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Andrei Markevich
Mark Harrison

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Andrei Markevich**
New Economic School, Moscow
Department of Economics, University of Warwick

Mark Harrison***
Department of Economics, University of Warwick
Centre for Russian and East European Studies, University of Birmingham
Hoover Institution on War, Revolution, and Peace, Stanford University

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** Mail: New Economic School, Suite 1721, Nakhimovskii Prospekt 47, 117418 Moscow, Russia. E-mail: amarkevich@nes.ru.

*** Mail: Department of Economics, University of Warwick, Coventry CV4 7AL, United Kingdom. Email: mark.harrison@warwick.ac.uk.

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Abstract

We are working towards filling the last remaining gap in the historical national accounts of Russia and the USSR in the twentieth century. The gap includes the Great War (1914 to 1917), the Bolshevik Revolution, the Civil War and War Communism (1918 to 1921), and postwar recovery under the New Economic Policy of a mixed economy (1921 to 1928). Our work builds on our predecessors and also returns to a number of original sources. We find that the economic performance of the Russian Empire in wartime was somewhat better than previously thought; that of War Communism was correspondingly worse. We confirm the persistence of losses associated with the Civil War into the postwar period, or the failure of the New Economic Policy to achieve full recovery, or some mixture of both. We conclude that the Great War and Civil War produced the deepest economic trauma of Russia's troubled twentieth century.

Keywords: Civil War, GDP, Russia, Soviet Union, World War I.

JEL Codes: E20, N14, N44, O52.

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The Great War, the Revolution, and the Civil War that followed it had, without question, a great impact on the economic life of Russia's citizens. When we try to measure this impact, however, there is a gap in the records. Paul R. Gregory (1980) has provided our best measure of the real national income of the Russian Empire, (GNP by final uses, finishing in 1913). The record begins again in 1928 with the GNP of the USSR measured by Abram Bergson (1961) (GNP by final uses in 1928 and subsequent benchmark years) and Moorsteen and Powell (1966) (GNP by sector of origin, 1928 and annually thereafter), summarized by Ofer (1987).

Why does this gap matter? The real national income of a country is, after all, only one dimension of its national experience. In this case, however, it is a missing dimension. Without it, we cannot offer conclusive judgments about the performance of Russia's wartime economy. Nor can we compare the relative merits of economic mobilization under the old and revolutionary regimes. And it is not easy to judge the pace of the postwar recovery when we do not know exactly the scale of the catastrophe that recovery was from.

It is also important to understand the starting point of Soviet industrialization under Stalin's five-year plans. By 1928, was the Soviet recovery from Russia's Great War and Revolution complete, adjusted for territorial change? Had national income per head, on average, returned to its 1913 benchmark by 1928? The answer has a clear bearing on the success or otherwise of Stalin's early five-year plans.

Gregory (1980, 1990) built a glass bridge across the gap in the sense of providing estimates of Soviet real national income in 1928 relative to 1913. As Table 1 shows, he found that by 1928 real national income exceeded the 1913 level (within Soviet frontiers) by at most 7 percent; since the population on that territory increased by more, average incomes declined somewhat over the years that lay between.

It is sometimes objected that such averages have little meaning, precisely because they are averages. To us, this misses the point. When we consider particular groups of the population, such as richer and poorer peasants, skilled and unskilled workers, female domestic workers, war workers, and soldiers, the average allows us to place their experiences in context. We can identify them as typical or untypical. Not only does it allow us to judge whether a person or group was (or became) better or worse off than the average. Deviations from the mean in one direction also allow us to infer the existence of compensating deviations in the other.

The gap remains in the sense that we continue to lack annual series for the traumatic years of world war, civil war, and recovery. We have estimates for the GNP of the Russian Empire up to 1916, provided originally by Prokopovich (1931) and revised by Gatrell (2005). We also have attempts to calculate GDP for particular years, namely for the economic years (October to September) 1922/23 and 1923/24 by Litoshenko (1925) and 1922/23 by Gukhman (1925, 1928). For 1920 and 1928 we

have sectoral index numbers (but only for agriculture, industry and transport, not for all sectors) calculated by Nutter (1963).

In this paper, we first review the legacy of our predecessors. On that basis we reflect, secondly, on general issues in the literature (including the relationship, if any, between national income and welfare), and on the contributions we can hope to make. Third, we consider the economic and demographic challenges presented by the changing borders of Russia and the Soviet Union. In the fourth section we discuss Russia's national income in 1913, our chosen base year. The fifth section sets out our view of the sectoral data from which we build up output by sector of origin. Sixth, we present our detailed results and review their implications. In the seventh section we place these results in the context of more than a century of Russian and Soviet economic growth. The final section concludes.

1. Starting Points

The Russian literature in this field starts from Prokopovich (1918a,b). His estimates of Russian empire GDP by sector of origin in 1913, and of the changes in imperial industry and agriculture over the war years, shown in Table 2, formed the starting point for all future scholars.

Under Soviet rule, national accountants at first found themselves in a relatively privileged position: there was a huge effort of data collection running to many statistical volumes published mainly by the Soviet central statistical agency (TsSU), and also by the production branch ministries (VSNKh and others). Soviet statisticians and economists used these data to evaluate the depth of the wartime crisis and the rate of recovery from it.

Litoshenko's (1925) estimate of national income in 1922/23 and 1923/24 (Table 3) was the only one to work from "social tables," aggregating the personal incomes of socially defined sub-groups of the population; other scholars worked on a sector-of-origin basis, as we will. Gukhman (1928) produced an estimate for 1922/23 (Table 4); his main concern was to adjust for the postwar change in relative prices known as the "price scissors." Finally, under Strumilin's leadership Gosplan (1929) estimated Soviet GDP for 1927/28, and this became an official Soviet figure for many years. Meanwhile, Kafengaus (1994/1930) prepared annual series of industrial products and a general index of large-scale industry over the forty years from 1887 to 1927; his book was prepared for publication in 1930 but suppressed following his arrest. Vorob'ev (1923) contributed a study of large-scale industry during the Great War, based on the 1918 industrial census.

The emergence of Stalin's dictatorship in 1929 put a stop to publication on this theme. With one exception, Soviet specialists turned away from the problem of national income to the mobilization of industry and labour (Sidorov 1973 illustrates this at its best). The outstanding exception was Al'bert Vainshtein (1960, 1969), who resumed his work on the topic after returning from the Gulag. Starting from Russia's national wealth in 1914, Vainshtein reviewed all previous attempts on Russian and Soviet GDP, and explored some vital questions concerning the quality of Russian Empire statistics. He proposed adjustments for border changes from the Russian

Empire to the Soviet Union, and offered corrections of the population and livestock figures. The population correction was later investigated by Soviet demographers such as Sifman (1977).

Finally, after the Soviet collapse, Politaev and Savel'eva (2001) provided a comparison of two crises, one in the 1990s and the other in the 1920s.

The Western literature again starts from Prokopovich who, exiled from Russia, made his estimates available in English (Prokopovich 1931). Thereafter, western scholars have divided their attention between the periods before and after 1917. As for the earlier period, the performance of the Russian economy in World War I has been surveyed by Gatrell and Harrison (1993) and Gatrell (2005). Table 5 shows the latter's revised estimate of the trend in Russia's national income through 1917.

On the economy of Soviet Russia from the Bolshevik Revolution through the Civil War, standard English-language sources include Dobb (1949), Carr (1952), Zaleski (1962), Nove (1972), Davies (1989), Malle (1985), Boettke (1990), and Lih (1990). These shared a focus on the evolution of Soviet economic regulation under War Communism, cooperation and conflict with the peasantry, and the transition to the New Economic Policy.

There have also been concerted efforts to understand the quantitative changes in the Soviet economy of 1928 compared with the Russian economy in 1913. The multi-author collections edited by Davies (1990) and Davies, Harrison, and Wheatcroft (1994) included chapters on national income by Gregory (1990), on agriculture by Wheatcroft (1990), on statistics, population, and agriculture by Davies and Wheatcroft (1994a,b,c), on transport by Westwood (1990, 1994), and specifically on the Great War and Civil War by Gatrell (1994). This literature does not yield any overall quantitative summaries of the trend of economic mobilization between 1913 and 1928, however. Nutter's earlier (1963) sectoral production indexes for 1920 and 1928, shown in Table 6, offer at best a partial substitute.

We continue to know little about economic developments on the territories occupied by the Whites and other anti-Bolshevik forces, including the scale of resources mobilized into warfare. Below, we discuss further the difficulty of measuring social welfare when one part of society is fighting another.

2. Our Contributions

Our starting point, therefore, is not a completely blank page, but there are certainly many gaps. To what extent can we expect to fill them? We hope to contribute under three headings.

First, we aim for intertemporal completeness. We plan to fill in all missing years, including some that have never been tackled even at a sectoral level – for example, agricultural output in 1918 and 1919.

Second, we aim to improve conceptually on existing measures of Russian and Soviet wartime GNP. On the output side, GNP should measure the value added by the factors of production engaging in producing all goods and services. To repeat, *goods and services!* It is notable that existing estimates that extend into the period of conflict have neglected most service branches, relying implicitly or explicitly on a

material-product concept of national income, not a goods-and-services concept. Applied to the long run, this approach would make most economic growth in Europe and North America disappear. Even in the short run it would result in significant distortion if the services component of GNP were to change sharply. That is exactly what happens in wartime, when the share of the economy devoted to producing military services is suddenly enlarged.

Third, we will offer explicit consideration of the welfare aspects of warfare. The measurement of GNP in wartime raises ethical issues, discussed recently by Harrison (1996) and Higgs (2006). In principle, GNP should measure the aspect of social welfare that is associated with the supply and demand for goods and services. The reason is that goods and services enter into GNP, valued at prices based – in practice, more or less distantly – on social rates of transformation and substitution. War then presents a paradox, since the trend of GNP is intuitively opposite to that of the trend in welfare. Commonly, at least in the short run, war reduces social welfare, yet wartime mobilization raises GNP, measured on a goods-and-services basis that includes military goods and services. (In the same way, an exogenous increase in crime is likely to reduce welfare while raising expenditures on policing, which contribute positively to measured GNP.)

This paradox can be resolved in two ways. One procedure is surgical: the exclusion of expenditures on national defense from GNP. In this perspective, defense is a cost of maintaining society, not a final use of resources (Higgs 2006). Accordingly, we should redefine defense as an intermediate use of output, and count only civilian goods and services as final contributions to social welfare. On this basis, we would expect to find that the outbreak of war shifts GNP and social welfare in the same direction – downwards.

The surgical procedure is a not unattractive solution, but leaves us with the same problem as with surgery generally: where to stop cutting. On the same criterion we should also remove from GNP the costs of policing, which is an input into personal security. Going further, should we not also remove the value of basic housing, fuel, and food? These too are essential inputs into personal maintenance; without them, people would die off and so society would break down. In other words, housing, fuel, and food are costs of society's upkeep, just like defense; if defense should be removed from GNP, so should they. In fact, just about everything can potentially be removed from GNP on the basis that it is intermediate to some other final goal.

Another problem with this approach is that it would violate statistical conventions that are operated universally on the basis of agreement at the level of the United Nations. Imperfect as these rules may be, it is questionable whether we should deviate from them unilaterally. One result would be to destroy the comparability of measures of Russian economic growth and development over both time and space, and what then is the point of producing them?

Solutions to the paradox are available that allow us reasonably to conserve existing conventions on the measurement of GNP. One involves a thought experiment. When war breaks out welfare declines and GNP rises but, without the increase in GNP, welfare would presumably decline by even more. In this sense the

output generated to wage war contributes positively to social welfare since, in its absence, society would be undefended and so worse off. This is one reason why defense goods and services should count positively in GNP.

There is one powerful objection to this argument: the case of civil war. When one part of a society wages war on each other, what is the “society” that stands to benefit from “national defense”? Civil war is a negative-sum game, since the military spending of each faction is not only to the detriment of the other, but also to the detriment of all. Note that, if this argument applies to civil wars, then it must apply to all wars. If we are one race, the human race, sharing a single planet, then all wars are fratricidal. It is a problem, however, that international relations are governed by a prisoner’s dilemma: conditional on the possibility of international conflict, the dominant strategy of each nation must be to protect its own welfare by force. Thus, we include the military spending of each nation when we aggregate GNPs up to a global measure of economic development – world GNP – despite the fact that military competition is a detriment for the world as a whole. If we apply this logic globally, is there any reason not to extend it to the fractions of society that engage in civil conflict with each other? One reason might be the principle of legitimate force. Under international law it is legitimate for states to maintain armed forces, whereas the preparation of civil war is always a crime under domestic law.

