriculture
1860	100.0	114.6		114.6	100.0	1887	169.0	193.7		168.1	146.7
1861	96.4	110.5		110.5	96.4	1888	176.3	202.0	111.1	170.2	148.5
1862	93.2	106.9		106.9	93.2	1889	111.5	127.7		111.7	97.5
1863	115.3	132.1		132.1	115.3	1890	140.9	161.5	115.2	146.6	128.0
1864	87.3	100.0	100.0	100.0	87.3	1891	101.0	115.7	111.3	114.4	99.8
1865	79.7	91.3		89.3	77.9	1892	143.5	164.4	106.2	145.1	126.6
1866	102.8	117.8	100.4	112.5	98.2	1893	213.0	244.0		202.5	176.7
1867	87.6	100.4		92.1	80.4	1894	218.2	250.0	105.1	195.1	170.3
1868	94.8	108.7		99.7	87.0	1895	193.4	221.7	107.5	180.2	157.2
1869	93.5	107.2		98.4	85.8	1896	194.2	222.6	133.2	192.1	167.7
1870	137.8	157.9	101.7	139.2	121.5	1897	148.0	169.6	135.7	159.2	138.9
1871	102.7	117.7		105.8	92.3	1898	218.7	250.6	133.0	209.1	182.4
1872	116.4	133.4		119.9	104.6	1899	211.9	242.8	134.0	204.8	178.7
1873	122.1	139.9		125.8	109.8	1900	214.1	245.3	137.8	208.0	181.5
1874	157.1	180.0		161.8	141.2	1901	185.2	212.2	134.5	186.2	162.5
1875	106.0	121.5		109.2	95.3	1902	256.0	293.4	139.1	236.9	206.8
1876	112.3	128.6		115.6	100.9	1903	250.6	287.2	137.1	232.4	202.8
1877	148.2	169.9	125.2	155.6	135.8	1904	281.0	322.0	138.2	252.8	220.6
1878	149.8	171.7		157.4	137.4	1905	224.5	257.3	134.8	213.8	186.6
1879	116.7	133.7		122.6	107.0	1906	182.3	208.9	131.8	183.1	159.8
1880	108.3	124.1		113.8	99.3	1907	211.2	242.0	128.2	201.8	176.1
1881	153.6	176.0		161.4	140.8	1908	220.5	252.6	127.5	207.7	181.3
1882	130.0	148.9	110.3	136.6	119.2	1909	295.8	339.0	129.7	257.5	224.7
1883	141.4	162.0	109.5	144.8	126.4	1910	287.1	329.0	133.7	254.2	221.9
1884	150.9	172.9		150.1	131.0	1911	215.7	247.2	133.7	207.3	180.9
1885	130.1	149.0		129.4	112.9	1912	292.9	335.7	133.3	257.7	224.9
1886	127.1	145.7		126.4	110.3	1913	331.9	380.3	138.7	284.9	248.6

Source: See the text for the estimation method.

Figure 2　Net Production Index for Agriculture (Values for 1864 = 100)



Source: Table 9.

Table 10　Estimations of National Income in 1913 (million rubles, 1913 prices)

	Falkus (1968)				Prokopovich (1918)		Prokopovich (1931)		Gosplan (1927)	
	Gross National Income	%	Gross National Income	%	Net National Income	%	Net National Income	%	Net National Income	%
	Empire		50 Provinces		50 Provinces		50 Provinces		Empire	
Agriculture	9304.5	48.3	6540.4	47.7	5630.2	47.7	5427	51.6	6720	46.2
Forestry	1067.0	5.5	632.1	4.6	632.1	5.4	632	6.0	661	4.5
Fishing & Hunting	257.9	1.3	146.9	1.1	97.9	0.8	98	0.9	244	1.7
Industry, Large	3215.5	16.7	2603.0	19.0	1665.0	14.1	1504	14.3	2541	17.5
Industry, Small	1346.1	7.0	803.6	5.9	901.6	7.6	879	8.4	742	5.1
Construction	1142.0	5.9	860.1	6.3	842.7	7.1	368	3.5	573	3.9
Trade	1639.7	8.5	1295.0	9.4	981.0	8.3	950	9.0	1126	7.7
Transport and others	1288.7	6.7	842.4	6.1	1055.1	8.9	665	6.3	1931	13.3
Total	19261.4	100.0	13723.5	100.0	11805.6	100.0	10523	100.0	14538	100.0

Source: Falkus (1968, p. 62); Vainshtein (1969, p. 68).

