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**Great War, Civil War, and Recovery: Russia's National Income, 1913
to 1928**

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WORKING PAPER SERIES

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Department of Economics

Great War, Civil War, and Recovery: Russia's National Income, 1913 to 1928*

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Abstract

The last remaining gap in the national accounts of Russia and the USSR in the twentieth century, 1913 to 1928, includes the Great War, the Civil War, and postwar recovery. Filling this gap, we find that the Russian economy did somewhat better in the Great War than was previously thought; in the Civil War it did correspondingly worse; war losses persisted into peacetime, and were not fully restored under the New Economic Policy. We compare this experience across regions and over time. 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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Great War, Civil War, and Recovery: Russia's National Income, 1913 to 1928

The long-run impact of the Great War (1914 to 1917), the Bolshevik Revolution of 1917, and the Civil War (1918 to 1921) on the economic life of Russia's citizens can scarcely be overstated. Their immediate impact was also profound, but comprehensive measures of this are lacking. Paul R. Gregory (1982) has provided our best measure of the real national product of the Russian Empire, based on final expenditures, year by year from 1885 to 1913. The annual record begins again in 1928 with Abram Bergson (1961) (GNP by final uses in 1928 and subsequent benchmark years), Moorsteen and Powell (1966) (GNP by sector of origin, 1928 and annually thereafter to 1966), and the U.S. Central Intelligence Agency (CIA 1982, 1990) (GNP from 1950 to 1985), summarized by Ofer (1987). The interval from 1913 to 1928 is left.

Why does the 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. How effectively did alternative government policies and economic systems mobilize the economy in time of war? After seven years of international and civil conflict, how great and how persistent were the damage and losses? 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.

The missing years have a wider significance beyond Russia. The horrors of war and civil war in Russia were not unique. By filling the gap we aim to place Russia more precisely in the spectrum of national experiences of war and civil war in the nineteenth and twentieth centuries.

In this paper we consider, first, the legacy of our predecessors and, in that context, the contributions we can hope to make. Second, we review the economic and demographic challenges presented by the changing borders of Russia and the Soviet Union. In the third section we discuss Russia's national income in 1913, our chosen base year. The fourth section sets out our detailed results. Fifth, we place our results in an international comparative context and, sixth, in the context of more than a century of Russian and Soviet economic growth. The final section concludes.

1. Starting Points

We are not the first to labor in this vineyard. Sectoral and national income and production estimates were previously compiled and published within Soviet Russia and the Soviet Union by Prokopovich (1918b), Litoshenko (1925, 1927), Groman (1927), Gukhman (1928), Varzar (1929),

and various official agencies including Gosplan (1929), TsUNKhU (1939), and TsSU (1957). Some of these have been helpfully collated by Poletaev (1998). Outside Russia we note Prokopovich (1930), Nutter (1963), Falkus (1968), Gatrell and Harrison (1993), and Gatrell (2005). In Appendix A we report and compare these estimates in more detail.

None of these estimates was complete, consistent, and internationally comparable in relation to the period, territory, and branches of activity that were covered. Some estimates took into account only industry and agriculture. As we discuss below, nearly all estimates conformed, intentionally or by default, to a material-product concept that excluded the contribution of final services to national income. A number of estimates incorporated significant statistical biases.

In the west there have 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).

Of all past attempts to understand what happened to Russian national income, by far the cleanest are those of Gregory. Gregory (1982) built up his expenditure-side figures from nominal outlays up to 1913, and also in 1928, deflated by price indices. Gregory (1990) modified the 1928 comparison in response to criticisms by Wheatcroft, Davies, and Cooper (1986). The result is a glass bridge across the gap from 1913 to 1928, providing consistent and comparable estimates of Soviet real national income in the final year relative to the initial year. As Table 1 shows, Gregory found that by 1928 real national income exceeded the 1913 level (within Soviet frontiers) by at most 6.5 percent; since the population on that territory increased by more, average incomes declined somewhat over the years that lay between.

As yet, we lack definitive measures of aggregate economic performance for the years in between. This lack has not deterred scholars from setting out to evaluate the changing Soviet economic policies and institutions over this period. Useful studies of the economic organization of Soviet Russia from the Bolshevik Revolution through the Civil War and the years of recovery include Dobb (1949), Carr (1952), Zaleski (1962), Nove (1972), Davies (1989), Malle (1985), and Boettke (1990). More specialized studies have given attention to agriculture and the peasantry (Kabanov 1988, Figes 1989; Lih 1990; Litoshenko 2001), industry (Kafengaus 1993), urban consumption and trade (Hessler 2004), the famine (Adamets 2006), public finance (Goland 2006; McMeekin 2009; Osokina 2009), and labour (Il'iukhov 2010) in this period.

Allen's (2003) reevaluation of Soviet economic development over the longer term does not address the Great War-Civil War period specifically but has important implications that we will address.

The page from which we start is not, therefore, completely blank, but there are significant gaps and discrepancies. To what extent and to what effect can we improve on what already exists? Our contributions to Russian national accounting fall under three headings – intertemporal completeness; conceptual improvement; and explicit consideration of the welfare aspect of national income in wartime.

First, we provide intertemporal completeness. We fill in all years of this turbulent period. Second, we improve conceptually on existing measures of Russian and Soviet wartime GNP. Russian national accounting has been dogged by the legacy of the “material product system.” This was formalized by the United Nations after World War II (UN 1971), but its intellectual roots go back to Adam Smith and before, and go deep into the thinking of many that would be unfamiliar with its methodological detail. The material product of a society is based on the value of physical commodities produced; this includes the value of intermediate services, such as freight transport, consumed in their production, but excludes services of all kinds (civilian and military, provided privately and by the government) that meet final demand. It has a natural appeal for all that prefer the counting of things over intangible services that are consumed in the same moment that they are produced. This includes many economic historians, given the priority that our discipline has traditionally granted to industrial over commercial revolution. These preferences are present in all previous estimates of Russia’s national income that extend into the period of Great War and Civil War.

Yet, for good reason, the GNP-based “system of national accounts,” which the 2008 SNA is the most recent version (UN 2009), insists that national income should include the value added by the factors of production engaging in producing all goods and services, including services that satisfy final demands. Final services contribute to consumer utility and social welfare. To omit them would make much economic growth in Europe and North America disappear (Broadberry 2006). Even in the short run, the neglect of final services would result in significant distortion if the final services component of GNP were to change sharply. National security is, by convention, a final demand, and the military services that produce it are a final use of resources. In wartime, when the share of the economy devoted to producing military services is relatively expanded. A national income concept that omitted this would ignore a vital discontinuity in the pace of economic activity.

This is what the international conventions say; is it right? It leads to our third contribution. We will offer explicit consideration of the welfare aspects of warfare. The measurement of GNP in wartime raises ethical issues, reviewed recently by Harrison (1996) and Higgs (2006). In principle, GNP should measure the aspect of social welfare that is associated with the provision of goods and services. There is then a paradox in war booms, when war and GNP move oppositely. War reduces social welfare, yet wartime mobilization may raise GNP, measured on a basis that includes military services as an addition to GNP. (In the same way, a crime wave lowers welfare, but crime fighting adds to GNP.)

There are two ways to resolve this paradox. One way is surgical: to exclude expenditures on national defense from GNP. In this perspective, defense is not a final service but an intermediate one that contributes to the costs of maintaining society (Higgs 2006). Accordingly, we should redefine defense as an intermediate use of resources, and count only civilian goods and services as final contributions to social welfare. On this basis, the paradox goes away because 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 surgical criterion we should also cut the costs of policing out of GNP, because policing is an input into personal security. Going further,

should we not also cut away the value of basic housing, fuel, and food? These 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 the surgical approach is that it would violate the international conventions on GNP that now give a more or less universal answer to what we mean by national income. Imperfect as the rules may be, it is questionable whether we should deviate 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?

There are other solutions to the paradox 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 military services ought to 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 in the present case, given that our base year is 1913 when Russia was still a relatively free market economy.

To conclude, 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 or the economic aspect of well being. When inequality is changing, for example, Stevenson and Wolfers (2008) have proposed that the trend in welfare may be captured by the average of logs of personal incomes better than average incomes. This is far beyond what we can do now, and is likely to remain out of reach.

2. Territory and Population

Between 1913 and 1928 the territory 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. Then, 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). Table 2 lists the effects of these changes on the territory and population of the Russian Empire and the Soviet Union. The net effect on territory was small; the land surface under Moscow's dominion in the 1920s was reduced by less than three per cent, compared with that under St Petersburg in 1913. Since the areas lost were densely settled, the effect on population was dramatic, removing one fifth of the official residents of the Empire of 1913 from Moscow's control.

The confusion of border changes raises the question of what national entity and associated territory we should take for our 1913 baseline. One option would be the Russian Empire, perhaps excluding Poland and Finland. We can follow what happened on this territory through 1917, but no further. Our other option is to take the territory of the Soviet state within the frontiers of 1925 to 1939 ("interwar borders") as our benchmark. What happened on this territory can be tracked back to 1913, either from estimates made retrospectively in the 1920s or, where possible, by ourselves deducting the western regions from the Empire. We then follow it through the years after 1917 with relative ease.