Finally, Abram Bergson (1961) argued cogently that, whether or not it corresponds with actual social welfare, GNP as conventionally measured does at least represent an observation of society’s productive possibilities, or the potential to deliver social welfare under alternative conditions – for example, the absence of war. Objections to this line of reasoning (Rosefielde and Pfouts 1995; Rosefielde 2005) are based primarily on the presumed divergence of Soviet “planned” prices from proportionality of marginal rates of transformation and substitution; these objections do not seem to be compelling, given that our base year is 1913 when Russia was still a relatively free market economy.

We have no original solutions to the paradox of GNP in wartime. Our default is to follow convention so as to produce measures of GNP that, whatever they mean, are at least internationally recognizable and comparable with national accounts of other periods and other countries. At the same time we will, where appropriate, make explicit the welfare implications. This will be our third contribution. Even then, having measured output and incomes, we will not have measured human development, living standards, consumption, or consumption inequality.

3. Territory and Population

Between 1913 and 1928 the country that we are accounting for changed. The Russian Empire disintegrated and was reassembled. During the revolutionary upheaval, Finland, Estonia, Latvia, Lithuania, Poland, and parts of the Ukraine and Belorussia left the Russian Empire. In Central Asia the territories of Khiva and Bukhara were incorporated into the Soviet Union, a process formalized in February 1925 by the creation of the Uzbek and Turkmen union republics (Carr 1959, pp. 288-289). It is customary to set aside Finland and Poland, which were never fully

integrated into the unitary Russian state. Not counting them, by the mid-1920s Moscow had experienced a net loss of territory that, in 1913, had been the home of more than one tenth of the population of the former Empire.

The confusion of border changes raises the question of what national entity and associated territory we should choose for our 1913 baseline. One option is the Russian Empire, excluding Poland and Finland. An advantage of this solution would be rough continuity with the Soviet Union as its territory became after 1945.

Our preferred option is to take the territory of the Soviet state within the frontiers of 1925 to 1939 (“interwar borders”) as our benchmark. This approach has the defect of interfering somewhat with the purpose of accounting for what happened to the old Russia in war and revolution. Its merits are ease of computation in the years after 1917, and the fact that it allows us to look forward more easily to the interwar period and preparations for the next war.

For 1913 to 1917 we provide figures in two formats: for the Russian Empire (excluding Poland and Finland) and for the USSR within interwar borders. We make the latter up either from estimates made retrospectively in the 1920s or, where possible, by ourselves deducting the western regions from the Empire. For population, the transition from one state to the other is detailed in Appendix A (Tables A-1 and A-2). Other transitions are found in the same way in each year of the overlap (agriculture and transport); or in the base year 1913, then interpolating the trend in one territory on the trend in the other (industry, construction, and other civilian sectors); or by assuming a common trend and scaling from one territory to the other on the basis of relative populations (military services); full details are in notes to the relevant tables.

As shown in Table 7, the population of the Russian empire in 1913 was officially some 159 millions; the official number of people living on the territory of the future Soviet state in the same year, at 138 millions, was more than 20 million less. These figures require correction. Official statistics overstated the population of the Russian Empire. The only census of the imperial population was held in 1897. In the years that followed, in the rural localities of European Russia, the authorities correctly registered births and deaths but failed to count the out-migration of peasants to cities or to Siberia. At the same time, these newcomers were counted in at their new places of residence. As a result, they appeared twice in the demographic statistics. This double counting accumulated for almost twenty years.

The scale of correction required is not completely clear. Statisticians were aware of the problem at the time. In the 1920s there were several attempts, reviewed by Vainshtein (1960), to estimate the true numbers. Because the authors generally did not describe their methodologies, it is hard for us prefer one correction over another. We reject Prokopovich’s correction as too large (he applied his downward adjustment to the entire country, including Siberia where there was no double-counting problem). We take the range of possible corrections that remain, shown in Table A-3, and obtain “high” and “low” population estimates as a result. In between the two, we find a “compromise estimate.”

It might be thought better practice if Table 7 reported our preferred population figures for each year from 1913 to 1916 as a range rather than a point. The upper

and lower limits are reported in Appendix A (Table A-2, columns F and G). In addition to “high” and “low” population estimates, we would then have “low” and “high” estimates of national income per head. One reason we avoid this is that we do not want to give the impression that population is the only or main source of uncertainty in our data.

Another reason is that we have some confidence in our compromise estimate. We deduct 5.5 per cent from the official figure. Although it is an approximate figure, it comes out very close to the 5.38 per cent correction proposed by Sifman (1977), who provided the best documented alternative, working forward from the 1897 census on the basis of births, deaths, and net migration in each year.

Table 7 shows our compromise estimate for the Russian Empire at the beginning of 1913 as 150 millions. Correspondingly, about 133 million people lived on future Soviet territory in 1913. By 1928, the Soviet population had grown to 152 millions – a relatively “safe” figure, based on the first Soviet census of 1926. Accounting for what happened between 1913 and 1926 is far less certain. There were three demographic catastrophes, associated with the Great War, the Civil War, and the famine respectively. Apportioning deaths among them is a hazardous business; Vishnevskii (2006) reviews existing attempts to do this. For the period from the closing stages of the Civil War (1920) to the first all-union population census (1926), we rely principally on the reconstruction by Andreev, Darskii, and Khar’kova (1992).

4. Values and Prices in 1913

Index number relativity is a topic of recognized significance for Russian and Soviet economic history; in fact, it was in connection with the estimation of Soviet machinery output that the so-called Gerschenkron effect was first identified (Wheatcroft and Davies 1994a). The Gerschenkron effect is the gap between measures of economic volume that emerges when both prices and quantities are changing relatively, and price and quantity changes are negatively correlated.

At the present stage of our present work we calculate the real national income of Russia and the Soviet Union only in the prevailing prices of 1913. We do not expect revaluation in the prices of 1928 to be either meaningful or productive.

In 1913 Russia had a relatively free market economy, participating fairly freely in world trade, with market prices responding flexibly to supply and demand. From this point of view the national income of 1928, revalued at 1913 prices, has a reasonably clear economic meaning.

The economic meaning of the national income of 1913, revalued at the prices of 1928, is not so clear. By 1928, the Soviet economy had been cut off from the world by a state monopoly of foreign trade. Domestic prices were distorted by controls, subsidies, and pervasive market disequilibria. New political, social, and economic priorities had opened the price “scissors” in favour of industry and against agriculture. While administrative pressure was squeezing the scissors together again in the late 1920s, an official comparison of industrial and agricultural producer prices in 1927/28 still showed terms of trade favouring industry by more than one quarter in comparison with before the war (Harrison 1990, p. 288). In fact, when

Abram Bergson (1961) surveyed the interwar years for the closest approximation to market-clearing prices, he settled on 1937 rather than 1928. This is why we do not expect revaluation in the prices of 1928 to be particularly meaningful.

The reason we do not expect it to be productive is more practical. A change in the base-year prices will affect comparisons of economic volumes across time only in the presence of structural change. If relative volumes do not change, change in relative prices will leave volume measures unaffected. There was marked change within sectors; within agriculture, for example, livestock and industrial crops expanded at the expense of grains. At the sectoral level, however, the shares of agriculture, industry, and transport in the Soviet economy in 1928 were nearly identical to that of the Russian economy in 1913. For this reason, changing the valuation of industrial commodities relative to agricultural produce would leave the comparison of 1928 to 1913 approximately unchanged. This is why we do not expect revaluation in the prices of 1928 to be productive.

Of course, there was some structural variation in intervening years. The most important variations within the period were the growing domination of large over small-scale industry, and the relative rise and decline of military services, the share of which was small in 1913 and smaller still in 1928.

A completely separate reason to question our choice of 1913 as a benchmark is the argument that it may have been an abnormal year. There was a bumper harvest of food grains, much above the trend since 1885 (Harrison 1994, p. 333n). This prompted Wheatcroft, Davies, and Cooper (1986), Davies (1990), and Harrison (1994) to recommend that the 1920s should be benchmarked against the non-agricultural production of 1913 combined with agricultural production averaged over 1909 to 1913.

We reject this procedure. What happened in 1913 happened. If smoothing is required, it should be done after calculating the national income, not in the course of doing so. If smoothing is applied to the grain harvest, moreover, consistency requires that it should also be done to the other four fifths of national income. But this turns out to be unnecessary. The log-linear trend of average real incomes from 1885 to 1912 predicts the outcome in 1913 within one half of one per cent.¹ For the economy as a whole, in other words, 1913 was a normal year.

Table 8 shows Malcolm Falkus's (1968) estimate of the shares of the main sectors in the net income of the Russian economy in 1913 within both Empire and Soviet borders. To reach his findings Falkus began from Prokopovich but found many difficulties with the latter's original estimates. To correct them he relied extensively – correctly in our view – on Gukhman.

Falkus shows agriculture as accounting for almost half of material production in 1913. The next largest sector was large-scale industry, but even large and small

¹ Net national income per head from 1885 to 1913 in rubles and 1913 prices is from Gregory (1980, pp. 56-57). Taking natural logs, with t ratios in brackets, and omitting 1913, $\ln(INCOME) = -28.48 (7.535) + 0.01738 (8.731) \times YEAR$; $R^2 = 0.7457$. Predicted income per head in 1913 is then 118 rubles 5 kopecks compared with measured 118 rubles 50 kopecks.

industry together came to less than half the size of agriculture. The main sectors making up the rest were forestry, construction, transport, and trade.

In Falkus's work, national income was limited to material production. Material production comprises commodity production, construction, and intermediate services such as transport and trade. Final services are missing, and must be added for national income on a goods-and-services basis. For Russian Empire territory, we find final services as the residual that is left when the net material product (18.5 billion rubles, found by Falkus) is deducted from the net national product (20.3 billion rubles, found by Gregory). The 1.8 billion ruble gap amounts to 8.8 per cent of the Gregory total.

Within final services, we identify value added by military services as the cost of soldiers' maintenance in 1913, marked up by 50 per cent as an arbitrary allowance for the contribution of defense capital services. We deduct this from the final services residual to leave civilian final services.

How reliable is our estimate of the importance of civilian final services in 1913? The two aggregates that mainly form it were estimated independently, the net material product from the output side, and the net national product from the expenditure side, so there is plenty of scope for measurement error in determining the size of the gap between them. Employment data for 1913 provide a rough check. According to a Soviet handbook (TsSU 1973, p. 343), trade and other civilian services (including medicine, science, culture, and state administration) accounted for 14 per cent of total employment in 1913. Our equivalent is found in Table 8 from the shares of trade and final civilian services under Soviet territory, which sum to 16.3 per cent. The fit is not exact, but it is close. A closer fit would not change our final results, moreover. The reason is that we have no independent measure of the changing output of civilian final services over time. Our only option is to allow it to follow the weighted average of the civilian series that are measured. Changing its weight would make no difference.

As described in the table, we adjust final services to Soviet territory in proportion to the adjustment of the net material product found by Falkus.

5. The Sectors of Origin

We estimate the real national income by sector of origin. Tables 9 to 16 summarize the usable production branch data that we have gathered, with agricultural and industrial production in physical units confined to Appendix B (Tables B-1 to B-3).

5.1. Agriculture

Agriculture (Table 9) was the largest sector of the economy. It accounted for nearly half of all economic activity, and more than half of employment.

The basic source for pre-revolutionary figures on Russian agriculture is an official summary of Russian economic development during World War I published in 1922. Figures for 1913 and 1914 cover the whole empire, but there are omissions for particular regions – mainly those that were occupied by Germany – and for

particular products in the later years.² We interpolated missing figures from trends in neighboring regions. To move from Imperial to Soviet territory, we used regional information from this volume and from the Imperial yearbooks for 1913 and 1915. In moving to Soviet frontiers we added the cotton production of Khiva and Bukhara.

Livestock figures are of worse quality than the arable data. For 1916 there are no livestock figures at all for the Asiatic part of the empire; the European part is represented by data for 48 out of 53 provinces. These omissions were interpolated using data on the regional distribution of livestock across the Empire in previous years. We use the same regional information to estimate figures for Soviet territory.

The agricultural data of lowest quality are those for 1918 and 1919. There are figures only on cropped area in 1918 and 1919, and on average yields per unit of area in 1917 and 1919, and only for 31 Russian regions. For these regions, multiplying cropped area by yields we get output (for 1918 we multiplied areas by yields of 1917). We then extend the figures to the whole territory of either the Empire or the future USSR. We do the same with the livestock figures, which exist only for the same 31 regions.