Table 11　Estimates of GDP Index for Imperial Russia, 1860-1913

	Max	Min	Average		Max	Min	Average
1860	100.0	100.0	100.0	1887	214.0	197.0	205.3
1861	98.4	98.0	98.2	1888	213.0	196.8	204.8
1862	85.0	86.7	85.8	1889	167.8	148.9	158.1
1863	100.3	103.4	101.8	1890	198.7	180.4	189.4
1864	88.6	88.3	88.5	1891	170.8	151.8	161.0
1865	81.2	80.5	80.8	1892	203.2	183.1	192.9
1866	100.9	100.3	100.6	1893	262.1	240.4	251.0
1867	93.5	90.5	92.0	1894	267.8	242.5	254.8
1868	95.9	93.8	94.8	1895	262.6	234.6	248.2
1869	99.3	96.2	97.7	1896	285.6	254.1	269.4
1870	125.6	124.7	125.1	1897	257.4	224.8	240.6
1871	109.3	105.3	107.3	1898	308.6	275.0	291.3
1872	119.9	116.3	118.1	1899	312.8	276.7	294.2
1873	125.5	121.9	123.7	1900	319.5	282.2	300.3
1874	154.2	151.2	152.7	1901	301.8	263.5	282.0
1875	121.9	115.5	118.6	1902	360.0	318.7	338.7
1876	126.1	120.1	123.1	1903	358.2	316.2	336.6
1877	155.2	150.7	152.9	1904	383.3	339.5	360.7
1878	167.1	160.1	163.5	1905	335.0	294.6	314.2
1879	145.2	135.8	140.4	1906	307.0	266.1	285.8
1880	137.6	128.1	132.8	1907	339.5	294.0	315.9
1881	184.4	173.8	179.0	1908	346.5	300.6	322.7
1882	167.0	155.1	161.0	1909	405.7	356.4	380.3
1883	177.6	164.8	171.1	1910	403.3	353.8	377.7
1884	181.3	168.9	175.0	1911	361.6	310.6	335.1
1885	167.8	153.8	160.7	1912	428.0	371.7	398.9
1886	171.4	155.6	163.3	1913	466.0	406.1	435.0

Note: See the text for the estimation method.

Table 12　Average Annual Growth Rates of Our Indices：1860-1913 (%)

	Factory Industry	Crop Farming	Livestock Farming	Total Agriculture	Maximum GDP	Minimum GDP	Average GDP
Based on index numbers for 1860 and 1913	5.50	2.29	0.67	1.73	2.95	2.68	2.81
Based on log-linear regression	6.05	2.14	0.68	1.75	3.17	2.86	3.01

Note: For "Livestock Farming," calculated based on index values for 1864-1913.

Source: Tables 4, 9, 11 in this paper.