As shown in Table 2, the population of the Russian empire (excluding Poland and Finland) in 1913 was officially some 159 million; on the same official figures, the number of people living on the territory of the future Soviet state in the same year, at 138 million, was more than 20 million less. These figures require correction. Government statistics overstated the population of the Russian Empire. The only census of the imperial population was held in 1897. Over 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 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 these authors generally did not describe their

methodologies, it is hard for us prefer one correction over another. Nearer to our own time, working forward from the 1897 census on the basis of births, deaths, and net migration in each year, Sifman (1977) proposed to subtract 5.38 percent from the 1914 population, and it is this that provides our point of departure.

Table 2 shows the corrected population of the Russian Empire at the beginning of 1913 (excluding Poland and Finland) as 150 millions. Correspondingly, about 133 million people lived on future Soviet territory in the same year. Appendix B provides full details of this transition. 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, in contrast, uncertain. Three demographic catastrophes overlapped, arising from the Great War, the Civil War, and a postwar famine. Apportioning deaths among them is a hazardous and unfinished business; Vyshnevskii (2006) reviews previous attempts. To summarize the appendix briefly, we divide the period into 1913 to 1918 and 1920 to 1928. In the first period, we start from Sifman's corrected 1914 population figure. For 1913 and 1915 to 1918 we apply annual birth and death rates from Boiarskii (1948), with war losses and net migration, forced and voluntary, from Volkov (1930). From the closing stage of the Civil War (1920) to the first USSR population census (1926), we use figures reconstructed by Andreev, Darskii, and Khar'kova (1993).¹ That leaves 1919, for which we average 1918 and 1920.

Table 3 presents the results of our reconstruction.² Series for Soviet interwar territory and the Russian empire both show an increase in the population during the first years of the Great War. After 1915 trends diverge. On the Empire territory population then fell continuously until the data come to an end. The main factors were a rise in mortality and (to a smaller extent) a drop in fertility. On Soviet territory, in contrast, the population continued to grow until 1918. The reason was that an incoming wave refugees from the borderland territories of the future independent states, which were strongly affected by conflict, to the interior regions of the Empire that would later form the Soviet Union. The influx onto Soviet territory more than offset the decline in the indigenous population. It came to an end when the Empire collapsed and Russia's Great War ended. Then the Civil War began and the Soviet population went into decline for several years. Its net natural increase remained negative because of high death rates associated with combat, infectious diseases, and famine. At the same time the earlier inward migration was partly reversed because some wartime refugees from the borderlands returned home, leaving Soviet territory to do so, and some indigenous inhabitants joined the White

¹ For full details see Appendix B. Andreev et al. (1993) provide three variants for the early years, based on higher, lower, and median estimates of mortality. We use the higher mortality series on the basis of a study on mortality by Adamets (2003). We further correct the figure for net migration used by Andreev et al. for a misprint that they took over from their original source, Maksudov (1989).

² In this and other tables, numbers are italicized when they are found by interpolation on other series or extrapolation from preceding or subsequent years.

emigration. Only after 1923 did population growth resume at the rate of 2.5 million per year on average.

Over the turbulent decade from the first day of 1914 to the last of 1923, the net change of the population on Soviet territory was positive by a small margin. We account for the components of this increase as follows (in thousands):³

1. Net increase	3,834
2. Births, total	52,156
3. Deaths, total	-49,994
Of which,	
4. Normal deaths	-36,958
5. Excess deaths (row 4, less 5)	-13,037
Of which,	
6. Military deaths, 1914 to 1917	-1,626
7. Other excess deaths (row 6, less 7)	-11,411
8. Net migration	1,672

“Excess” deaths are not the exact number that were killed or died prematurely as a direct result of the Great War and Civil War, for this number is not knowable. Rather, it is the least number that must have been killed or died prematurely because of warfare, given the peacetime probability that some would have died anyway. Our figure of 13 million excess deaths falls between the 12 million proposed by Boiarskii (1948) and the 13.8 million found by Maksudov (1989).

³ For full details, see Appendix B, Table B-3. Our starting point is the 3.8 million net increase found by subtracting the population of 1913 (working forward from the 1897 census) from that of 1924 (working backwards from the 1926 census). We calculate the total of births from fertility rates of Boiarskii (1948), based on the age composition of the population from 1926 census and aging factors. The total of deaths is based on civilian death rates from Boiarskii (1948) for 1914 to 1917, Great War military losses from Volkov (1930), and total death rates from Adamets (2003) for 1918 and 1919 and Andreev et al (1993) for 1920 to 1928. We project normal losses on the base of average mortality in the years before and after the decade. Subtracting normal from total mortality leaves 13 million excess deaths. Thus the total number of births over the decade exceeded the total number of deaths by 2.16 millions. Since this falls short of the net increase in the population, we estimate net migration as the residual. The inflow of refugees from the Western provinces of the Empire before 1918 exceeded the combined sum of the return migration after this year and the White emigration by 1.67 million people. Because the White emigration was about 2 million people it follows that, of the inward refugees, 3.67 million resettled in the USSR. This result is consistent with the findings of Volkov (1930) and Gatrell (1999), who report that report 9.7 million as the gross number of inward refugees, and 4.75 million as the number that were registered as having subsequently left Soviet territory; an unknown fraction of the remaining 4.95 million also left without being registered.

3. Values and Prices

The importance of index number relativity for Russian and Soviet economic history has been recognized since Alexander Gerschenkron's (1951) work on Soviet machinery output identified the gap between alternative measures of the change in economic volume when price and quantity changes are negatively correlated.

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 informative. With regard to meaning, the most important consideration is that in 1913 Russia had a relatively free and open market economy, participating extensively 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. The terms of peasant trade with industry were much less favorable than before (Harrison 1990, pp. 113, 288; Allen 2003, p. 83). Bolshevik interventions sought increasingly to control both prices and quantities (Harrison 2008). In fact, when Abram Bergson (1961) surveyed the interwar years for the closest approximation to market-clearing prices, he preferred 1937 to 1928 – which says little for 1937, but even less for 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 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. We will see in Table 4 that the sector shares of the main branches in value added, calculated at 1913 prices, were as follows:

	Agriculture	Civilian non- agriculture	Military services	NNP
1913	44.4%	54.3%	1.3%	100%
1920	53.0%	36.5%	10.5%	100%
1927/28	44.9%	54.6%	0.5%	100%

Branch shares in the Soviet economy in 1927/28 were nearly identical to those of the Russian economy in 1913.⁴ There was some within-sector change: in agriculture, livestock and industrial

⁴ From 1922 to 1930, annual Soviet economic accounts were organized on the basis of the "economic year," which ran from October to September, i.e. from harvest to harvest. Our usage follows the rule that "1922" refers to the calendar year, while "1922/23" is the economic year, running from October 1, 1922, to September 30, 1923. This is why, in Table 3, we were at pains to identify the July 1 (mid-calendar year) and April 1 (mid-economic year) population totals separately.

crops expanded at the expense of grains, and in industry large scale public establishments squeezed the private artisan sector. These changes were very limited. The effect is that revaluing industrial commodities relative to agricultural produce would leave the comparison of 1928 to 1913 approximately unchanged. To this extent, revaluation in the prices of 1928 would be unproductive.

The figures do show that sector shares varied a lot in intervening years; it was only the starting and finishing points that were roughly similar. In wartime civilian nonagriculture lost ground relatively as well as absolutely, and would be relatively favored by a shift to 1928 prices. Because of this, revaluing everything in terms of 1928 would make the wartime decline look still more catastrophic and the recovery correspondingly steeper. This is what makes the choice of base year non-trivial. But we would not learn anything from it that we do not know already.

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.⁵ For the economy as a whole, in other words, 1913 was a normal year.

4. Real National Income

In Table 4, we estimate the real national income of the Russian Empire and the Soviet Union by sector of origin. We start from the production branch structure of net value added in 1913 on the territories of the Russian Empire (excluding Finland) and the USSR within interwar borders. We use these to weight annual series of branch production, rolling national income of the two territories forward in parallel, year on year to 1917.⁶ In each year of the overlap, the transition

⁵ 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,

$$\ln(INCOME) = -28.48 (7.535) + 0.01738 (8.731) \times YEAR; N = 28, R^2 = 0.7457.$$

Predicted income per head in 1913 is then 118 rubles 5 kopecks compared with measured 118 rubles 50 kopecks.

⁶ Underlying national income shares are taken from Appendix C, Table C-1. There is a discrepancy of territorial coverage for the Russian Empire up to 1917. Annual time series of wartime production of the Russian Empire by sector of origin are based on the Empire territory,

from Russian to Soviet territory is found by subtracting activity on the lost territories (agriculture and transport); or by 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). From 1918 Appendix C provides branch-level data and describes sources and methods, while Appendixes D and E provide commodity-level data for agriculture and industry.

Chart 1 compares our aggregate figures for national income with previous estimates for comparable years, setting both Russia and USSR to 100 percent in the base year (1913 or thereabouts). Some previous estimates have provided relatively complete series for industry and agriculture combined, and Chart 2 compares these with our estimates for these two sectors alone.