Border adjustments are not the only obstacle to comparability between agriculture statistics before and after the Revolution. We apply various corrections to the pre-revolutionary statistics, also shown in Table A-3. To start with grains, many contemporary statisticians and economists believed that peasants tended to underreport yields and sown areas, particularly before the Revolution. In the 1920s, Gosplan statisticians applied a 1.19 correction factor to scale up the pre-revolutionary grain harvest retrospectively (Wheatcroft and Davies 1994c). While the intrinsic validity of this correction is debatable, it continues to be required for comparability between grain statistics gathered before and after the Revolution. We apply it therefore to our series for 1913 to 1919.

We apply further corrections to the potato harvest and livestock figures reported for the same years. At this time official figures included only field-grown potatoes, omitting those grown on the side (in “subsidiary” agriculture) in both town and country. Wheatcroft and Davies (1994c) cite Gukhman’s (1925) estimate of 1913 potato production for a correction factor of 1.283, which we use to scale the figures up. As for livestock, serious undercounting in the Russian empire became clear from the first livestock census organized in 1916. We follow Vainshtein (1960) in multiplying livestock figures for 1913 to 1915 by factors of 1.198 for horses; 1.415 for cattle; and 1.896 for pigs. The correction factor for sheep and goats (1.504) is the arithmetic mean of the three Vainshtein correction factors for other livestock.

Finally, we are missing data for the cotton harvest from 1917 to 1923, and we fill the gap by interpolation. In this and other tables, numbers are italicized when they

² For 1915 there are no data on grain production for 6 out of 53 regions in the European part of the Russian Empire, and 3 out of 24 regions in the Asiatic part. In 1916 we miss 5 European and 13 Asiatic regions, and in 1917 we miss 2 and 5. On potatoes in 1916 there are no data for the Baltic region, Belorussia, the Middle Volga, South Steppe, and Steppe regions, Turkestan, Transcaucasia, and Siberia and in 1917 for the Steppe region and Turkestan.

are found by interpolation on other series or extrapolation from preceding or subsequent years; full details are given in notes to the table.

A notable feature of our results is that the famine year of 1921 was not the worst year for agricultural production. The lowest point in our aggregate series was 1919; a modest improvement in 1920 was followed by a second dip in 1921, but not to the same depth as 1919. To see why 1921, not 1919, was the famine year, bear in mind two other factors. First, the famine of 1921 was regionally concentrated in the grain growing districts of the Volga and Ukraine. Table 9 indicates that 1921 was the worst year for grains. Second, Ó Gráda (2007, pp. 7-9) has shown that famine is much more likely after two consecutive harvest failures, when the countryside has exhausted its reserves. As Table 9 reveals, 1921 was the fourth and worst year in a series of catastrophic grain harvests. Consistently with this, new research on this topic by Adamets (2003, cited by Vishnevskii 2006, p. 401), suggests that the famine actually began in the summer of 1920, and in some regions as early as 1919.

5.2. Industry

We start with large-scale (“census”) industry on Soviet territory (Table 10). We have 78 annual series of industrial products from Kafengaus (1994) and official figures for 1928 (TsSU 1929a), reported in Table B-2 and B-3. Of the 78 series, many of them incomplete, we actually use 60. The industrial classification in use before the Revolution divided industry into 11 branches; the only one on which we have no data, electricity production, was of minor importance at this time. Within each branch, each product series enters with equal weight. At the branch level in 1913 we construct value-added weights from the 1918 industrial census, which includes retrospective figures from 1913 onwards. Applying value-added weights to each branch index, we obtain an index for large-scale industry.

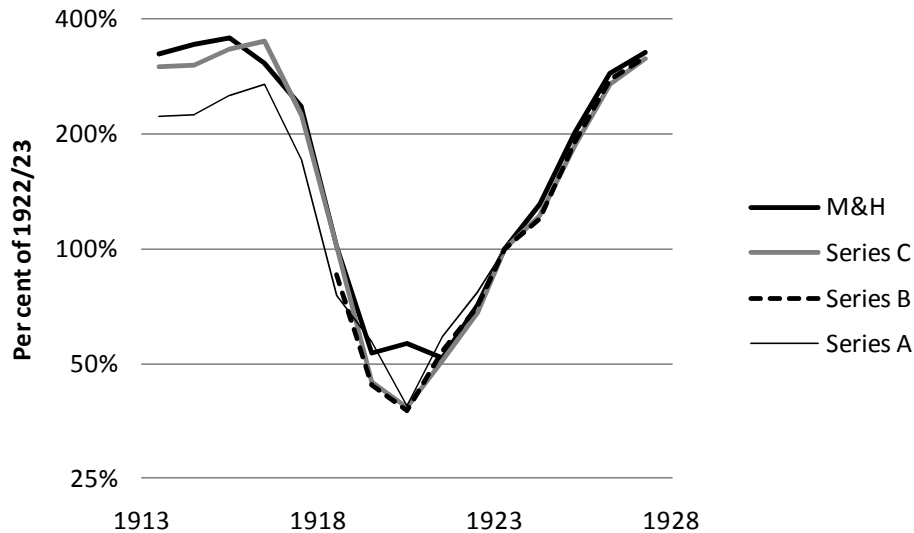
It is of interest to compare our new index of large-scale industrial production with those of others. Table 11 reports the contemporary reconstruction by Gukhman (Series A) and rival estimates by Soviet official agencies (B and C). Only Series C spans all years; Series A is curtailed in 1922/23 and Series B does not begin until 1918. For these reasons, it is convenient to recalculate all the series as percentages of 1922/23. The comparison is shown in Chart 1. In the period of postwar recovery from 1922/23 onward, our index essentially coincides with Series B and C. We find this somewhat reassuring, considering the divergences that are apparent for the war period.

In terms of its evolution from the starting point in 1913, our index matches Series C relatively well, but shows a steeper decline than Series A. Both the previously existing series show industrial production peaking in 1916; we show the wartime peak in 1915. Both the existing series show the trough in 1920; we show the trough in 1919, an aborted recovery in 1920, and a second trough in 1921. This mirrors the pattern that we found for agriculture in Table 8.

We prefer the pattern in our own index over that shown by others for two reasons. First, the pattern of our aggregate index for large-scale industry is supported by the underlying data; we cannot explain why Series A and C do not also reflect it. Second, there is further confirmation in the similarity of the industrial

series with agriculture. In the Soviet period, for example, when food was short industrial production and productivity fell (Gregory and Harrison 2005, pp. 731-732).

Chart 1. Large-scale Industry on Soviet Territory, 1913 to 1928: Alternative estimates, per cent of 1922/23



Source: M&H from Table 9; Series A, B, and C from Table 10. All figures are indexed to 1922/23.

We combine our index of large-scale industry with the only available measure of small-scale production, a Soviet official index (Table 11, Series C), using the associated 1913 weights of large and small industry to aggregate them.

We make no allowance for quality changes. Prokopovich (1931) made the assumption that between 1913 and 1928 the average quality of Soviet industrial products declined by about one fifth. Quality change cannot have been all one way; the typical airplane of the late 1920s, for example, flew higher and faster for longer than before the war, but we do not allow for this either. Despite such omissions, our index numbers for 1926/27 and 1927/28 fit within the range proposed by Wheatcroft, Davies, and Cooper (1986).³

5.3. Transport, Construction, Trade, and Civilian Final Services

Railway transport (Table 12) is relatively well served by official statistics. We use the dataset assembled by John Westwood (1994) in ton- and passenger-kilometers for both Empire and Soviet territory. Westwood also provides data on waterway freight traffic for widely separated benchmark years; since this element is too large to be omitted, we interpolate missing observations as best we can. Highway traffic was surely important too, but was almost entirely unmeasured. We have data only for

³ "If [our] figures are approximately correct, gross industrial production as a whole in 1927/8 was 18-23 per cent higher than in 1913; in 1926/7 it was 2-6 per cent higher than in 1913" (p. 267).

mechanical road traffic which, although growing rapidly, remained insignificant in volume until after our period.

For construction (Table 13) we rely on the production of building materials (cement, red bricks, window glass, and sawn timber). Effectively, we assume that the production of these materials equaled their intermediate consumption in the construction industry, and that the construction industry's ratio of intermediate consumption to value added remained unchanged over the period.

The coverage of trade and civilian services (Tables 14 and 15) is limited to 1920 and the postwar years. While we hope to find longer employment series in future, at present these are lacking for the pre-Soviet period.

5.4. Military Services

Table 16 shows two series for military employment; Series A is that provided by the authoritative Correlates of War international historical database, but we believe Series B improves on this significantly from Russian sources. This uses figures on the number of soldiers from 1913 to 1921 for several months of each year from Golovin (1931, reprinted 2001) and Direktivy (1978). We infer annual averages from the monthly data. For later years we use official Soviet annual averages. The great expansion of the Russian army and navy in 1914 to 1916 is the most notable feature of Table 15. Even at its 1920 maximum, the Red Army was less than half the peak size of the Imperial army.

It is necessary, but not easy, to allow for military services of the anti-Bolshevik forces in 1918 to 1920: not only the White armies but national insurgents in the Ukraine, the Caucasus, and Central Asia. The allowance we make is arbitrary and symbolic rather than precise.

6. Real National Income

Table 17 shows our estimates of the real national income of the Russian Empire and the Soviet Union by sector of origin. Table 18 then compares our aggregate figures with previous estimates for comparable years. Chart 2 illustrates the alternatives on the same basis, setting both Russia and USSR to 100 percent in the base year (1913 or thereabouts).

Taking military services into account for the first time, our results suggest that Russia did better in the first years of the Great War than previous estimates would indicate. The Russian economy held up well through 1915. By 1916 it was in decline, but was still less than 10 percent below the peacetime benchmark of 1913.

By the same token, the economic decline through the Revolution and Civil War appears sharper than in previous estimates. It is not really surprising but perhaps still merits emphasis: civil war, raging through the interior of the country, was far more destructive than the international conflict fought largely in the borderlands of the Empire that preceded it. In the three years from 1916 to 1919, the economy lost more than half of its total output. The first signs of recovery appeared in 1920 but were then lost in the disastrous famine year of 1921.

Postwar recovery began with 1922. The recovery was strong at first, with the aggregate growth rates peaking in 1924/25 at more than 25 per cent in a single year.

After that, there was a marked slowdown to single-digit growth. In 1927/28 aggregate output was around 10 percent larger than in 1913 on the same territory. At this point the composition of national income by sector of origin was almost the same as it had been 1913; this is found by comparing the first and last rows of Table 17. There were two important differences, however. One was the growth of large-scale industry, mostly under public ownership, at the expense of small-scale industry under mostly private ownership. Another was a decline in the share of military activities by more than one half. This was hardly sustainable, given Soviet Russia's state of military encirclement— both real and imagined – in the late 1920s.

Chart 2. Russian and Soviet real national income, 1913 to 1928: New and old estimates, per cent of 1913



Source: Table 18.

Table 19 compares output with population to find average incomes. Taking the period as a whole, the population grew by around 14 per cent; as an annual average this was less than one per cent per year. The overall expansion was the net result of relatively normal growth from 1913 to 1916, and from 1922/23 to 1927/28, partly offset by a sharp contraction in the years between, when natural and unnatural deaths and emigration substantially outweighed the natural increase. Premature deaths from warfare, disease, and famine included 3 million soldiers and 11.5 million civilians (Wheatcroft and Davies 1994b, p. 63).

When output is divided by population the result is income per head. This is shown in Table 19. Not surprisingly, the course of average incomes that we have estimated followed closely that of total output, particularly during the war years when the population did not change much. In the worst years, from 1919 to 1921, average incomes were around two fifths of the prewar benchmark. Our estimates also confirm that by 1928 the Soviet postwar recovery was still incomplete. Although total output within given frontiers had expanded by around 10 per cent compared with 1913, the population had expanded by more. In fact, we find that Soviet

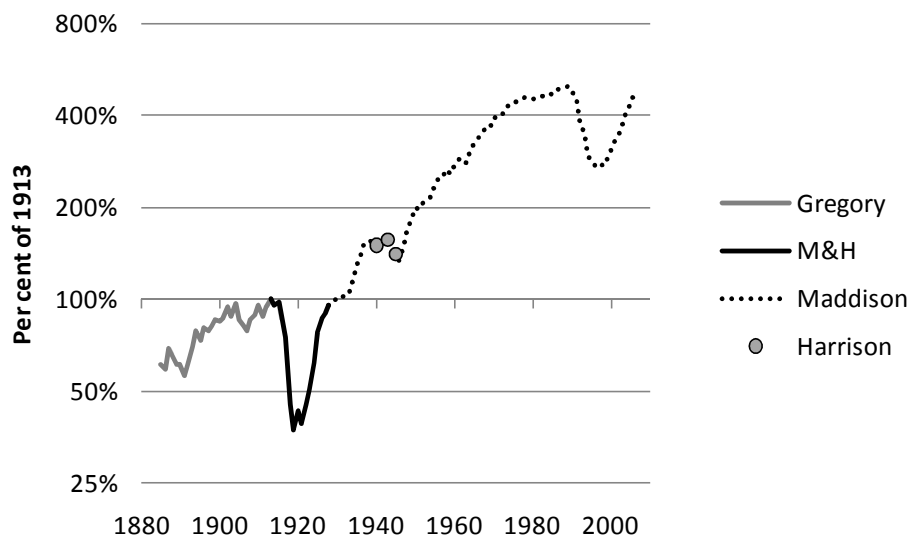
incomes in 1928 fell short of the previous benchmark by around 4 percent; this is in basic agreement with the shortfall found independently by Gregory (1990).