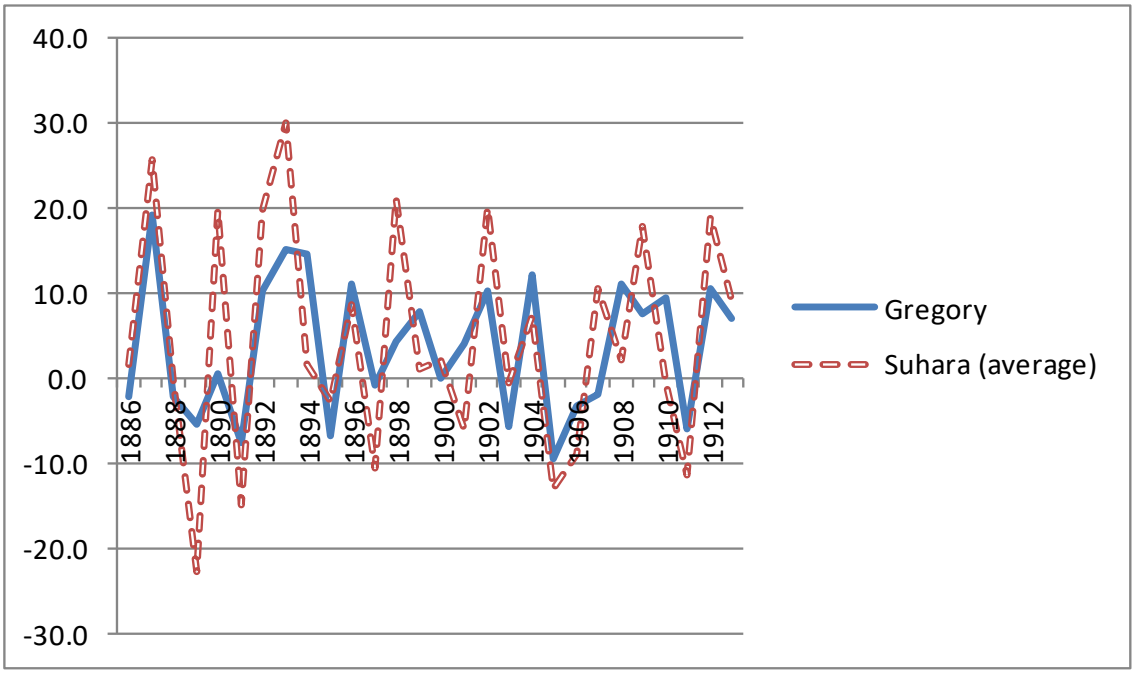
Table 13　Comparison of Estimation Results of GDP Index for Imperial Russia

Estimation Period	Author	Publication Year	Annual Growth (%)
1900-1913	Prokopovich	1918	2.6
	Falkus-Prokopovich	1968	3.1
	Varzar	1929?	3.1
	Goldsmith	1961	2.4
	Gregory	1982	3.3
	Suhara	2018	2.9
1885-1913	Goldsmith	1961	2.8
	Varzar	1929?	3.3
	Gregory	1982	3.4
	Suhara	2018	3.6
1870-1913	Maddison	2003	2.4
	Suhara	2018	2.9
1860-1913	Goldsmith	1961	2.5
	Suhara	2018	2.8

Note: Growth rates of the Suhara index are calculated based on the average of the maximum and minimum indices in Table 11.

Source: Goldsmith (1961, p. 474); Gregory (1982, p. 71); Maddison (2003, p. 96); Table 11 in this paper.

Figure 3　Annual Growth Rates of GDP for Imperial Russia



Source: Gregory (1982, pp. 56-57); Table 11 in this paper.

Table 14　Comparison of Growth Rates of GDP and Population in Selected Countries

	USA	UK	France	Germany	Italy	Spain	Brazil	China	India	Japan	Russia
GDP											
1860–1913	3.9	1.9	1.4	2.7	1.8	1.5					2.8
1870–1913	3.9	1.9	1.6	2.8	1.9	1.8	2.4	0.6	1.0	2.4	2.9
Population											
1860–1913	2.1	0.9	0.2	1.1	0.7	0.5					1.6
1870–1913	2.1	0.9	0.2	1.2	0.7	0.5	2.1	0.5	0.4	0.9	1.7

Note: GDP growth rates for Russia are calculated based on the average of the maximum and minimum indices. Population growth in Russia is that for 50 provinces of European Russia.

Source: Maddison (2003, pp. 34-37, 42, 43, 46-49, 54, 55, 81, 82, 84, 85, 121, 132, 160, 170); Mitchell (2007, pp. 84, 86); Table 11 in this paper.