Chart 1. Russian and Soviet real national income, 1913 to 1928: New and old estimates, per cent of 1913



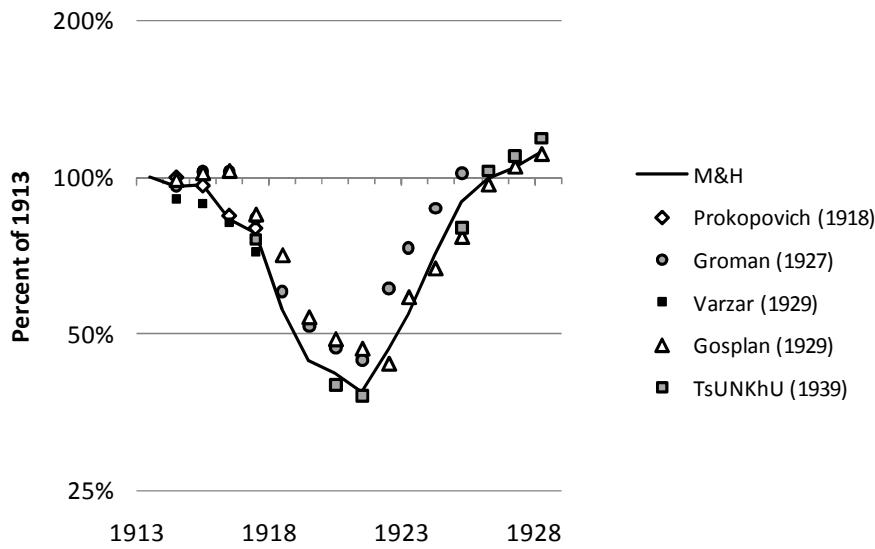
Source: Tables 1 and 4 and Appendix A, Tables A-2 to A-4.

Table 5 compares output with population to find average incomes. While aggregate real output was about 10 percent greater in 1928 than in 1913, average incomes did not fully recover. The reason is that the total population increased by about 14 percent, within constant

excluding Finland and Poland. We weight them by national income shares based on the territory excluding Finland only. Ideally we would deduct the contributions of the Polish provinces of the Russian empire from these shares. The Polish provinces, with other western provinces of the future independent states, formed the economically most developed region of the Russian Empire, but the exact sectoral composition of Poland's national income in 1913 is unknown. Correction for this would leave our estimates effectively unchanged. As a cross-check, we applied Soviet-territory production branch weights estimated for 1913 to the Russian Empire production series. Annual pairs differed by not more than 0.15% in any year.

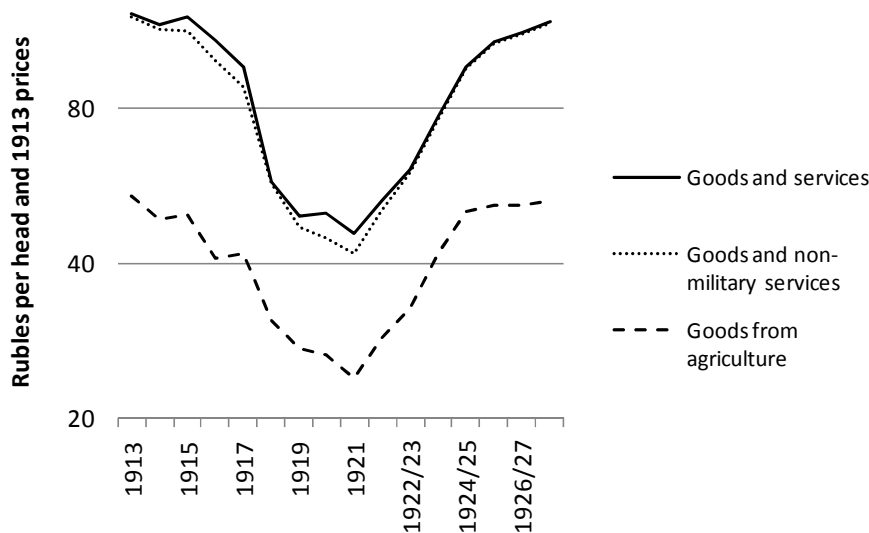
boundaries and taking the period as a whole. As a result, Soviet national income per head in 1928 fell short of the prewar benchmark by around 3 percent. This finding confirms the shortfall found independently by Gregory (1990) and reported in Table 1.

Chart 2. Real national income produced in industry and agriculture on Soviet interwar territory, 1913 to 1928: New and old estimates, per cent of 1913



Source: Table 4 and Appendix A, Tables A-1 and A-5.

Chart 3. Real national income and consumption per head, 1913 to 1927/28: Soviet territory and various measures in rubles and 1913 prices



Source: Table 5.

Chart 3 shows, in addition to national income (“goods and services”) per head, two other measures of the average level of existence of Russian and Soviet citizens. “Goods and non-military services” aims to capture the availability of resources for civilian use. In the spirit of Higgs (2006), it would exclude defense from national income as an intermediate rather than final use of resources. The military services excluded here are the labor services provided to defense; ideally we would also subtract the value of capital services and material consumption in the defense budget, but there are no measures on which we could base such a series. So this series is only an upper bound on the measure we desire. As the chart makes clear, resources for civilian use fell more rapidly than total output during the Great War, and again during the Civil War; although the Red Army never achieved the absolute numbers of the Imperial Army, overall resources were so shrunken by the low point of 1920 and 1921 that the proportional burden it represented was as great or larger.

Finally, “Goods from agriculture” aims to capture the trend in food availability per head, which fell to a catastrophically low level. The result was urban famine, then famine. The February 1917 Revolution that brought down the Tsar was sparked by urban food shortages. In October 1917 the Bolsheviks inherited a public and private distribution system in collapse (Carr 1952). Despite falling harvests, procurement brigades stripped the grain producing regions of food (Malle 1985; Figs 1989). Those who stayed in the towns were forced into a “crisis mode of consumption” (Hessler 2004, pp. 38-48). By the end of the war, money wages were apparently 4 percent of their prewar level in real terms (Il’iukhov 2010, p. 24), with workers surviving on public and private inventories and barter.

Although average incomes were not fully restored in 1927/28, 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 4. There were two important differences. 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. From the standpoint of the civilian economy and consumption this was a “peace dividend,” but one that caused military and political leaders huge anxiety given Soviet Russia’s state of military encirclement— both real and imagined – in the late 1920s (Simonov 1996; Sokolov 2008). This concern became an important stimulus to Stalin’s Great Leap Forward.

The year-on-year pattern of change in real national income per head is revealing in various ways. As Chart 1 suggests, our results give Russia fuller credit for the military mobilization of 1914 through 1916 than previous estimates, and revise the pessimistic view of Russia’s Great War that is well established in the literature (Sidorov 1973, Gatrell 2005). The economy held up 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 accounts. Comparing 1917 with 1913, output per head fell by one fifth in four years. Over the two years that followed, from 1917 to 1919, output per head halved. On Soviet territory the year-on-year decline (taken from Table 5) was as follows:

1914	-4.5%
1915	2.9%
1916	-11.1%
1917	-12.1%
1918	-38.8%
1919	-13.7%
1920	0.3%
1921	-8.5%

Notably, output fell most precipitously *before* 1919 when the Red and White armies clashed most fiercely. This suggests strongly that the confrontational policies of “war communism,” with widespread nationalization of finance and industry, and rule by decree instead of market incentives, caused greater disruption than the fighting. Moreover, as the fighting died away, the economy stabilized at around 40 percent of prewar output but did not at first recover. By 1920, with a command economy in place, the Bolsheviks were able to stabilize large-scale state industry and return it to a path of modest growth. But agriculture continued to struggle, because the policy of surplus confiscation under war communism gave peasants no reason to produce food above subsistence (Litoshenko 2001). A deadly game ensued between the farmers and the authorities over the true level of food reserves in the countryside.

A notable feature of our results is that the famine year of 1921 came after a run of disastrous harvests. 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 4 and chart 3 reveal, 1921 was the third and worst year in a series of catastrophic grain harvests. Consistently with this, new research by Adamets (2003), suggests that the famine actually began in the summer of 1920, and in some regions as early as 1919.

Postwar recovery began only in 1922, following the revolutionary government’s decision to restore market relations and the private sector in small industry and urban-rural trade. The “New Economic Policy” (NEP) was announced in March 1921 under crisis conditions of accelerating hyperinflation and famine; recovery was marked only in the following year. The main mechanism of recovery was the exploitation of spare capacity which, according to Davies (1994, p. 345, footnote 15), continued until 1929/30. The year-on-year growth of Soviet GDP per head up to 1927/28 was then as follows:

1922	16.1%
1922/23	15.3%
1923/24	26.6%
1924/25	24.9%
1925/26	12.3%
1926/27	4.1%
1927/28	5.2%

Strong at first, the recovery slowed rapidly to single-digit growth. In April 1929 when the Bolsheviks officially endorsed the “optimal” variant of the first Five-Year Plan, average incomes were just below the prewar level. In fact, Soviet GDP per head did not significantly exceed this benchmark until 1934. The prewar benchmark is a intuitive focal point for comparison, but is it

the right one? Inspired by Jánosy (1971), the comparative literature on trend growth, war, and postwar catch-up (Crafts and Mills 1996; Crafts and Toniolo 1996; Harrison 1998) suggests that productive potential does not stand still when war breaks out. From this point of view, the prewar benchmark is an excessively low bar. By 1928, fifteen years had passed since the outbreak of the Great War. If in the intervening period Russia's potential GDP per head had risen along its modest pre-1913 log-linear trend of 1.75 percent per year, then by the end of the 1920s the actual fell short of the potential by about one quarter.