Paul Collier (2008, p. 28) has observed that “Most of the costs of civil war, perhaps as much as half, accrue after the war is over.” Our figures confirm either the persistence of losses associated with the Civil War into the postwar period, or the failure of the New Economic Policy to achieve full recovery within the time available, or some mixture of both.

7. The Long Run

Chart 3 shows our new estimates in the context of established long run real growth series for Russia and the Soviet Union from 1885 to 2006. It turns out that the Great War and Civil War induced the deepest crisis that Russia experienced in more than a century of modern economic growth.

Chart 3. Real Income per Head, Russia and the Soviet Union: per cent of 1913



Source: Appendix C, Table C-1. All figures are indexed to 1913.

Table 20 provides a more detailed comparison with other major shocks of the twentieth century: the Great Breakthrough and Great Terror, the Great Patriotic War, and the post-Soviet collapse. These comprise just about every disaster that can befall modern societies – one civil war (1918 to 1920), four foreign wars (against Germany in 1914 to 1917 and 1941 to 1945, against Poland in 1920 to 1921, and against Finland in 1940), two state collapses (1917 and 1991), four famines (1920 to 1922, 1932 to 1934, Leningrad in 1941 to 1944, and 1946 to 1948), and many episodes of organized killing. In Table 20 we include consumption measures where available, with estimates of the accompanying demographic losses. In precise terms few of the figures in the table will ever command a scholarly consensus, but they are still instructive in a broad-brush way.

Table 20 confirms that the Great War and Civil War rank first among Russia’s economic disasters of the last century. While we do not have direct measures of

consumption at this time, it is all but certain that living standards fell in proportion to the three-fifths loss of average incomes. Normalized by the prewar population, the burden of premature deaths came not far behind that of World War II. Hunger was the single most important cause of excess mortality, followed by fighting and terror in the Civil War. Thus, the great majority of premature deaths took place between 1917 and 1922. Mass emigration also took place during these years.

During the time of Stalin's Great Breakthrough and Great Terror, the economy was rapidly industrialized. At first, living standards were depressed by forced saving and losses arising from state violence. In the mid-1930s, living standards recovered, but stagnated over the period as a whole. Famine in the early 1930s was the single most important cause of premature deaths, followed by the mass operations of 1937 and 1938.

The shock of World War II was first of all territorial. As Germany seized and occupied territory and population, the output of Soviet-controlled territory also fell. Stalin's policies successfully managed the war economy, however. Comparing 1943 with 1940, output per head of the population under Soviet control may have risen somewhat. The intense mobilization of resources into war production and military services put consumption into a tight squeeze, however. Consumption per head most likely fell by about two fifths. There is no tidy list of causes of the 25 million (at least) excess deaths, but it seems likely that German occupation policies were the largest single contributor, followed by military deaths. Stalinist repression (of Soviet ethnic Germans and Chechens, for example) played a subsidiary but still significant role. At the end of the war, another regional famine interrupted the recovery and carried off more lives.

The post-Soviet collapse is the only one of the four crises in which organized violence did not take the lead. The breakup of the Soviet Union was accompanied by small-scale ethnic clashes and regional conflicts in which, according to Ellman (2000b), around 100,000 people lost their lives. The major causes of premature death were social and economic, but the detailed attribution of responsibility continues to be hotly contested (e.g. Stuckler, King, and McKee 2009; Demoscope 2009). Economic deprivation was clearly a factor; our table shows that in the period of most rapid change both output and personal consumption may have fallen by about two fifths. But the main burden of reduced life expectancy fell upon men of working age. Other prime candidates include the stresses of economic system change and the effects of much cheaper alcohol. If violence played a role, it was largely interpersonal and decentralized. Whatever the causes, the post-Soviet collapse was associated with economic losses on the scale of a major war, but without such a war taking place.

If there is a general lesson from Table 20, it is the importance of the state in the history of modern Russia. The scale of deaths on each occasion reflects the fact that, when the state set out deliberately to kill millions of people, it generally succeeded. When the state set out to put millions of people on short rations, or simply take their food away, it could do that too, even if the result was to kill them. The worst economic disasters in the table came about differently, but in a way that still reflects the importance of the state: they resulted from the state failures of 1917 and 1991.

Russia's present administration appears to believe that the answer for Russia is to shore up the state at all costs. Whether the answer is this, or to build an economy that is more deeply rooted in civil society and more resilient in the face of political action, is another story.

8. Conclusions

Our work fills the last remaining gap in the record of Russian and Soviet national income in the twentieth century. This gap is full of historic and traumatic events: Russia's Great War, the Bolshevik Revolution and Civil War, and postwar reconstruction under the New Economic Policy.

In comparison with previous interpretations, our findings give a somewhat more favourable picture of Russia's economic mobilization for the Great War. We show the economic catastrophe of the Civil War in a harsher light. Our results confirm that by 1928 economic recovery, measured by national income per head, was most likely still incomplete.

Wars and revolutions have the capacity to wreak havoc on modern societies. By nesting one inside the other, Russia's Great War and Civil War led to economic disaster and demographic tragedy. This was Russia's worst disaster of the twentieth century for both production and consumption. For consumption, it was almost certainly worse than World War II; for production, it was worse than the post-Soviet economic collapse. As a demographic tragedy it was exceeded only by World War II.

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Table 1. Gregory's national income: USSR, 1913 and 1928, billion rubles at 1913 market prices

	Original version:		Maximum upward revision:	
	Net national product	Personal consumption	Net national product	Personal consumption
<i>Billion rubles</i>				
1913	16.5	13.2	16.5	13.2
1928	15.3	11.2	17.6	13.5
<i>Ratio to 1913:</i>				
1928	0.93	0.85	1.07	1.02

Source: Gregory (1990, p. 337). The "original version" is that of Gregory (1980, p. 113), subsequently modified in response to criticisms by Wheatcroft, Davies, and Cooper (1986, pp. 268-269).

Table 2. Prokopovich's national income: Russia, 1914/15 to 1917/18, percent of 1913/14

	Agri-culture	Industry	National income
1914/15	100.5%	100.0%	100.0%
1915/16	98.3%	92.6%	96.5%
1916/17	90.7%	70.9%	84.5%
1917/18	93.2%	50.0%	80.0%

Source: Prokopovich (1918b, p. 173).

Table 3. Litoshenko's national income (by social group): USSR, 1922/23 and 1923/24 in budget rubles

	Peasants	Manual and non-manual workers	Taxpayers		Other urban citizens	Total
			Basic rate	Higher rate		
<i>1922/23</i>						
Thousands	111624	12050	3761	1202	4867	133504
Annual income in rubles:						
Average	49.26	96.08	172.1	555	62.24	62
Total, mn	5498	1153	654	666	305	8276
<i>1923/24</i>						
Thousands	113856	12484	3438	1274	5102	136154
Annual income in rubles:						
Average	50.38	126.8	172.1	612	73.12	66.5
Total, mn	5736	1574	598	780	373	9061

Source: Litoshenko (1925, p. 47).

Table 4. Gukhman's net national income: USSR, 1913 and 1922/1923 in 1913 rubles

	Agri-culture	Large-scale	Industry			Total	Total	Total
			Urban	Rural	Total			
<i>In 1913 prices:</i>								
1913	8620	2657	430	326	756	3413	12033	
1922/23	6257	821	114	176	290	1111	7368	
<i>In current prices:</i>								
1922/23	4676	1100	148	232	380	1480	6156	

Source: Gukhman (1928, p. 51).

Table 5. Gatrell's national income: Russia, 1914 to 1917, percent of 1913

	Industry		Agri- culture	Forestry	Trade	Transport	Con- struction	Weighted total
	Large scale	Small scale						
1914	101%	98%	100%	79%	84%	73%	96%	95%
1915	111%	78%	110%	59%	68%	71%	100%	96%
1916	104%	88%	90%	31%	50%	43%	81%	80%
1917	76%	78%	87%	18%	37%	29%	68%	68%

Source: Gatrell (2005, p. 241).

Table 6. Nutter's production indexes: USSR, 1920 and 1928, per cent of 1913

	Agri- culture	Industry	Transport	Weighted average
	1920	64%	20%	22%	48%
1928	118%	102%	106%	112%

Source: Nutter (1963, p. 165). The implicit total is calculated using shares

Note: The implicit total is calculated using relative Soviet interwar territory from Table 8.

Table 7. Population of Russia and the USSR, 1913 to 1928

	Official figures		Compromise estimate	
	Jan. 1	Jan. 1	July 1	Apr. 1
	(A)	(B)	(C)	(D)
	000	000	000	000
<i>Russian Empire territory (excluding Poland and Finland)</i>				
1913	158942	150201	152066	...
1914	162890	153931	155711	...
1915	166658	157492	158735	...
1916	169290	159979	159375	...
1917	...	<i>158771</i>	158172	...
1918	...	<i>157573</i>	...	...
<i>Soviet interwar territory</i>				
1913	...	133055	134624	...
1914	...	136193	137891	...
1915	...	139588	140777	...
1916	...	141966	141430	...
1917	...	<i>140894</i>	<i>140363</i>	...
1918	...	<i>139831</i>	<i>139303</i>	...
1919	...	<i>138775</i>	<i>138251</i>	...
1920	137727	137727	137761	...
1921	137795	137795	137352	...
1922	136909	136909	137198	...
1923	137487	137487	138728	140107
1924	139969	139969	141487	142918
1925	143004	143004	144349	145762
1926	145694	145694	147175	148657
1927	148656	148656	150139	151647
1928	151622	151622	153155	153155
1929	154687	154687	...	...

Sources for Table 7:

A and B. Figures for 1913-1916, both official and after adjustment for border changes and corrections for prewar double-counting, are shown in Tables A-1, column H, and A-2, columns H and K. Figures for 1920 to 1928 are from Andreev, Darskii, and Khar'kova (1993, p. 16); missing figures for 1917 to 1919 are interpolated.

C and D. The June 1 figure, which we use for the calendar year average, is found as the average of the January 1 figures for the current and following years. The April 1 figure, used for the economic year average, is the average of the January and July figures for the current year.

Note:

In this and following tables, numbers that are interpolated or extrapolated are shown in italics.

Table 8. National income within Russian and Soviet borders, 1913: million rubles

	Russian Empire		Soviet territory	
	Million Rubles	Percent	Million Rubles	Percent
Agriculture	8969.5	44.3%	7291.6	44.4%
Forestry	1067.0	5.3%	812.0	4.9%
Fishing and hunting	257.9	1.3%	244.2	1.5%
Industry, large	3022.6	14.9%	2407.5	14.6%
Industry, small	1311.1	6.5%	981.0	6.0%
Construction	1035.0	5.1%	878.0	5.3%
Transport	1051.9	5.2%	832.7	5.1%
Communications	120.9	0.6%	97.3	0.6%
Trade	1639.7	8.1%	1442.3	8.8%
Net material product	18475.6	91.2%	14986.6	91.2%
Final services	1790.4	8.8%	1452.3	8.8%
Of which:				
Civilian services	1527.9	7.5%	1239.4	7.5%
Military services	262.5	1.3%	212.9	1.3%
Net national income	20266.0	100.0%	16438.9	100.0%

Source: Rows down to "Net material product" from are Falkus (1968, p. 55).

Other rows:

Russian Empire territory: Final services are calculated as the residual when the net material product is deducted from net national income. Military services are soldiers' maintenance, 175 million rubles in 1913, from Gregory (1982, p. 247), marked up 50 per cent to account for the contribution of defense capital services. Final services, less military services, gives final civilian services.

Soviet territory: final services, civilian and military, are adjusted from Russian Empire territory in the same proportion as the net material product. Net national income is then the sum of the net material product and final services.