While the period under scrutiny is all too short, our figures do not support the view that NEP provided effective institutions and policies for long term Soviet economic development. Once widely held, this view was updated recently by Allen (2003). Specifically, Allen argued that the best development strategy for the Soviet economy in the 1930s would have been industrialization under a soft budget constraint on industrial producers and without collectivization of agriculture, i.e. the New Economic Policy as it was implemented in the late 1920s. This conclusion is hard for us to swallow. One reason is in our figures: agriculture stagnated as the investment mobilization intensified, with significant aggregate effects that showed up in the deceleration and failed restoration of average incomes. Another reason is that Stalin was turning to violence against the peasantry at exactly this time, motivated by the need to resolve the urban rural market disequilibrium brought about by the soft budget constraint on industry.⁷

5. Russia in Comparison

In this section we aim to compare Russia's economic experience of world war, civil war, and recovery with that of other countries. Russia's experience of the Great War up to 1917 was neither better nor worse than that of most other European countries that entered the war. Previous research has suggested that national success in wartime mobilization varied inversely with the prewar level of economic development, controlling for contingent factors such as distance from the war and the time to mobilize (Broadberry and Harrison 2005, 2008; Eloranta and Harrison 2010). But this relationship is created with a limited sample, largely by contrasting

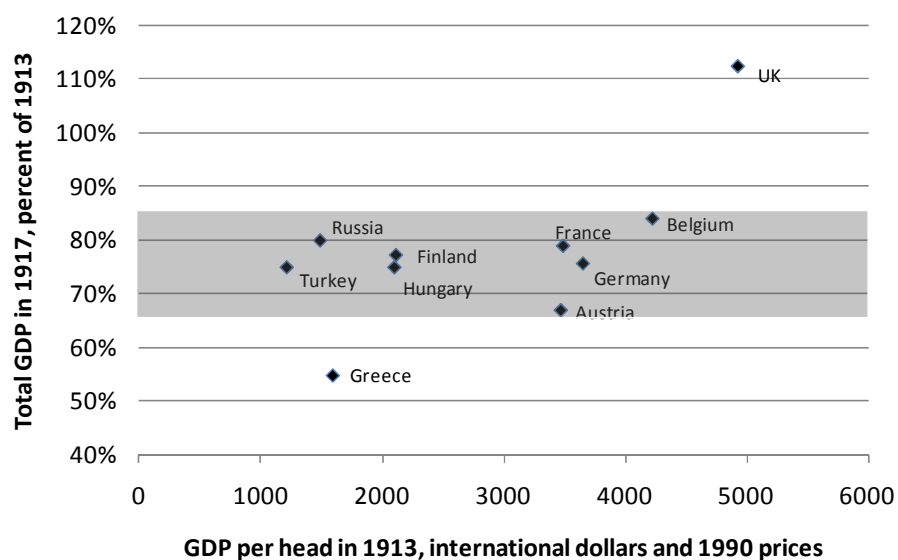
⁷ These views have long pedigrees. It was the rethinking of the Soviet "model" of economic development in the 1960s and 1970s that did most to propagate favourable reevaluation of the New Economic Policy; for a survey see Harrison (1980). The adverse impact of macroeconomic disequilibrium on microeconomic incentives in the late 1920s, emphasized by Harrison (1980, 1990) and Johnson and Temin (1993), provides necessary context for new evidence on Bolshevik decision making surveyed by Harrison (2008). Allen's (2003) rethinking of the macroeconomics of NEP appears inconsistent: in simulations he finds that a soft budget constraint on public-sector industry added to Soviet welfare by raising aggregate employment and output (2003, pp. 167-171), while in narrating the history of the 1920s he accepts that macroeconomic imbalance contributed to the demise of NEP (pp. 85-86). But excess aggregate demand in the macroeconomy flowed from the soft budget constraint in the microeconomy. For related reservations see also Davies (2004).

the richer maritime powers with poorer continental economies. It is also sensitive to the revision of individual data points.

Chart 4 plots changes in real GDP of ten Eurasian countries from 1913 to 1917 against their prewar level of economic development, represented by GDP per head in 1913, and incorporating revised data for Russia. In addition to Russia itself, we observe eight other continental powers (Belgium, Germany, France, Austria, Finland, Hungary, Greece, and Turkey), and one offshore power (the United Kingdom). There is a positive slope to the relationship, but this slope relies on two observations, the richest country (the United Kingdom, the only offshore power) and the third poorest (Greece). If these are excluded, the relationship is flat; the average for the continental powers was a GDP decline of 23%, while Russia's GDP declined by 20%.

Underlying this was a continental Eurasian pattern of wartime economic decline. The pattern reflected a common story, based on the burden of subsistence agriculture (Broadberry and Harrison 2005). Across the continent from Russia through Germany, Austria, Hungary, and the Balkans to the Ottoman Empire, military mobilization deprived peasant farmers of men and horses, which initiated a production decline. But the supply effect was secondary compared with the market disruption caused by the mobilization of domestic industry; this squeezed the availability of all those things for which peasants were willing to trade their food surpluses. Peasants withdrew from the market, cutting flows of food from country to town to a trickle. Interventions to ration food at low prices to urban consumers generally increased the market disequilibrium that already existed.

Chart 4. Wartime mobilization: The GDPs of selected Eurasian countries in 1917, percent of 1913



Source: Appendix F, Table F-1.

In Russia, town and country were drifting apart well before the revolutions of February and October 1917. This drift led to urban food shortage in 1916/17 and so contributed to the downfall of the old regime. But Russia was not alone in its experience of urban famine, and Russia's overall economic performance was no worse than that of other countries that conformed to the continental pattern of decline. Other factors must be called upon to explain why Russia took first place among the countries where the Great War ended in revolution.

The turn to political and social confrontation and civil war vastly magnified Russia's economic disintegration. In principle the causes and consequences of Russia's Civil War may be compared with those of other civil wars of the past two centuries. Quantitative studies using cross-country data have been limited to the period after 1945 (Paul Collier and Hoeffler 2007; Blattmann and Miguel 2010); they seem intrinsically unlikely to throw much light on the causes of civil war in Russia in 1917. Russia shows two markers that have had predictive value for the onset of civil war: a political constitution that restricted competition and participation, and several years of declining output (Blattmann and Miguel 2010). But so did most other countries in Central and Eastern Europe at that time; we will probably not be able to explain why Russia was the first to descend into revolution and civil war without reference to historical factors that were unique to that country and period.

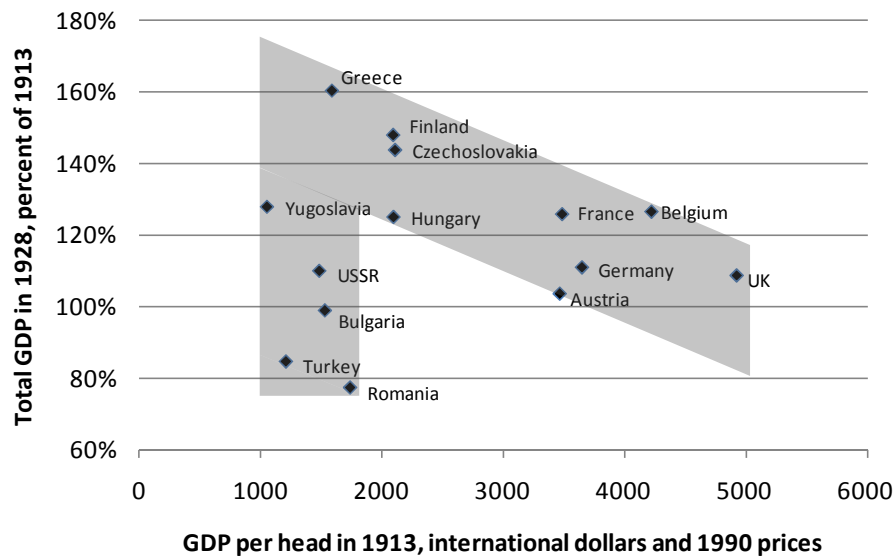
In the same way the progress and outcome of Russia's civil war have specific as well as general features. Paul Collier and Hoeffler (2004) have suggested civil conflict may begin with grievances, but selection into the ranks of the contending forces ensures that grievance gives way quickly to greed as the force that drives conflict to a conclusion. We see the Russian conflict sparked by grievance, then fuelled by greed, but with the difference that Bolshevik greed was for totalitarian power to the extent that it was not already for careerism and corruption (Raleigh 2006, p. 154).

The consequences of Russia's civil war were very severe in international comparison. In Russia, output fell by more than one half; this is much more than the average effects found for civil wars since 1945 (Blattmann and Miguel 2010). We look to earlier periods to find devastation on the same scale. On the losing Confederate side of the American Civil War of 1861 to 1865, production fell by half and real wages collapsed to 11 percent of their prewar level (Ransom 2001). What happened in the Russian Civil War was similar or worse. A difference was that it happened to the winners, not the losers.

The economic outcomes of the Russian Civil War also appear to have been more severe than those of civil war in Spain from 1936 to 1939. There, GDP fell by more than one quarter and consumption by more than one third between 1935 and 1938 (Martín Aceña 2006). In addition there was excess mortality of more than half a million up to 1942, or around 2 per cent of Spain's prewar population (Antonio Ortega and Silvestre 2006).

No production figures are available for China during its Civil War, fought intermittently from 1927 to 1949. As in the Russian case it is impossible to disentangle the premature deaths in the Civil War from those of the World War, but the total up to 1945 exceeded 35 million (Tao 2010, p. 13). In proportion to China's prewar population, around 500 million in the early 1930s, Russia's losses were similar or worse.

Chart 5. Postwar recovery: The GDPs of selected Eurasian countries in 1928, percent of 1913



Source: Appendix F, Table F-1.

Finally, we turn to recovery. Russia's recovery from its Great War and Civil War is placed in Eurasian context in Chart 5. This chart shows two principal moments in the pattern of postwar performance. One group of countries is ranged along a downward sloping convergence frontier from Greece on the left to the UK on the right. To the left, a second group of countries from Yugoslavia to Romania, all relatively poor at the outset, and more or less badly performing over the period, falls below the frontier.⁸ The Soviet economy is found in the midst of this group. This confirms our pessimistic evaluation of Soviet economic performance under NEP.

6. The Long Run

Chart 6 sets 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

⁸ This argument might be formalized further. We regress the annual average growth rate of GDP per head, 1913 to 1928, on the logarithm GDP per capita in 1913, a World War I dummy and a Soviet Union dummy for all 43 countries for which data are available in the Maddison dataset (<http://www.ggdc.net/maddison/>). We get:

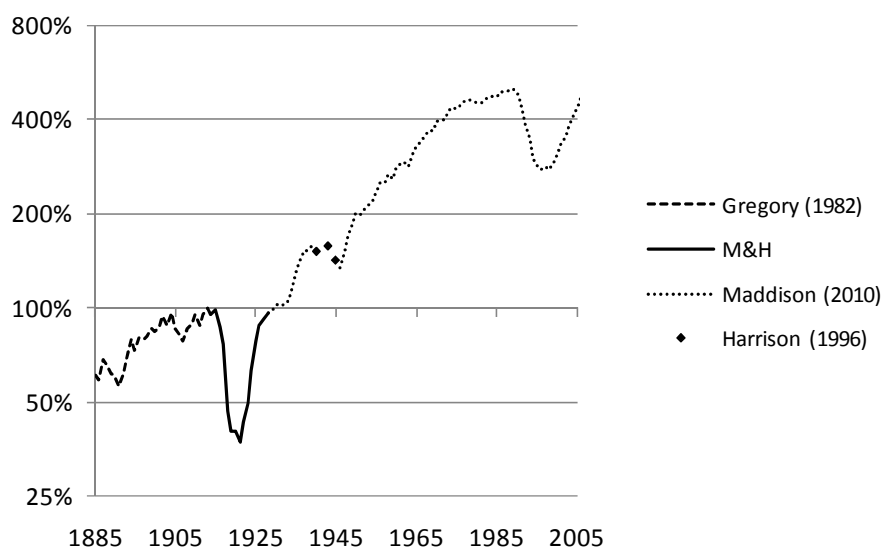
$$\text{Rate191328} = 0.07^{**} - 0.007^{**} \ln(\text{GDP/head1913}) - 0.009\text{WW1} - 0.015^{***}\text{SU};$$

$$N = 43, R^2 = 0.17$$

Table F-2 provides the dataset and results of other specifications. The coefficient on the Soviet Union is negative and statistically significant at the 1% level, i.e. the annual growth rate of average Soviet incomes between 1913 and 1928 was 1.5% slower than it should have been, conditional on the prewar GDP level and engagement in the war.

induced the deepest crisis that Russia experienced in more than a century of modern economic growth.

Chart 6. *Russia and the Soviet Union: Real national income per head, percent of 1913*



Source: Appendix F, Table F-3. All figures are indexed to 1913.

Table 6 provides a more detailed comparison with other major shocks to Russia in its troubled twentieth century. Taken together these comprise just about every disaster that can befall modern societies, including foreign wars, internal wars, famines, and state collapses. In the table we combine income and consumption measures with estimates of the accompanying demographic losses. Few of the figures in the table will ever command a scholarly consensus in precise terms, but they are broadly instructive. We briefly narrate the stories behind them.

Stalin's Great Breakthrough refers to the events following the adoption of the first Five Year Plan in April 1929. Consumption was repressed; capital was created in industry and labor and food were moved out of agriculture. Since productivity in both sectors declined, there was at first no gain in total output. The average figure for the consumption decline hides wide variation between regions and especially within the countryside. The struggle to control food distribution stripped the countryside of grains and spread famine through the Ukraine, the Volga region, the North Caucasus and Kazakhstan. Famine in the early 1930s contributed 5.5 to 6.5 million premature deaths.

Only in the mid-1930s did living standards begin to recover, peaking in 1937. Allen (2003) has argued with some justice that traditional index number concepts employed, for example, by Bergson (1961), somewhat understated the underlying welfare gain of up to 30 percent by 1937, compared with 1928 to 1937. However, Allen's own estimates for farm income in 1937 are probably too high; they rely too heavily on inferences from production statistics, and make no allowance for market disequilibrium (Davies 2004; Ellman 2004). And it should not be forgotten that millions of citizens who ought to have been alive to enjoy the unexpectedly good harvest of

1937 had starved to death in the interim. Presumably, their absence helped to lift the average consumption of the survivors.

It is notable from Chart 6 that Soviet average real incomes reached an interwar peak around 1939. Let us compare this peak with an earlier one, not 1913 but 1904, the eve of the 1905 Revolution, when incomes were already almost at the level of 1913. Over the 35 years from 1904 to 1939, incomes rose by about 75 percent. But in most intervening years there was no net growth at all. In fact, three quarters of the net growth that took place from peak to peak was achieved in just five years, from 1933 to 1937. By that year, the Soviet economy had just about struggled back to the pre-1913 trend.⁹ This suggests that all Stalin had brought about by World War II was recovery from the 1905 Revolution, World War I, the Bolshevik Revolution, the Civil War, and his own policy of collectivization.

The central event of the decade from 1937 to 1947 was the Great Patriotic War of 1941 to 1945. Linked to it are preparations for war in the preceding years and a food crisis that followed the end of the war. Under war preparations we include both large-scale rearmament and the Great Terror, Stalin's preemptive war against his potential internal enemies (Khlevniuk 1996) that killed up to a million people in 1937/38. The war then added more than 26 million excess deaths in combat, and from disease, famine, and repression on both sides of the front line. With the German invasion, Soviet-controlled territory shrank, but Stalin's policies successfully managed the war economy. The loss of agricultural land and the intense mobilization of resources into war production and military services put living standards into a deadly squeeze, however. Coming on top of a prewar decline induced by rearmament pressures, consumption per head fell by up to one half. At the end of the war, a regional food crisis struck the Ukraine, southwestern Russia, and Soviet Moldavia and carried off more lives.

Finally, the collapse of the Soviet Union led to economic and demographic upheaval for post-Soviet Russia. The transition from socialism is the only crisis in which mass violence did not take the lead. In fact, it was associated with economic losses on the scale of a major war, but with only minor wars taking place. Official figures suggest that up to 1998 average incomes and consumption fell by around two fifths. Such figures overstate the decline in welfare, however, because they neglect the contemporaneous gain to consumers as the retail market evolved from severe shortage to equilibrium; this gain may have been substantial (Irwin Collier 2005).

While economic aspects are debated, assessments of the demographic costs of transition are extremely polarized. In Table 6 we give an upper and a lower limit. Our lower limit is 100,000 deaths arising from small-scale ethnic clashes and regional conflicts. Our upper limit includes additional deaths among men of working age across Russia as a whole, particularly from alcoholic-related causes, interpersonal violence, and other diseases (UNICEF 2000). The causes of increased mortality are disputed. The upper limit attributes all mortality above that predicted by the application of age-specific mortality rates of 1989 to transition. In support, Stuckler, King, and McKee (2009) assign responsibility for the additional mortality burden to mass privatization and the actual or expected unemployment that, they claim, it brought about.

⁹ For the pre-1913 trend, see footnote 2.

To the contrary, Earle (2009), Brown and Gehlbach (2010) and Gerry, Mickiewicz, and Nikoloski (2010) reject the attribution of mortality while Brown, Earle, and Telegdy (2010) reject the transmission from privatization to unemployment. In earlier work, Brainerd and Cutler (2005) attributed up to a quarter of the increased mortality to the relative cheapening of alcohol over the same period. More generally, male life expectancy in the Soviet Union was on a downward trend from the 1960s until the last Soviet anti-alcohol campaign of the mid-1980s (Demoscope 2009). It is plausible that the mortality spike of the early 1990s consisted entirely of deaths that were postponed by the campaign, and so were stored up and waiting to happen when the campaign came to an end. These views of transitional mortality are uncompromisingly opposed to each other, and cannot be averaged.

Table 6 confirms that the Great War and Civil War rank first among Russia's economic disasters of the last century. National income per head fell by more than three fifths from 1913 to 1921. We approximate the consumption loss by agricultural production per head, which fell by more than one half. The overall burden of excess deaths was around 9 percent of the prewar population. Normalized by the prewar population, the demographic burden fell not far short of that of World War II. Hunger-related causes were the most important factor in excess mortality, followed by fighting and terror in the Civil War. Mass emigration also took place.

If there is a general lesson from Table 6, it is the importance of the state in the history of modern Russia. In the Great Breakthrough and the Great Patriotic War, the state remained intact. Production was maintained in the midst of disasters that killed millions of people. In particular the state retained its ability to transfer food from people of secondary status such as peasants and forced laborers, who then died, to soldiers and industrial workers, who then lived. In contrast the state failures of 1917 and 1991 were associated with huge losses of output as well as of consumption and lives. In each case the scale of deaths depended heavily on the presence of open violence; this is exemplified by the comparison of two transitions.