Table 9. Agriculture, 1913 to 1928: percent of 1913

	Livestock						Industrial crops		Total % of 1913
	Grains Tons 000	Potatoes Tons 000	Horses Head 000	Sheep and		Pigs Head 000	Flax Tons 000	Cotton Tons 000	
				Cattle Head 000	goats Head 000				
<i>Russian Empire territory (excluding Poland and Finland)</i>									
Weight:	48.3%	15.6%	7.0%	7.0%	7.0%	7.0%	4.0%	4.0%	100.0%
1913	100%	100%	100%	100%	100%	100%	100%	100%	100.0%
1914	83%	105%	104%	102%	98%	106%	67%	110%	92.2%
1915	94%	89%	98%	97%	102%	92%	59%	128%	94.1%
1916	80%	59%	92%	88%	116%	80%	58%	107%	80.9%
1917	82%	80%	62%	59%	70%	59%	53%	57%	73.8%
1918	49%	61%	60%	53%	62%	47%	63%	94%	54.9%
1919	39%	59%	58%	47%	53%	34%	40%	79%	46.3%
<i>Soviet interwar territory</i>									
Weight:	50.3%	12.9%	7.1%	7.1%	7.1%	7.1%	4.2%	4.2%	100.0%
1913	100%	100%	100%	100%	100%	100%	100%	100%	100.0%
1914	83%	106%	104%	100%	98%	107%	67%	120%	92.0%
1915	93%	95%	99%	97%	103%	90%	57%	140%	95.0%
1916	79%	55%	88%	82%	82%	95%	58%	114%	78.5%
1917	81%	85%	60%	58%	66%	65%	58%	61%	74.4%
1918	48%	68%	58%	53%	59%	52%	64%	100%	55.5%
1919	38%	66%	56%	47%	51%	38%	40%	85%	46.6%
1920	38%	81%	71%	64%	50%	72%	28%	97%	53.4%
1921	31%	83%	65%	60%	49%	61%	31%	88%	48.1%
1922	53%	89%	53%	54%	39%	37%	34%	104%	56.9%
1923	52%	129%	56%	63%	56%	44%	33%	119%	64.6%
1924	58%	141%	70%	94%	97%	94%	46%	148%	80.8%
1925	82%	151%	74%	99%	113%	92%	40%	242%	99.2%
1926	86%	168%	81%	105%	120%	89%	34%	240%	104.4%
1927	81%	161%	86%	108%	130%	110%	31%	308%	106.4%
1928	80%	156%	90%	110%	135%	123%	39%	382%	110.8%

Sources for Table 9:

For quantities see Appendix B, Table B-1.

Weights in agricultural gross value of output at 1913 prices are taken from Gukhman (1925, pp. 130-135). Value-added weights, available from Vainshtein (1960) only for 1910 and for European Russia, do not differ greatly.

There are no figures for the cotton harvest from 1918 to 1923. Numbers are interpolated on the weighted sum of other rows, adjusted for the marked difference of trend between benchmark years.

Table 10. Large-scale industry by sector: Soviet territory, per cent of 1913

	Stone and glass	Mining	MBMW	Wood- working	Chemi- cals	Food, drink, and nar- cotics	Leather and fur	Cotton textiles	Woolen textiles	Flax and hemp textiles	Paper and printing	Total
<i>Number of series:</i>	3	15	7	1	16	10	2	2	2	1	1	60
<i>Weight:</i>	3.9%	29.9%	13.2%	2.7%	6.2%	21.5%	1.4%	13.1%	3.1%	1.9%	3.2%	100.0%
1913	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100.0%
1914	107%	93%	144%	85%	106%	111%	108%	100%	98%	125%	89%	106.3%
1915	78%	80%	216%	64%	105%	110%	99%	110%	101%	132%	75%	110.9%
1916	61%	82%	141%	49%	111%	83%	111%	110%	97%	115%	51%	94.2%
1917	40%	60%	146%	47%	85%	64%	93%	63%	70%	80%	29%	73.3%
1918	11%	23%	31%	23%	29%	39%	69%	41%	54%	42%	12%	31.4%
1919	5%	18%	18%	17%	18%	21%	35%	6%	21%	23%	6%	16.6%
1920	5%	17%	22%	12%	18%	26%	21%	5%	17%	25%	5%	17.5%
1921	4%	28%	7%	14%	24%	12%	37%	6%	12%	12%	4%	16.0%
1922	9%	25%	17%	26%	23%	21%	57%	20%	27%	50%	8%	22.1%
1922/23	14%	29%	31%	39%	42%	31%	86%	27%	35%	55%	25%	31.0%
1923/24	21%	39%	32%	47%	55%	40%	159%	36%	41%	73%	33%	40.4%
1924/25	38%	51%	74%	69%	82%	58%	209%	66%	60%	89%	53%	62.7%
1925/26	65%	74%	120%	84%	119%	87%	205%	85%	72%	124%	69%	89.4%
1926/27	81%	89%	150%	95%	124%	88%	102%	99%	89%	126%	99%	101.4%
1927/28	99%	91%	153%	105%	174%	123%	314%	110%	109%	116%	93%	118.4%

Sources:

For quantities, see Appendix B, Table B-3.

Weights in industry gross value added at 1913 prices are from TsSU (1924b, p. 198).

Table 11. Industry gross value of output, 1913 to 1927/28, alternative estimates: Soviet Union, billion prewar rubles

	Large-scale			Small- scale
	(A)	(B)	(C)	(C)
1913	5.62	...	6.39	2.04
1914	5.69	...	6.43	2.00
1915	6.39	...	7.06	1.60
1916	6.83	...	7.42	1.80
1917	4.34	...	4.78	1.60
1918	1.91	1.85	2.16	1.50
1919	1.45	0.96	0.95	1.00
1920	0.98	0.82	0.82	0.90
1921	1.49	1.17	1.08	1.00
1922	1.95	1.52	1.44	1.10
1922/23	2.54	2.17	2.13	1.20
1923/24	...	2.59	2.59	1.46
1924/25	...	4.14	3.96	1.69
1925/26	...	6.02	5.72	1.86
1926/27	...	6.89	6.72	2.04
1927/28	...	8.43	...	...

Sources:

A. Gukhman (1928, p. 114).

B. TsSU (1929a, pp. 302-311).

C. Akademii nauk (1960, p. 198), citing *Planovoe khoziaistvo* 1929, no. 5, p. 191.

Table 12. Construction materials: Soviet territory, per cent of 1913

	Cement	Red bricks	Window glas	Sawn timber	Total
1913	100%	100%	100%	100%	100.0%
1914	119%	110%	93%	85%	101.5%
1915	93%	64%	77%	64%	74.6%
1916	88%	43%	53%	49%	58.3%
1917	58%	31%	30%	47%	41.8%
1918	6%	15%	13%	23%	14.3%
1919	...	9%	7%	17%	10.9%
1920	2%	9%	5%	12%	7.1%
1921	4%	4%	4%	14%	6.9%
1922	10%	6%	10%	26%	12.9%
1922/23	15%	10%	18%	39%	20.3%
1923/24	24%	14%	24%	47%	27.5%
1924/25	48%	23%	43%	69%	45.7%
1925/26	88%	47%	61%	84%	69.9%
1926/27	108%	65%	70%	95%	84.7%
1927/28	126%	82%	88%	105%	100.3%

Source: Calculated from Tables B-3.1 and B-3.5. The total is the unweighted mean of the component series in each year.

Table 13. Rail and water transport, 1913 to 1927/28: physical units

	Railways			Water-ways	Rail and waterways, total	
	Freight	Pass-engers	Convent-ional			
	Ton/km billion	Person /km, bn	Ton/km billion		Ton/km billion	Ton/km billion	% of 1913
<i>Russian Empire territory (excluding Poland and Finland)</i>						
1913	76.8	29.7	106.5	...	...	100.0%
1914	74.7	38.5	113.2	...	...	106.3%
1915	83.0	53.2	136.2	...	...	127.9%
1916	73.0	37.6	110.6	...	...	103.8%
1917	63.0	22.0	85.0	...	...	79.8%
1918	14.1	15.3	29.4	...	...	27.6%
1919	14.8	11.8	26.6	...	...	25.0%
<i>Soviet interwar territory</i>						
1913	65.7	25.2	90.9	29.0	119.9	100.0%
1914	...	...	...	...	...	...
1915	...	...	...	...	...	...
1916	...	...	...	...	...	...
1917	53.9	18.8	72.7	15.0	87.7	73.1%
1918	12.1	13.0	25.1	2.9	28.0	23.3%
1919	12.7	10.1	22.8	3.0	25.8	21.5%
1920	11.4	11.2	22.6	2.7	25.3	21.1%
1921	14.0	10.3	24.3	3.3	27.7	23.1%
1922	18.0	12.3	30.3	4.3	34.6	28.8%
1922/23	23.5	13.9	37.4	5.6	43.0	35.8%
1923/24	33.7	15.4	49.1	8.0	57.1	47.6%
1924/25	47.4	19.0	66.4	8.6	75.0	62.5%
1925/26	68.9	23.4	92.3	12.5	104.8	87.4%
1926/27	81.7	22.1	103.8	14.8	118.6	98.9%
1927/28	88.2	23.6	111.8	16.0	127.8	106.6%

Source: Westwood (1990, pp. 305, 309),

Notes:

"Conventional" ton/kilometres sum freight and passenger traffic, converting one passenger/kilometre to one ton/kilometre of freight.

With many gaps in the underlying data, the table relies on extensive interpolation. Railway traffic in 1916 is found as the mid-point between the years before and after. Railway freight traffic within Soviet borders from 1917 to 1919 is found by interpolation from 1913 on the same figures for the Russian Empire, and we prefer the figure found in this way for 1919 to the one given by Westwood, which is larger than that for the greater Empire territory.

Passenger traffic within Soviet borders from 1917 to 1922 is found by interpolation from 1913 on the value of output of industry and agriculture (from Table 17); this yields a pleasingly close fit to the actual figure for 1922/23.

In the case of waterway traffic, too large to be completely ignored, there are only four figures across the entire period (for 1913, 1917, 1923/24, and 1927/28), and these are limited to Soviet territory. We make no attempt to fill the gaps for Empire territory. For the missing years and Soviet frontiers, we interpolate it on the annual changes in railway freight traffic, adjusted to fit the different trends for waterways between benchmark dates.

Table 14. Trade, 1923/24 to 1927/28: Soviet Union, persons employed

	Persons
	<i>000</i>
1922/23	286
1923/24	279
1924/25	420
1925/26	532
1926/27	582
1927/28	599

Sources:

1922/23: Vovsi (1926, p. 8), from a census of 1923.

1923/24-1927/28: TsSU (1929a).

Table 15. Civilian services, 1923/24 to 1927/28: Soviet Union, persons employed

	Finance	Govern- ment	Edu- cation	Medical services	Commu- nications	Domestic service
	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>
1920	...	...	...	111	...	...
1921	...	...	...	103	...	...
1922	...	...	...	117	...	...
1922/23	31	923	421	179	92	0
1923/24	48	947	484	244	76	133
1924/25	66	1004	551	271	82	193
1925/26	82	1127	603	324	94	253
1926/27	85	1164	714	365	95	317
1927/28	86	1135	781	405	95	317

Sources:

1922/23: Vovsi (1926, p. 9).

1923-27: TsSU (1929a).

1920-23: Employment in medical services is based on TsSU (1927, pp. 104-5).

Table 16. Military services, 1913 to 1927/28: employment

	Armed forces of Russia and USSR		Anti- Bolshevik forces	Total
	(A)	(B)	(C)	(D)
	000	000	000	000
<i>Russian Empire territory (excluding Poland and Finland)</i>				
1913	1286	1423	...	1423
1914	1321	2405	...	2405
1915	5500	6425	...	6425
1916	10900	9108	...	9108
1917	9050	7992	...	7992
<i>Soviet interwar territory</i>				
1913	...	1239	...	1239
1918	...	313	50	363
1919	1550	1867	100	1967
1920	3050	4139	50	4189
1921	5500	3113	...	3113
1922	3600	1590	...	1590
1922/23	2100	703	...	703
1923/24	562	562	...	562
1924/25	562	562	...	562
1925/26	562	562	...	562
1926/27	562	562	...	562
1927/28	562	562	...	562

Sources:

A. Correlates of War database, at www.correlatesofwar.org.

B. 1913-1917: Calculated from Golovin (2001, pp. 166, 186).

The figure given for Soviet territory in 1913 under column (B) is notional, and represents the Russian Empire figure for the same year adjusted in proportion to the official population figures for the two territories shown in Table 7. Figures for 1918 to 1921 are calculated from Direktivy (1978, pp. 15-227) and those for 1922 to 1927 are from TsSU (1929a).