Since Vladimir Putin (2000), Russia's political establishment appears to believe that the answer for Russia is to shore up the "power vertical" of the state at all costs. In this view, no outcome is worse than a failed state. Russia's twentieth century shows that a failed state could be associated with terrible suffering, but it also associates grim suffering with a state powerful enough to starve and kill without restraint, with or without the intention to do so. Whether the answer for Russia is confined to state consolidation, or includes building an economy that is more deeply rooted in civil society and private enterprise and more resilient in the face of political action, is another story.

7. Conclusions

Our work fills the last remaining gap in the record of Russian and Soviet national income in the twentieth century. This gap, starting in 1914 and finishing in 1928, 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, which set the stage for Stalin's Great Breakthrough to forced industrialization.

In comparison with previous interpretations, our findings give a more favorable picture of Russia's economic mobilization for the Great War. Correspondingly, 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. We draw negative inferences concerning both the quality of Soviet economic institutions and policies in the 1920s and the economic achievements of the 1930s.

Wars and revolutions have the capacity to wreak havoc on modern societies. Nesting one inside the other, Russia's Great War and Civil War led to economic disaster and demographic tragedy. The scale of losses can be measured against both Russian and global standards. In Russian terms it was the worst economic disaster of the twentieth century. Only World War II resulted in a greater loss of Russian lives. International comparisons also rank the Russian experience of warfare between 1914 and 1921 highly in the damage done to life and living standards.

Tables

Table 1. Gregory's population and national income: Russia and USSR, 1913 and 1928

	Russian	Soviet Union,	
	Empire	interwar borders	
	exc.	Best	Upper
	Finland	estimate	limit
<i>Population, million</i>			
1913	171	139.7	
1928	...	154	154
Percent of 1913	...	110.2%	110.2%
<i>NNP, million rubles at 1913 prices</i>			
1913	20266	16520	
1928	...	15600	17600
Percent of 1913	...	94.4%	106.5%
<i>NNP/head, rubles</i>			
1913	118.5	118.3	
1928	...	101.3	114.3
Percent of 1913	...	85.7%	96.6%

Sources:

Russia and Soviet Union, best estimate: Gregory (1982, p. 113).

Soviet Union, upper limit: Gregory (1990, p. 337).

Table 2. From Russia to the USSR: Territories and Populations of January 1, 1913

	Area in square km	Official popula- tion	Less double counting	Corrected popula- tion
	000	000	000	000
Russian Empire in 1913 borders	21800	174100	...	...
Finland	-326	-3197	...	...
Empire exc. Finland	21474	170903	-9195	161708
Poland	-113	-11961	...	...
Empire exc. Finland and Poland	21361	158942	-8551	150391
Other territory lost*				
Western	-375	-20047	...	...
Caucasus	-22	-475	...	...
USSR in 1922 borders	20964	138420	...	...
Territory gained**				
Central Asia	278	2259	...	...
USSR in 1925 borders	21242	140679	-7447	133232

Sources:

Area: Figures in square versts given by IRI RAN (1995), pp. 11-15, converted at 1.0668 km per verst.

Population: As Tables B-1 and B-2.

Notes:

* West: The provinces of Bessarabia, Vilno, Vitebsk (33%), Volyn (50%), Grodno, Kovno, Kurliand, Lifliand, Minsk (33%), Podolsk, Pskov (10%), Kholm, Estliand, and insignificant parts of Arkhangel and Petrograd. Caucasus: the provinces of Kars, Batumi (50%), and insignificant parts of Erivan.

** Central Asia: Khiva and Bukhara.

Table 3. Population of Russia and the USSR, 1913 to 1928

	Official figures Jan. 1 (A)	Corrected for double- counting, border changes and migration			Territory under government control	
		Jan. 1	Apr. 1	July 1	Jan. 1	July 1
		(B)	(C)	(D)	(E)	(F)
	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>	<i>000</i>
<i>Russian Empire exc. Finland and Poland</i>						
1913	158942	150391	...	152259	150391	152259
1914	162890	154127	...	155188	154127	155188
1915	166658	156249	...	156050	156249	150620
1916	169290	155851	...	155329	144991	144469
1917	...	154807	...	154432	143948	143573
1918	...	154057	...	...	...	...
<i>Soviet interwar territory</i>						
1913	...	133232	134015	134798	...	...
1914	...	136363	137073	137783	...	...
1915	...	139203	139787	140371	...	...
1916	...	141539	142087	142634	...	...
1917	...	143729	143943	144157	...	...
1918	...	144585	144146	143707	...	...
1919	...	142829	142390	141950	...	...
1920	...	141072	140070	139068	...	...
1921	...	139068	138722	138376	...	...
1922	...	137684	137720	137756	...	...
1923	...	137827	138419	139012	...	...
1924	...	140196	140938	141680	...	...
1925	...	143163	143818	144472	...	...
1926	...	145781	146500	147219	...	...
1927	...	148656	149398	150139	...	...
1928	...	151622	152388	153155	...	...
1929	...	154687	...	...	...	...

(Table 3 cont.) Sources:

A and B. Figures for 1913 to 1918, official and after adjustment, are from Tables B-1, column H, and B-2, columns H and K. Figures for 1920 to 1928 are from Andreev, Darskii, and Khar'kova (1993, p. 119), using their high-mortality series for 1920 through 1922. For discussion and our own corrections, see Appendix B.

C and D. The July 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 (October to September) average, is the average of the January and July figures for the current year.

E and F. Figures are adjusted for territory held by the Imperial government.

Note:

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

Table 4. Net national income of Russia and USSR: million rubles at 1913 market prices and percent

	Industry							Total	Percent of 1913
	Agri- culture	Large- scale	Small- scale	Con- struction	Trans- port	Other Civilian	Military Services		
<i>Russian Empire exc. Finland and Poland</i>									
1913	8288	2793	1212	956	972	4263	243	18727	100.0%
1914	7643	2969	1188	971	1033	4138	410	18352	98.0%
1915	7795	3099	950	714	1243	4137	1095	19034	101.6%
1916	6709	2631	1069	557	1329	3686	1553	17535	93.6%
1917	6575	2046	950	400	776	3222	1362	15331	81.9%
1918	5128	876	891	137	...	...	...	...	...
1919	4464	463	594	104	...	...	...	...	...
<i>Russian Empire (exc. Finland and Poland) under government control</i>									
1913	8288	2793	1212	956	972	4263	243	18727	100.0%
1914	7643	2969	1188	971	1033	4138	410	18352	98.0%
1915	7301	3099	950	714	1243	3989	1095	18392	98.2%
1916	6198	2631	1069	557	1329	3533	1553	16870	90.1%
1917	6054	2046	950	400	776	3065	1362	14653	78.2%
<i>Soviet interwar territory</i>									
1913	7292	2408	981	878	833	3835	213	16439	100.0%
1914	6710	2560	962	891	859	3708	360	16050	97.6%
1915	6931	2671	769	655	1088	3750	961	16825	102.3%
1916	5723	2268	866	512	1198	3270	1363	15199	92.5%
1917	5838	1764	769	367	658	2908	1196	13500	82.1%
1918	4464	755	721	126	175	1932	62	8236	50.1%
1919	3878	399	481	96	222	1571	372	7019	42.7%
1920	3653	421	433	62	145	1459	724	6897	42.0%
1921	3282	384	481	60	178	1357	535	6277	38.2%
1922	3927	533	529	113	229	1650	273	7254	44.1%
1922/23	4527	746	577	178	298	1958	121	8406	51.1%
1923/24	5891	973	702	242	396	2539	97	10839	65.9%
1924/25	7236	1509	813	401	521	3243	97	13819	84.1%
1925/26	7613	2152	894	614	728	3715	97	15812	96.2%
1926/27	7756	2442	981	744	824	3945	97	16788	102.1%
1927/28	8079	2852	981	881	887	4234	97	18010	109.6%

(Table 4 cont.) Sources:

For 1913, the starting point for national income and value added by sector of origin on both Russian and Soviet territory is Table C-1, but the Empire territory here includes Poland, which we deduct from national income as a whole in proportion to its population (Table 2) multiplied by the relative income coefficient of 1.0852. We assume that Poland was at least as wealthy, relative to the rest of the Empire, as all western provinces were, relative to the provinces that formed the Soviet Union. Comparing the two territories shown in Table C-1, it is easily found that, in the western provinces of the empire in 1913, average incomes were 132.3 rubles, compared with 122.0 rubles on Soviet territory. Thus, average incomes of the western provinces exceeded those on Soviet territory by a factor of 1.0852.