C. An arbitrary allowance.

D. The sum of B and C.

Table 17. Net national income of Russia and USSR: million rubles and 1913 market prices

	Industry							Total
	Agri- culture	Large- scale	Small- scale	Con- struction	Trans- port	Other Civilian	Military Services	
<i>Russian Empire territory (excluding Poland and Finland)</i>								
1913	8970	3023	1311	1035.0	1052	4613	263	20266
1914	8272	3213	1285	1050.3	1118	4478	444	19861
1915	8436	3353	1028	772.6	1345	4477	1185	20598
1916	7261	2848	1157	603.1	1092	3885	1680	18526
1917	6619	2214	1028	432.4	840	3337	1474	15945
1918	4927	948	964	148.3	...	...	...	...
1919	4156	501	643	112.9	...	...	...	...
<i>Soviet interwar territory</i>								
1913	7292	2408	981	878.0	833	3835	213	16439
1914	6710	2560	962	891.0	885	3716	360	16084
1915	6931	2671	769	655.4	1065	3742	961	16795
1916	5723	2268	866	511.6	865	3167	1363	14763
1917	5428	1764	769	366.8	609	2766	1196	12899
1918	4044	755	721	125.8	194	1808	62	7710
1919	3395	399	481	95.8	179	1408	338	6296
1920	3891	421	433	62.4	176	1542	720	7244
1921	3508	384	481	60.2	192	1432	535	6591
1922	4150	533	529	113.4	240	1723	273	7561
1922/23	4709	746	577	178.2	298	2015	121	8644
1923/24	5891	973	702	241.6	396	2539	97	10839
1924/25	7236	1509	813	401.1	521	3243	97	13819
1925/26	7613	2152	894	613.7	728	3715	97	15812
1926/27	7756	2442	981	743.8	824	3945	97	16788
1927/28	8079	2852	981	880.9	887	4234	97	18010

Sources:

For 1913, figures for national income and value added by sector of origin on both Russian and Soviet territory are taken from Table 8. Value added by other civilian sectors (forestry, fishing and hunting, communications, trade, and other civilian services) in 1913 is found as the residual after value added by agriculture, large and small industry, construction, transport, and military services is deducted from national income.

Figures for subsequent years are then interpolated on aggregate index numbers or other series as follows: agriculture, Table 9 (total); large-scale industry, Table 10 (total); small-scale industry, Table 11 (column C, small-scale); construction, Table 12 (total); transport, Table 13 (rail and waterways, total); military services, Table 16 (column D). An exception is the 1927/28 figure for small industry, missing from the source; we assume that, in the deteriorating conditions of the late 1920s, small industry ceased to grow.

For years after 1913, other civilian sectors are interpolated on the sum of agriculture, large and small industry, construction, and transport.

Table 18. National income, new and old estimates: per cent of 1913

	Proko- povich	Gatrell	Gukhman	Nutter	Gregory	H&M
<i>Russian Empire territory (excluding Poland and Finland)</i>						
1916	97%	80%		...	...	91%
<i>Soviet interwar territory</i>						
1920	48%	...	44%
1923	61%	...	...	53%
1928	112%	107%	110%
<i>Soviet post-1945 territory</i>						
1928

Source: Tables 1, 2, 5, 6, and 16.

Table 19. Net national income of Russia and USSR, total and per head, in 1913 market prices

	Mid-year population, compromise estimate, '000	National income	
		Million rubles	Rubles per head
<i>Russian Empire territory (excluding Poland and Finland)</i>			
1913	152066	20266	133.3
1914	155711	19861	127.5
1915	158735	20598	129.8
1916	159375	18526	116.2
1917	158172	15945	100.8
<i>Soviet interwar territory</i>			
1913	134624	16439	122.1
1914	137891	16084	116.6
1915	140777	16795	119.3
1916	141430	14763	104.4
1917	140363	12899	91.9
1918	139303	7710	55.3
1919	138251	6296	45.5
1920	137761	7244	52.6
1921	137352	6591	48.0
1922	137198	7561	55.1
1922/23	140107	8644	61.7
1923/24	142918	10839	75.8
1924/25	145762	13819	94.8
1925/26	148657	15812	106.4
1926/27	151647	16788	110.7
1927/28	153155	18010	117.6

Sources:

Population (compromise estimate): for calendar years, the July 1 figure given in Table 7, and for economic years the April 1 figure.

National income: Table 17.

Income per head: national income, divided by population (compromise estimate).

Table 20. Russian and Soviet economic and demographic losses in four crises

	Economic losses, per cent			Premature deaths, million		
	National income per head	Personal con- sumption per head	Years	Million	Per cent of initial popul- ation	Years
Great War-Civil War	-63%	...	(1913-19)	14.5	10.8%	(1913-26)
Great Breakthrough-Great Terror	57%	-3%	(1928-37)	9.7	6.2%	(1930-38)
Great Patriotic War	4%	-42%	(1940-43)	24.9	13.1%	(1941-48)
Post-Soviet transition	-38%	-38%	(1990-94)	3.4	2.3%	(1990-98)

Sources:

Economic losses

1913-1919: National income per head at 1913 prices is from Table 19.

1928-1937: GNP (at 1937 factor costs) and household consumption (at 1937 adjusted market prices) per head are from Bergson (1961, pp. 225, 252).

1940-1943: Household consumption per head is from Harrison (1996, p. 104), and national income per head is calculated from GNP and population data given on the same page; all at 1937 factor costs.

1990-1994: National income per head at 1990 "international" dollars is from Angus Maddison at <http://www.ggdc.net/maddison>. Consumption change is for "average money incomes" deflated by consumer prices in Goskomstat Rossii (1995, p. 77).

Demographic losses

1913-1926: Lorimer's figure, adjusted by Wheatcroft and Davies (1994b, p. 63). The 14.5 million deaths include 3 million soldiers and 11.5 million civilians.

1930-1938 and 1990-1998: Rosefielde (2001, p. 1164).

1941-1946: Ellman and Maksudov (1994, pp. 672-673) give 23.9 million as the lower limit on war deaths, to which we add 1 million as the lower limit on deaths from famine in 1946 to 1948 from Ellman (2000a, p. 616).

APPENDIX A. Population and Agriculture: Border Changes and Other Adjustments

Table A-1. Official population of the Russian Empire, 1913 to 1916

	European Russia		Finland	Caucasus	Siberia	Steppe and Central Asia	Total	
	(51 provinces)	Poland					Empire	Excluding Poland and Finland
	000	000	000	000	000	000	000	000
1913	125684	11961	3197	12513	9788	10957	174100	158942
1914	128864	12248	3241	12922	10001	11104	178379	162890
1915	131797	...	3277	13229	10378	11254	...	166658
1916	133552	...	3315	13422	10558	11758	...	169290

Sources:

1913: TsSK (1914, pp. 33-57).

1914: TsSK (1915, pp. 33-57)

1915: TsSK (1916, pp. 33-57).

1916: TsSK (1918, pp. 25-50).

Notes:

Column G is the sum of A to F; Series H is G, less B and C.

Table A-2. Population adjustments and corrections, 1913 to 1916

	Official figures									
	Empire excluding Poland and Finland	Provinces leaving the Empire, 1918-22	USSR in 1922 borders	Correction for double counting			Corrected subtotal		Provinces joining the USSR, 1924-25	
	(A)	(B)	(C)	7% (D)	4% (E)	Low estimate (F)	High estimate (G)	Com-promise estimate (H)	(J)	USSR in 1925 borders (K)
	000	000	000	000	000	000	000	000	000	000
<i>Russian Empire territory (excluding Poland and Finland)</i>										
1913	158942	...	...	-11126	-6358	147816	152585	150201	...	...
1914	162890	...	...	-11402	-6516	151488	156375	153931	...	...
1915	166658	...	...	-11666	-6666	154992	159992	157492	...	...
1916	169290	...	...	-11850	-6772	157440	162519	159979	...	...
<i>Soviet interwar territory</i>										
1913	158942	-20522	138420	-9689	-5537	128731	132884	130807	2248	133055
1914	162890	-21204	141686	-9918	-5667	131768	136019	133893	2300	136193
1915	166658	-21436	145222	-10166	-5809	135057	139413	137235	2353	139588
1916	169290	-21608	147682	-10338	-5907	137344	141775	139559	2407	141966

Sources:

A. Table A-1, column H.

B. The sum of totals living in provinces that left the Empire in whole (from Note 1, below) or part (from Note 2).

C. The sum of A and B.

D and E. Column A (for the Russian Empire territory) or C (for Soviet interwar territory) is corrected for prewar double-counting, as described in the text; since the extent of double-counting is uncertain, the correction may be large or small, and the recommended range of corrections is taken from Table A-3.

F and G. C minus D and E respectively.

H. The average of F and G.

J. Khiva and Bukhara: Population of 1913 is from Vainshtein (1960, p. 453) and for adjacent years is assumed to have been growing at 2.3% annually, the same rate as the population of the Empire from 1913 to 1915.

K. The sum of H and J.

Note 1. Provinces leaving the Russian Empire in whole

	Bessarabia	Vilno	Grodno	Kovno	Kurland	Lifland	Podolsk	Kholm	Estland	Kars	Total
	000	000	000	000	000	000	000	000	000	000	000
1913	2588	2020	2020	1842	783	1493	3955	1068	492	390	16652
1914	2657	2076	2048	1857	798	1744	4057	1088	507	396	17229
1915	2687	2083	2094	1871	812	1779	4128	1088	513	355	17409
1916	2699	2083	2094	1871	812	1795	4191	1088	517	410	17561

Note 2. Provinces leaving the Russian Empire, in part

	Volyn	Minsk	Vitebsk	Pskov	Batumi	Total
	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>
<i>Population living within Empire borders:</i>						
1913	4071	2979	1896	1407	171	...
1914	4189	3036	1953	1425	183	...
1915	4242	3071	1985	1447	186	...
1916	4253	3095	1995	1466	188	...
<i>Of which, living outside future Soviet borders:</i>						
Per cent	50%	33%	33%	10%	50%	...
1913	2035	983	626	141	86	3870
1914	2095	1002	645	143	92	3975
1915	2121	1013	655	145	93	4027
1916	2127	1021	658	147	94	4047

Sources:

Provincial populations: as Table A-1. To fill in observations missing from some columns, numbers (shown in italics) are copied from higher rows.

Proportions living outside future Soviet borders are from Vainshtein (1960, p. 455). Also left outside future Soviet borders were "insignificantly small" numbers of the residents of the Petrograd, Arkhangelsk, and Erevan provinces.

Table A-3. Correction factors for population and agriculture

	Factor
<i>Population, 1913 to 1916</i>	
Large	0.93
Small	0.96
<i>Agriculture, 1913 to 1919</i>	
Grains	1.19
Potatoes	1.283
Horses	1.199
Cattle	1.416
Pigs	1.897
Sheep and goats	1.504

Sources:

The range of population corrections (for double-counting) is found from those listed in the survey by Vainshtein (1980, p. 543), after excluding the unduly large correction proposed by Prokopovich (as we discuss in the text).

Agricultural corrections (for under-reported prewar and wartime harvests and stocks are applied to grains on the authority of Wheatcroft (1990) and Wheatcroft and Davies (1994c); to potatoes following Gukhman (1925), cited by Wheatcroft and Davies (1994c); and to horses, cattle, and pigs following Vainshtein (1960). The correction factor for sheep and goats is the arithmetic mean of the three Vainshtein correction factors for other livestock.

APPENDIX B. Physical Products of Industry and Agriculture

Table B-1. Agriculture, 1913 to 1928: physical units

	Livestock						Industrial crops				
	Grains	Potatoes	Horses	Cattle	Sheep and goats	Pigs	flax fibre	hemp fibre	flax seed	hemp seed	cotton
					Head		Tons	Tons	Tons	Tons	
	<i>Tons</i>	<i>Tons</i>	<i>Head</i>	<i>Head</i>	<i>Head</i>	<i>Head</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>
<i>Weights</i>	51.0%	14.0%	7.0%	7.0%	7.0%	7.0%	3.5%	...	...	...	3.5%
<i>Russian Empire territory (excluding Poland and Finland)</i>											
1913	99176	32699	39099	69495	110034	25948	1071	...	...	...	199
1914	82155	34225	40606	70831	107821	27581	721	...	...	...	218
1915	93212	28958	38344	67462	112540	23790	637	...	...	...	255
1916	79406	19431	36100	61092	127281	20832	619	...	...	...	212
1917	80912	26091	24289	40668	76842	15299	573	...	...	...	113
1918	48581	19799	23479	36645	67839	12121	679	...	...	...	...
1919	38522	19403	22669	32622	58835	8943	425	...	...	...	...
<i>Soviet interwar territory</i>											
1913	88934	25640	35638	61096	101526	20546	928	...	...	...	233
1914	73428	27112	36969	61359	99209	22009	618	...	...	...	279
1915	82919	24404	35207	59151	105047	18423	533	...	...	...	326
1916	69920	14045	31506	49966	83176	19587	537	307	563	289	265
1917	72054	21752	21327	35708	67471	13433	539	...	...	...	141
1918	42657	17385	20616	32176	59566	10643	596	...	...	...	...
1919	33824	17037	19904	28644	51660	7852	373	...	...	...	...
1920	34111	20863	25412	39101	51030	14830	263	257	...	...	...
1921	27668	21343	23331	36818	49721	12491	286	216	...	...	...
1922	46971	22889	18875	33031	40022	7637	319	291	279	257	...
1923	45895	33089	20035	38567	56745	9105	305	316	312	313	...
1924	51581	36237	24980	57690	98389	19254	430	321	303	268	346
1925	72657	38606	26440	60781	114502	18946	367	483	576	548	565
1926	76562	42969	28772	64074	121671	18249	315	431	536	529	559
1927	71719	41218	30727	66203	131768	22552	292	511	518	596	718
1928	71542	39904	32207	67124	137138	25367	365	489	563	534	891

Sources:

All figures in the original sources cited below have been multiplied by the correction coefficients in Table A-3, for reasons given in the text.

Russian Empire territory (excluding Poland and Finland):

1913-1917: Grains, potatoes, livestock, and cotton are from Narkomfin (1922). Grains are computed as the sum of winter and oats, barley, spring rye and wheat, buckwheat, and millet. Original data for 1916 and 1917 do not cover the entire territory of the Empire because of the occupation of western provinces and the failure of some interior provinces to report to the centre. Adjustments are based on the weights of missing provinces in 1913-1915. Poods are converted-tons.

1917: livestock are from TsSU (1921b). Original data for 34 provinces are multiplied by a factor of 82/34 for the 82 provinces of the Empire. An alternative correction would use population weights.

1918-1919: grains, potatoes, livestock, and cotton are from TsSU (1921b). Original data for 34 provinces are multiplied by a factor of 82/34 for Empire territory.

Soviet interwar territory:

1916: livestock are from TsSU (1924b, pp. 136-137).

1913-1917: grains and potatoes are calculated from Narkkomfin (1922).

1913-1916: livestock are calculated from Narkkomfin (1922).

1913-1917: cotton is from Narkkomfin (1922).

1917: livestock are from TsSU (1921b). Original data for 34 provinces are multiplied by a factor of 72/34 for the 72 provinces of the interwar Soviet Union.

1918-1919: grains, potatoes, livestock, and cotton are from TsSU (1921b). Original data for 34 provinces are multiplied by a factor of 72/34 for Soviet interwar territory.

1920-1921: grains, potatoes, livestock, and flax are from TsSU (1924b, pp. 131, 135).

1922: potatoes, livestock, and flax are from TsSU (1924b, pp. 131, 135).

1923: potatoes are from Gukhman (1925, p. 133).

1922-1923: grains are from TsSU (1924a, p. 83).

1924: grains, potatoes, flax, hemp, and cotton are from TsSU (1927, p. 119).

1924-1926: livestock are from TsSU (1927, p. 188).

1925-1928: grains, potatoes, flax, hemp, and cotton are from TsSU (1929b, pp. 221, 249-261).

1927-1928: livestock are from TsSU (1929b, p. 221).

Table B-2. Large-scale industry, 1913 to 1917: the Russian Empire, physical units

	Coal	Anthracite	Oil	Peat	Pig iron	Open hearth steel	Rolled steel	Aircraft	Gasoline	Solar oil	Flour	Raw spirit
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Units</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Grams</i>
	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>		<i>000</i>	<i>000</i>	<i>000</i>	<i>million</i>
1913	30631	4077	8876	1458	4186	4302	3560	280	29.2	77.0	1713	87101
1914	30288	4366	8896	1649	4062	4442	3625	535	25.0	69.9	1528	79972
1915	31212	3258	9197	1417	3667	4098	3249	1305	22.0	39.8	1520	93307
1916	32018	2150	9723	1360	3779	4252	3356	1870	...	...	1659	83351
1917	28615	5189	8198	1163	3121	2549	...	1897	...	...	1761	...

Sources: TsSU (1921a); Narkkomfin (1922).

Table B-3.1. Large-scale industry on Soviet territory, 1913 to 1927/28: Stone and glass, physical units

	Cement	Red brick	Window glass
	<i>Casks</i>	<i>Units</i>	<i>Tons</i>
	<i>000</i>	<i>million</i>	
1913	9275	2143.6	403255
1914	10996	2353.6	374344
1915	8632	1374.2	310230
1916	8167	921.5	214011
1917	5425	674.1	121789
1918	578	314.5	53351
1919	42	188.8	28224
1920	222	189.7	18919
1921	397	94	17600
1922	888	129	41600
1922/23	1385	215.6	70858
1923/24	2250	303.5	98122
1924/25	4454	486.3	174563
1925/26	8144	1007.9	246078
1926/27	10056	1397.8	281788
1927/28	11661	1765	356200

Sources:

1917: TsSU (1927), pp. 244-247.

1918-1928: TsSU (1929a), pp. 302-311.

1913-1927/28: Kafengaus (1994/1930, pp. 354-551).

Note: For some columns in Table B-3, units are not specified or apparently mis-specified in the source. Our methodology for aggregating them is, fortunately, unit-free.

Table B-3.2. Large-scale industry on Soviet territory, 1913 to 1927/28: Mining, physical units

	Coal and lignite	Anthracite	Lignite	Oil	Peat	Coke	Iron ore	Copper ore	Manganese	Sulphur pyrites	Chrome ore	Asbestos	HCl salts
	<i>Tons million</i>	<i>Tons million</i>	<i>Tons million</i>	<i>Tons 000</i>	<i>Tons million</i>	<i>Tons million</i>	<i>Tons million</i>	<i>Tons 000</i>	<i>Tons million</i>	<i>Tons 000</i>	<i>Tons</i>	*	<i>Tons 000</i>
1913	24.257	4.706	9.235	9235	1.724	...	9.215	1117	1.254	66.2	25979	22490	1978
1914	26.813	5.137	9.132	9132	1.814	...	6.539	999	0.906	131.3	9828	15905	1933
1915	26.443	5.037	9.305	9305	1.635	...	5.269	838	0.537	158.8	7207	10172	2003
1916	28.935	5.511	9.880	9880	1.608	...	6.635	762	0.472	364.5	4259	12171	2602
1917	26.232	4.997	8.725	8725	1.391	...	4.955	607	0.382	206.3	13694	6274	1804
1918	10.894	2.075	3.842	3842	1.099	...	0.772	135	0.065	...	868	1360	1321
1919	7.805	1.487	4.614	4614	1.187	...	0.183	64	0.056	...	115	672	610
1920	7.186	1.369	3.831	3831	1.526	...	0.164	4	0.097	...	2965	1458	740
1921	7.002	1.528	...	4001	2.027	...	0.129	4	...	...	...	...	983
1922	7.317	1.723	4.646	4912	2.137	...	0.244	13	0.066	6.3	966	3391	743
1922/23	8.604	2.035	5.271	5271	2.376	...	0.481	62	0.320	18.5	672	6028	1040
1923/24	12.659	2.530	6.069	6069	2.821	0.725	1.043	100	0.427	24.9	7273	8469	1207
1924/25	13.138	3.334	7.060	7060	2.680	1.356	2.083	178	0.573	46.0	30648	12318	1356
1925/26	20.180	5.351	8.323	8323	3.510	2.761	3.307	381	0.970	95.0	26667	18297	1587
1926/27	25.220	6.798	10.284	10284	4.813	3.415	4.804	541	0.840	167.4	18060	21056	2088
1927/28	26.439	8.074	...	11509	5.040	...	5.357	647	0.737	...	...	...	2428

Source: As Table B-3.1.

Note: * Units not reported.

Table B-3.3. Large-scale industry on Soviet territory, 1913 to 1927/28: Metallurgy, physical units

	Iron	Sheet steel	Rolled steel	Copper	Zinc	Lead	Silver	Rails
	<i>Tons 000</i>	<i>Tons 000</i>	<i>Tons 000</i>	<i>Tons 000</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons 000</i>
1913	4216	4247	3509	32.3	2948	1371	4.1	645
1914	4082	4400	3582	32.3	2408	1082	2.4	706
1915	3685	4106	3257	26.0	1884	819	2.0	561
1916	3798	4273	3372	23.6	1523	901	0.9	408
1917	3023	3080	2444	18.5	...	41	...	195
1918	516	402	357	4.0	...	...	...	19
1919	113	199	179	...	...	...	...	35
1920	115	162	147	...	82	193	...	21
1921	116	182	224	...	...	...	...	...
1922	188	317	250	10.8	...	328	0.4	6
1922/23	300	615	474	2.3	16	405	2.6	65
1923/24	680	993	690	2.8	508	643	2.8	93
1924/25	1292	1873	1390	7.6	1491	876	4.2	169
1925/26	2202	2911	2250	11.6	1867	1273	10.0	295
1926/27	2961	3592	2744	13.7	2266	1027	12.6	313
1927/28	3282	4104	3232	...	...	...	...	...

Source: As Table B-3.1.

Table B-3.4. Large-scale industry on Soviet territory, 1913 to 1927/28: Machine building and metalworking, physical units

	Aircraft	Tractors	Ploughs	Harrows	Seeders	Threshers	Winnow- ers and sorters	Reapers and mowers	Steam engines	Pass- enger wagons	Freight wagons
	<i>Units</i>	<i>Units</i>	<i>000</i>	<i>Units</i>	<i>Units</i>	<i>Units</i>	<i>Units</i>	<i>Units</i>	<i>Units</i>	<i>Units</i>	<i>Units</i>
1913	280	1	667	...	68300	110180	49000	111000	654	1031	13801
1914	535	0	...	...	...	...	...	...	763	1223	20385
1915	1305	0	...	...	...	...	...	...	917	886	23486
1916	1870	0	133	...	13688	22000	...	22200	600	502	16792
1917	1897	0	50	6500	...	15200	3200	7600	420	298	12702
1918	255	0	13	100	...	100	500	600	...	...	...
1919	137	0	23	1000	...	100	800	1000	...	...	...
1920	166	0	89	2600	9900	1200	3300	2300	...	...	...
1921	13	0	101	6200	5000	1700	2000	1700	...	...	...
1922	44	0	159	15400	8500	19700	8800	19700	...	...	...
1922/23	146	2	207	26800	10700	25900	11600	25900	...	...	...
1923/24	208	10	174	125800	9700	13600	21300	13600	...	...	...
1924/25	326	481	582	174500	29980	35600	57600	55800	...	...	...
1925/26	469	813	945	310200	61995	54700	94800	88100	...	...	...
1926/27	575	781	1037	355390	58065	66472	141974	170501	...	...	...
1927/28	870	1332	1167	590028	55123	84025	194052	244895	...	...	...

Source: As Table B-3.1.

Table B-3.5. Large-scale industry on Soviet territory, 1913 to 1927/28: Woodworking, physical units

	Sawn timber	Ply- wood
	<i>Cu. m</i> <i>million</i>	<i>Cu. m</i> <i>000</i>
1913	11875	24556
1914	10062	40459
1915	7657	42583
1916	5813	45905
1917	5578	54652
1918	2754	...
1919	2008	...
1920	1484	...
1921	1710	...
1922	3057	3330
1922/23	4584	22995
1923/24	5621	52600
1924/25	8165	84500
1925/26	9943	118000
1926/27	11322	137435
1927/28	12458	...

Source: As Table B-3.1.