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 C-2 (total); large-scale industry, Table C-4 (total); small-scale industry, Table C-5 (column D); construction, Table C-7 (total); transport, Table C-8 (rail and waterways, total); military services, Table C-11 (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 5. Net national income of Russia and USSR: rubles per head in 1913 market prices

	National income per head					
	Rubles			Per cent of 1913		
	Goods	Goods	Goods	Goods	Goods	Goods
	and services (A)	and non-military services (B)	from agriculture (C)	and services (A)	and non-military services (B)	from agriculture (C)
<i>Russian Empire exc. Finland and Poland</i>						
1913	123.0	121.4	54.4	100.0%	100.0%	100.0%
1914	118.3	115.6	49.3	96.2%	95.2%	90.5%
1915	122.0	115.0	50.0	99.2%	94.7%	91.8%
1916	112.9	102.9	43.2	91.8%	84.8%	79.3%
1917	99.3	90.5	42.6	80.7%	74.5%	78.2%
<i>Russian Empire territory (exc. Finland and Poland) under government control</i>						
1913	123.0	121.4	54.4	100.0%	100.0%	100.0%
1914	118.3	115.6	49.3	96.2%	95.2%	90.5%
1915	122.1	114.8	48.5	99.3%	94.6%	89.1%
1916	116.8	106.0	42.9	94.9%	87.3%	78.8%
1917	102.1	92.6	42.2	83.0%	76.3%	77.5%
<i>Soviet interwar territory</i>						
1913	122.0	120.4	54.1	100.0%	100.0%	100.0%
1914	116.5	113.9	48.7	95.5%	94.6%	90.0%
1915	119.9	113.0	49.4	98.3%	93.9%	91.3%
1916	106.6	97.0	40.1	87.4%	80.6%	74.2%
1917	93.6	85.4	40.5	76.8%	70.9%	74.9%
1918	57.3	56.9	31.1	47.0%	47.2%	57.4%
1919	49.4	46.8	27.3	40.5%	38.9%	50.5%
1920	49.6	44.4	26.3	40.7%	36.9%	48.6%
1921	45.4	41.5	23.7	37.2%	34.5%	43.8%
1922	52.7	50.7	28.5	43.2%	42.1%	52.7%
1922/23	60.7	59.9	32.7	49.8%	49.7%	60.5%
1923/24	76.9	76.2	41.8	63.1%	63.3%	77.3%
1924/25	96.1	95.4	50.3	78.8%	79.3%	93.0%
1925/26	107.9	107.3	52.0	88.5%	89.1%	96.1%
1926/27	112.4	111.7	51.9	92.1%	92.8%	96.0%
1927/28	118.2	117.5	53.0	96.9%	97.7%	98.0%

Sources:

Population: for calendar years, the July 1 figure given in Table 2 and for economic years the April 1 figure.

National income: Table 4.

Income per head: national income, divided by population.

Table 6. Russian and Soviet economic and demographic losses in four crises

	Decline over			Premature deaths, million		
	period, percent			Per cent		
	Total	Personal	Years	Million	of initial	Years
	national	consumption			popul-	
	income	per head			ation	
Great War-Civil War	-62%	-56%	(1913-21)	13.0	8.4%	(1914-23)
Great Breakthrough	1%	-14%	(1930-32)	6.0	3.8%	(1932-34)
Great Terror-Great Patriotic War	-21%	-44%	(1937-42)	28.6	15.1%	(1937-47)
Post-Soviet transition	-38%	-38%	(1990-94)	0.1-3.8	0.1-2.6%	(1991-98)

Sources:

Economic losses

1913-1921: Table 5 (national income per head at 1913 prices and, for the change in consumption, national income per head from agriculture.

1930-1932: National income per head at 1990 "international" dollars is by Angus Maddison at <http://www.ggd.net/maddison>. Consumption per head is from Allen (2003, p. 147).

1937-1943: Total real GDP, percent of 1937, is given by Harrison (1996, p. 93) for government-controlled territory only, which was enlarged by annexations in 1939/40 and then reduced (by much more) by invasion and occupation in 1941 and 1942. Household consumption combines the decline estimated for 1937 to 1940 by Bergson (1961, p. 252 with that estimated for 1940 to 1943 by Harrison (1996, p. 104), both at 1937 prices. The wartime low point for household consumption was most likely 1942, but we have no population figure for that year, so we use 1943 instead.

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

Demographic losses

1914-1923: For sources and methods, see the text and Table B-3.

1932-1934: The mid-point of the 5.5 to 6.5 million range given by Davies and Wheatcroft (2004, p. 401).

1937-1947: The official figure for excess war deaths in 1941 to 1945 is now 26.6 million (Andreev, Darskii, and Khar'kova 1990). As Ellman and Maksudov (1994) it may (or more likely may not) include roughly 2.7 million wartime emigrants. To the 26.6 million we add 950,000 as a lower limit on deaths in the Great Terror of 1937/38 (Ellman 2002, p. 1154), plus one million for the lower limit on deaths from famine in 1946/47 Ellman (Ellman 2000a, p. 616).

1990-1998: Our lower limit is the 100,000 violent deaths in regional wars and ethnic conflicts, cited by Ellman (2000b). The upper limit is found by adding 3.7 million excess deaths attributed to transitional reforms by UNICEF (2000, p. 51). The upper and lower limits are based on entirely opposed assumptions and should not be averaged. For their relative merits see discussion in the text. In this crisis, unlike others, Russia received substantial net immigration of more than 13 millions by the year 2000, including many from the "near abroad" (UN 2002, p. 3).

Appendix A. National Income: Past Estimates*

The Russian literature starts from Prokopovich (1918a,b). His estimates of Russian Empire GDP by sector of origin in 1913, based on changes in industry and agriculture over the war years, shown in Table A-1, formed the starting point for all future scholars.

Soviet statisticians and economists were mainly interested in estimating the depth of the wartime crisis and the rate of recovery from it. There were a number of attempts to produce national income calculations for particular years. Litoshenko (1925, 1927) elaborated on 1922/23 and 1923/24 (Table A-2). He was the only one to work from “social tables,” aggregating the personal incomes of socially defined sub-groups of the population deriving incomes from the sphere of material production – industry, agriculture, construction, and intermediate transport and distribution.

Other scholars worked on a sector-of-origin basis, as we do, but generally restricting their scope to industry and agriculture alone. Thus, Gukhman (1928) produced an estimate for 1922/23 (Table A-3), based on the material production of industry and agriculture. The practice of basing national income estimates for our period on industry and agriculture alone continued through the Soviet period. Various Soviet-era estimates on this basis are shown side by side in Table A-4.

There were also important sectoral investigations in the 1920s such as that of Vorob’ev (1923) who contributed a study of large-scale industry during the Great War, based on the 1918 industrial census. Two others were suppressed at the time but survived to be published many years later: a general index of large-scale industry over the forty years from 1887 to 1927 by Kafengaus (1994) and a study of agriculture by Litoshenko (2001).

In the early years of Soviet rule, national accountants were actively engaged into data gathering issues as well as into their analysis, running to many statistical volumes published by the Soviet central statistical agency (TsSU) and the production branch ministries (VSNKh, responsible for industry, and others). The TsSU, with its local branches, was the leading organization responsible for data collection. Established in 1918, it combined two main lines of pre-revolutionary statistics – the Central Statistical Committee attached to the Ministry of Internal Affairs, and the local *zemstvo* statistical agencies – into a unified hierarchy. In the early years of Soviet rule the TsSU was a relatively independent organization dominated by pre-revolutionary specialists; up to 1925, in particular, it was headed by a prominent *zemstvo* statistician, P. I. Popov. Early Soviet statistical volumes described the data-gathering methodologies and explicitly discussed data limitations where appropriate. Both Russian and Western scholars view the official statistics of the 1920s, especially from the first half of the decade, as of generally high quality (for more detail see Wheatcroft and Davies 1994a).

The emergence of Stalin’s dictatorship in 1929 reduced dramatically the number of statistical publications and put a stop to independent studies on this theme. With one

* Not for publication.

outstanding exception, Soviet specialists turned away from the problem of national income to the mobilization of industry and labor (Sidorov 1973 illustrates this at its best).

The exception was Al'bert Vainshtein (1960, 1969), who resumed his work on the topic after returning from more than twenty years in the Gulag and internal exile. Starting from Russia's national wealth in 1914, Vainshtein used his knowledge as an insider to explore the quality of Russian Empire statistics and review previous attempts on Russian and Soviet national income. 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 further investigated by later demographers such as Sifman (1977).

Reviving the subject after the Soviet collapse, Poletaev (1998) provided a systematic review of this literature; Poletaev and Savel'eva (2001) compared two crises, one in the 1990s and the other in the 1920s.

The Western literature starts again from Prokopovich (1931) who, exiled from Russia, made his estimates available in English. 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 A-5 shows the latter's revised estimate of the trend in Russia's national income, based on production in the material production sectors, through 1917. For the period after 1917, worthy of note is the estimate provided by Warren Nutter (1963) for three production sectors in 1920 and 1928 relative to 1913 (Table A-6).

Table A-1. 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 A-2. 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 A-3. Gukhman's net national income produced in industry and agriculture: USSR, 1913 and 1922/1923 in current and 1913 rubles

	Agri- culture	Industry				Total	Total
		Large- scale	Small-scale:		Total		
		Urban	Rural				
<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 A-4. Various Soviet estimates of national income produced in agriculture and industry (percent of 1913)

	Groman 1927 (A)	Varzar 1929 (B)	Gosplan 1929 (C)	TsUNKhU 1939 (D)	TsSU 1957 (E)
1913	100	100	100	100	100
1914	96	91	99	...	...
1915	103	89	102	...	...
1916	103	82	103	...	...
1917	83	72	85	76	75
1918	61	...	71	...	...
1919	52	...	54	...	...
1920	47	...	49	40	40
1921	45	...	47	38	38
1922	61	...	44	...	57
1923	73	...	59	...	...
1924	87	...	67	...	...
1925	102	...	77	80	80
1926	...	...	97	103	103
1927	...	...	105	110	110
1928	...	...	111	119	119

Sources:

A. Groman (1927, p. 47).

B, C, D, and E. Compiled by Poletaev (1998: unpublished appendix). TsUNKhu (Central Administration for National Economic Accounts) was the acronym for the Soviet official statistical agency from 1930 to 1940; before and after these dates it was known as TsSU (Central Statistical Administration).