Table B-3.6. Large-scale industry on Soviet territory, 1913 to 1927/28: Chemicals, physical units

	Caustic soda	Baking soda	House- hold soap	Rubber foot- wear	Sul- phates	Nitric acid	Hydro- chloric acid	Sul- phuric acid	Conc. sul- phuric acid	Paints
	<i>Tons</i>	<i>Tons</i>	<i>Boxes</i> <i>000</i>	<i>Pairs</i> <i>000</i>	<i>Tons</i>	*	*	*	*	*
1913	49338	159873	94892	27885	70649	9992	60737	132786	51142	3243
1914	52565	144378	96252	23164	41033	8665	42376	98414	43441	3964
1915	46291	117071	111273	23769	54973	16626	31582	156172	79773	1114
1916	49205	135647	111273	19695	49010	25390	39263	184980	73704	164
1917	40017	101307	87341	17402	30502	20197	39354	194693	85224	410
1918	7797	18984	63835	5856	14489	5602	21726	45197	24586	213
1919	1671	4056	7579	2616	3623	3178	4875	22403	17418	98
1920	...	11212	11475	10	9999	1769	16734	16911	6952	49
1921	...	...	8348	626	...	...	...	...	...	...
1922	10631	32170	11603	8568	...	...	17780	36491	6843	524
1922/23	19384	55120	20263	9971	15398	...	23440	51848	12489	1605
1923/24	29550	78151	41197	6178	26176	...	38380	84818	22146	1458
1924/25	35742	98447	74957	15731	23408	...	35906	106064	23424	3800
1925/26	43621	136728	101690	25302	27912	...	43310	147949	24047	8485
1926/27	51437	171445	129623	29631	29824	...	46481	167705	32986	...
1927/28	55734	209011	156097	36004	...	...	...	...	...	...

Source: As Table B-3.1.

Note: * Units not reported.

Table B-3.6 (continued).

	Gasoline	Lighting oil	Solar oil	Residual oils	Matches
	<i>Tons</i> <i>000</i>	<i>Tons</i> <i>000</i>	<i>Tons</i> <i>000</i>	<i>Tons</i> <i>000</i>	<i>Boxes</i> <i>000</i>
1913	262.6	1553	144.1	4127	3753
1914	179.3	1366	111.6	4132	4092
1915	91.3	1153	76.1	5514	2940
1916	223.5	1164	112.9	3713	2900
1917	229.8	1223	147.8	3410	2280
1918	18.7	386	36.9	956	1019
1919	50.9	524	23.2	1643	1008
1920	36.2	396	103.8	1115	633
1921	67.0	532	32.0	2167	782
1922	83.0	565	39.0	2258	1031
1922/23	140.3	613	242.0	2190	1425
1923/24	223.4	789	275.1	2399	1883
1924/25	406.6	1132	355.1	2927	3162
1925/26	603.0	1324	521.6	3191	3955
1926/27	775.2	1740	482.5	3705	4250
1927/28	934.0	2047	655.0	4683	5554

Source: As Table B-3.1.

Table B-3.7. Large-scale industry on Soviet territory, 1913 to 1927/28: Food, beverages, and narcotics, physical units

	Beet sugar	Vinegar	Candle wax	Gly- cerin	Cigar- ettes	Makh- orka	Butter	Beer	Starch	Molasses	Flour	Groats	Raw spirit
	<i>Tons</i>			<i>Tons</i>	<i>Units</i>	<i>Tons</i>	<i>Tons</i>	<i>Hectol.</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Hectol.</i>
	<i>million</i>				<i>trillion</i>			<i>000</i>			<i>million</i>	<i>000</i>	
1913	1794	7257	19100	4980	22.1	78676	...	8064	123673	54154	4938	218631	11564
1914	2130	5242	16348	17707	25.7	84654	...	5015	114357	110241	5496	243365	13443
1915	2578	6634	12482	15561	31.1	73304	...	136	97418	111027	7305	321582	6028
1916	2354	3833	10467	16184	29.4	82330	...	...	77578	93664	3888	172126	2005
1917	2030	1556	4292	2637	22.0	81564	...	...	58495	66996	...	...	476
1918	1166	770	2817	2850	12.7	28468	...	...	13497	30304	...	...	...
1919	394	442	...	...	12.0	18722	...	...	9370	17331	...	...	60
1920	98	246	...	...	4.8	21384	...	...	5831	8354	2977	203348	309
1921	65	...	...	...	5.1	11923	26754	...	...	...	...	...	504
1922	241	...	131	98	12.6	13252	55995	...	35415	5209	...	...	216
1922/23	248	410	573	442	10.8	19546	87652	989	...	17593	2673	182266	280
1923/24	499	770	1491	704	13.0	30599	127506	2276	51861	...	3524	180076	220
1924/25	753	983	3636	1769	26.3	46506	219320	2531	63702	20115	4231	277972	1004
1925/26	1507	1523	5111	3112	37.3	81458	327034	4084	99168	22277	5881	358499	4106
1926/27	1285	1770	4346	4310	40.7	82486	252922	4181	119320	26995	7060	250151	4726
1927/28	1637	...	...	...	49.0	83815	335070	...	...	...	6753	300000	5205

Source: As Table B-3.1.

Table B-3.8. Large-scale industry on Soviet territory, 1913 to 1927/28: Leather and fur, physical units

	Large hides	Small hides	Foot- wear	Pig bristle
	<i>Units</i>	<i>Units</i>	<i>Pairs</i>	<i>Tons</i>
	<i>000</i>	<i>000</i>	<i>000</i>	
1913	570	1203	8349	491
1914	1021	4872	9743	491
1915	1156	4353	8705	459
1916	1100	4919	9837	508
1917	1049	3587	7173	491
1918	3140	4764	4551	410
1919	2613	4517	3105	164
1920	2466	3665	2638	49
1921	3416	3274	3361	165
1922	3510	2856	3442	357
1922/23	4973	4676	4070	606
1923/24	6249	5379	4568	1294
1924/25	7385	9651	8200	1572
1925/26	8397	12521	10827	1376
1926/27	10163	13347	17035	...
1927/28	11554	15643	26246	...

Source: As Table B-3.1.

Table B-3.9. Large-scale industry on Soviet territory, 1913 to 1927/28: Cotton textiles, physical units

	Un-bleached	
	Yarn	cloth
	<i>Tons</i>	<i>Metres</i>
		<i>000</i>
1913	270770	250064
1914	270311	...
1915	298207	...
1916	297945	...
1917	209638	120188
1918	118906	92992
1919	17986	15266
1920	13514	11984
1921	21819	10008
1922	71501	33118
1922/23	74394	65440
1923/24	101893	84196
1924/25	185050	157330
1925/26	240826	201857
1926/27	278101	237778
1927/28	316878	256836

Source: As Table B-3.1.

Table B-3.10. Large-scale industry on Soviet territory, 1913 to 1927/28: Woollen textiles, physical units

	Un-bleached		Finished fabric
	Yarn	cloth	
	<i>Tons</i>	<i>Metres</i>	<i>Metres</i>
		<i>000</i>	<i>000</i>
1913	46455	45063	...
1914	45521	44161	...
1915	46815	45407	...
1916	44244	44358	...
1917	32450	31483	78602
1918	24948	24194	60417
1919	9943	9632	24068
1920	8045	7338	18340
1921	6790	4583	14305
1922	13745	10694	23402
1922/23	14564	17237	29946
1923/24	19306	17855	33853
1924/25	27665	27664	51823
1925/26	32943	32943	66796
1926/27	41100	40606	85209
1927/28	52383	47240	78575

Source: As Table B-3.1.

Table B-3.11. Large-scale industry on Soviet territory, 1913 to 1927/28: Silk textiles, physical units

	Finished fabrics
	<i>Metres</i>
	<i>000</i>
1913	...
1914	...
1915	...
1916	...
1917	...
1918	...
1919	604
1920	429
1921	663
1922	2245
1922/23	3542
1923/24	2161
1924/25	2212
1925/26	5588
1926/27	6468
1927/28	9776

Source: As Table B-3.1.

Table B-3.12. Large-scale industry on Soviet territory, 1913 to 1927/28: Flax and hemp textiles, physical units

	Finished fabrics
	<i>Metres</i>
	<i>000</i>
1913	53253
1914	66751
1915	70076
1916	61198
1917	42360
1918	22605
1919	12367
1920	13104
1921	6605
1922	26678
1922/23	29402
1923/24	39038
1924/25	47536
1925/26	66003
1926/27	66860
1927/28	61979

Source: As Table B-3.1.

Table B-3.13. Large-scale industry on Soviet territory, 1913 to 1927/28: Paper and printing, physical units

	Cartons
	<i>Tons</i>
1913	38216
1914	34055
1915	28764
1916	19657
1917	11188
1918	4714
1919	2277
1920	1854
1921	1553
1922	2935
1922/23	9422
1923/24	12427
1924/25	20168
1925/26	26536
1926/27	37772
1927/28	35460

Source: As Table B-3.1.

APPENDIX C. Russia's Great War and Revolution in Long-Term Perspective

Table C-1. Real national income per head in the former Russian Empire and USSR, 1885 to 2006

	Maddison, inter-			
	Gregory, rubles of 1913	M&H, rubles of 1913	national dollars of 1990	Harrison, rubles of 1937
1885	72.5	...	...	...
1886	69.7	...	...	...
1887	81.5	...	...	...
1888	78.4	...	...	...
1889	72.9	...	...	...
1890	72.6	...	...	...
1891	66.5	...	...	...
1892	72.8	...	...	...
1893	82.5	...	...	...
1894	93.8	...	...	...
1895	86.8	...	...	...
1896	95.6	...	...	...
1897	94	...	...	...
1898	96.5	...	...	...
1899	102.4	...	...	...
1900	100.2	...	1237	...
1901	102.7	...	...	...
1902	111.6	...	...	...
1903	103.9	...	...	...
1904	114.9	...	...	...
1905	101.7	...	...	...
1906	97.2	...	...	...
1907	93.4	...	...	...
1908	102	...	...	...
1909	105.9	...	...	...
1910	113	...	...	...
1911	104.4	...	...	...
1912	112.8	...	...	...
1913	118.5	122.1	1488	...
1914	...	116.6	...	...
1915	...	119.3	...	...
1916	...	104.4	...	...
1917	...	91.9	...	...
1918	...	55.3	...	...
1919	...	45.5	...	...
1920	...	52.6	...	...
1921	...	48.0	...	...
1922	...	55.1	...	...
1923	...	61.7	...	...
1924	...	75.8	...	...
1925	...	94.8	...	...
1926	...	106.4	...	...
1927	...	110.7	...	...
1928	...	117.6	1370	...
1929	...	...	1386	...
1930	...	...	1448	...
1931	...	...	1462	...
1932	...	...	1439	...
1933	...	...	1493	...
1934	...	...	1630	...
1935	...	...	1864	...
1936	...	...	1991	...
1937	...	...	2156	...
1938	...	...	2150	...
1939	...	...	2237	...

Table C-1 (continued)

	Gregory, rubles of 1913	M&H, rubles of 1913	Maddison, inter- national dollars of 1990	Harrison, rubles of 1937
1940	2144	1309
1941
1942
1943	1363
1944
1945	1226
1946	1913	...
1947	2126	...
1948	2402	...
1949	2623	...
1950	2841	...
1951	2806	...
1952	2937	...
1953	3013	...
1954	3106	...
1955	3313	...
1956	3566	...
1957	3576	...
1958	3777	...
1959	3669	...
1960	3945	...
1961	4098	...
1962	4140	...
1963	3985	...
1964	4439	...
1965	4634	...
1966	4804	...
1967	4963	...
1968	5202	...
1969	5225	...
1970	5575	...
1971	5667	...
1972	5643	...
1973	6059	...
1974	6176	...
1975	6135	...
1976	6363	...
1977	6454	...
1978	6559	...
1979	6472	...
1980	6427	...
1981	6432	...
1982	6535	...
1983	6684	...
1984	6708	...
1985	6707	...
1986	6921	...
1987	6950	...
1988	7040	...
1989	7109	...
1990	6890	...
1991	6419	...
1992	5470	...
1993	4928	...
1994	4247	...
1995	4025	...
1996	3911	...
1997	3995	...

Table C-1 (continued)

	Gregory, rubles of 1913	M&H, rubles of 1913	Maddison, inter- national dollars of 1990	Harrison, rubles of 1937
1998	3907	...
1999	4098	...
2000	4454	...
2001	4741	...
2002	5006	...
2003	5397	...
2004	5852	...
2005	6264	...
2006	6766	...

Sources:

Gregory, 1885-1913 (Russian Empire territory): Gregory (1980, pp. 56-57).

M&H, 1913-1928 (Soviet interwar territory): Table 18.

Maddison, 1900, 1913, 1928-1940, and 1946-2006 (Soviet post-1945 territory): <http://www.ggdc.net/maddison/>.

Harrison, 1940, 1943, and 1945 (Soviet controlled territory): GDP from Harrison (1996, p. 92); population from Andreev, Darskii, and Khar'kova (1990, pp. 25-27).