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

	Agri- culture	Industry	Transport
1920	64%	20%	22%
1928	118%	102%	106%

Source: Nutter (1963, p. 165).

Appendix B. Population

Our population series falls into two subperiods, 1913 to 1918 and 1920 to 1928. For 1919, which cannot be separately reconstructed, we interpolate between 1918 and 1920.

1913 to 1918

Table B-1 reports official figures for the population of the Russian Empire and its main subregions from 1913 through 1916. Table B-2 reports our reconstruction of the figures and their extrapolation through 1918.

Table B-2 is divided horizontally into two sections, showing the territories of the Russian empire (excluding Poland and Finland) and the interwar Soviet Union respectively. In the upper section official figures (column A, drawn from Table B-1), provide the starting point. Reading across, the first adjustment (column D) is for internal migration.

The Imperial registration of births and deaths was of sufficiently high quality, but officials failed to account correctly for rural-urban migration. They double counted migrants, once in the place of origin and again at their destinations. A census could correct for this mistake, but the only Empire census was conducted in 1897. The double counting accumulated each year from that time. In column C we adjust the 1914 population for this error, following Sifman (1977) who, starting from the 1897 population figure, accounts annually for fertility, mortality, and net migration over the next two decades. Vainshtein (1960) previously reviewed various attempts to estimate the true numbers. Sifman's adjustment is close to the mid-point of the range of these corrections. In contrast to Sifman, other authors rarely reported details of their correction procedures. Volkov's (1930) is the most transparent, but does not account for net external migration and does not correct official figures of the population of the Empire's periphery. Prokopovich's (1918a) downward adjustment is too large, because he applied it to the entire country, including Siberia where there was no double-counting.

To estimate annual figures for 1913 and 1915 to 1918, we apply Boiarskii's (1948) net growth rate to the 1914 population figure and adjust for cumulative war losses and net migration on the basis of Volkov (1930) (columns E, F and G respectively). Boiarskii calculated the rate of natural increase for the Soviet interwar territory only; we assume that the two territories followed the same path. Column J reports the results.

In working on this basis, we reject two other options. One would be to continue with the official figures, corrected à la Sifman. Given the government's wartime difficulties, including the loss of some territories and the irregular information from the rest, the figures are just too unreliable. Another option would be to use Volkov's (1930) population estimates. But these rely too heavily on the 1916 and 1917 agricultural censuses, which covered only the rural population, requiring many assumptions and adjustments to arrive at the total population. So, we reject this too. We do make use of Volkov's data for migration and military losses, which appear to be well founded. A separate argument for our methodology is that at least it is free of rural-urban migration bias, since it accounts for wartime migration flows directly.

Table B-2 (columns K,L, and M) reports our estimations for the territory under direct control of the tsarist government. Starting from the Empire territory, we subtract the population on the

periphery occupied by the Central Powers, adding back the inward flow of refugees from these territories.

The lower section of Table B-2 shows our adjustments to Soviet interwar territory. Again, we start from the official Empire population of 1914. We first subtract official populations of the territories of the future independent states (column B), summing figures for the provinces that left the empire in whole (Note 1) and, weighted appropriately from Vainshtein (1960), in part (Note 2). An “official” figure for the 1914 population within 1922 Soviet borders results (column C).

We then repeat the correction for double counting (column D) and extrapolate for the natural increase (column E). We estimate military deaths (column F) from the Empire figure, excluding deaths of soldiers mobilized from the western provinces. Volkov (1930) put the share of soldiers from the future Soviet territory at 81.4 percent of the total mobilized into the army, and we apply the same share to all military deaths. For net migration (column G), we adjust the number of Russian prisoners-of-war in the same proportion, then add the number of incoming refugees from the western provinces based on Volkov (1930). Accounting for refugees changes the sign of net migration from negative to positive.

We add the populations of Khiva and Bukhara (column H), which joined the Soviet Union in 1924 and 1925. Their combined populations in 1914 were about 2.3 million people (Davies et al. 1993), and we extrapolate this figure to subsequent years on the growth of the population in the rest of the country.

The final result (column J) is the population on Soviet interwar territory from 1913 to 1918. We are unable to go beyond 1918 because the data on migration in 1918 and 1919 are substantially incomplete (Volkov 1930). The net migration in these years was large and negative because many refugees and prisoners of the war left Soviet territory.

1920 to 1928

The Soviet 1926 population, based on the census conducted in December of that year, is the most reliable figure in our data. It is free of the double-counting of rural-urban migrants in the Imperial statistics. Demographers agree that this was one of the best Soviet censuses, requiring little correction. Andreev, Darskii, and Khar’kova (1993) (hereinafter ADK) adjust it upward by about 1 percent for the underreporting of Muslim females in Azerbaidzhan and Central Asia and of infants.

We accept this revision, and we generally follow the ADK reconstruction of population for 1923 to 1928.

For 1920 through 1922, ADK offer three variants based on high, low, and medium mortality rate in the famine of 1921/22. They express no preference between the three, noting that the question awaited further investigation. We adopt their “high” mortality series on the basis of Adamets (2003), who conducted a special study on mortality during the Civil War and famine. Adamets did not reconstruct the population himself. He calculated a mortality index in two variants: from available data for particular regions, and from mortality tables, simulated using the age compositions of 1926 and 1910 respectively. His regional mortality index is supportive of the “high” ADK mortality assumptions. His simulated mortality tables produce an even higher

estimate of 17 million excess deaths between 1918 and 1922. But this relies on many fragile assumptions, and we find it implausible.

We apply one correction to ADK ourselves. This concerns the figure for 1920, which we inflate by 1.8 million. This corrects a misprint, originally in Maksudov (1989), which ADK cite as their source on the White emigration. In his text (p. 185) Maksudov puts the White emigration between 1920 and 1922 at two million but in the relevant table (p. 202) he reports the annual figures (in millions) as 0.9, -1, and -0.1; the first figure is missing a minus sign. ADK reproduce this misprint in their book (p. 14).

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

The Russian Empire, exc. Finland and Poland									
	European Russia (51 pro- vinces) (A)	Caucasus (B)	Siberia (C)	Steppe and Central Asia (D)	Subtotal (E)	Poland (F)	Russian Empire, exc. Finland (G)	Fin- land (H)	The Russian Empire (J)
	000	000	000	000	000	000	000	000	000
1913	125684	12513	9788	10957	158942	11961	170903	3197	174100
1914	128864	12922	10001	11104	162890	12248	175138	3241	178379
1915	131797	13229	10378	11254	166658	...	...	3277	...
1916	133552	13422	10558	11758	169290	...	...	3315	...

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 E is the sum of A to D; Column G is E plus F; J is G plus H.

Table B-2. Population adjustments and corrections, 1913 to 1918

	Official figures					Adjusted figures				Less regions occupied by Central Powers in 1915 (K)	Plus refugees from these (L)	Population under Imperial government control (M)
	Empire exc. Poland and Finland, (A)	Territory lost, 1918/22 (B)	USSR in 1922 borders (C)	Less double counting (D)	Extrapolated from Boiarskii (E)	Cumulative military losses from Volkov (F)	Cumulative net inflow from Volkov (G)	Territory gained, 1924/25 (H)	Present population (J)			
	000	000	000	000	000	000	000	000	000	000	000	000
<i>Russian Empire exc. Finland and Poland</i>												
1913	158942	...	...	-8551	150391	...	...	...	150391	...	...	...
1914	162890	...	...	-8763	154127	-255	-166	...	154127	...	...	...
1915	...	...	...	...	156670	-951	-981	...	156249	...	...	156249
1916	...	...	...	...	157782	-1675	-1568	...	155851	-11752	893	144991
1917	...	...	...	...	158050	-1998	-1553	...	154807	-11772	2413	145449
1918	...	...	...	...	157608	...	...	...	154057	-11739	2778	145096
<i>Soviet interwar territory</i>												
1913	158942	-20522	138420	-7447	130973	...	...	2259	133232	...	...	...
1914	162890	-21204	141686	-7623	134063	-208	794	2300	136363	...	...	...
1915	...	...	...	...	136275	-774	2685	2342	139203	...	...	...
1916	...	...	...	...	137243	-1364	5188	2385	141539	...	...	...
1917	...	...	...	...	137476	-1626	6647	2429	143729	...	...	...
1918	...	...	...	...	137091	...	...	2473	144585	...	...	...

Sources:

- A. Table B-1, column E.
- 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. Column A (for the Russian Empire territory) or C (for Soviet interwar territory) is deflated by 5.38 percent to correct for prewar double-counting on the authority of Sifman (1977), as described in the text.
- E. Figures for 1913 and 1914 are the same as in column A. Figures for 1915 onward are calculated by applying Boiarskii's (0000) net reproduction rate to the population in the previous year.
- F. Calculated from Volkov (1930, pp. 54-68) as the sum of military losses of all kinds.
- G. Calculated from Volkov (1930, pp. 69-77) as the net inflow of migrants, refugees, and prisoners of war.
- H. Khiva and Bukhara: Population of 1914 is from Vainshtein (1960, pp. 453) and for adjacent years is assumed to have been growing at 1.83% annually, the average net reproduction rate in Turkestan for 1900-1913 (Volkov 1930, p.40).
- J. The sum of E through H.
- K. In 1915 the Central Powers occupied the provinces of Kurland, Kovno, Vilnius, Grodno, Rovno (50%), Minsk (50%), and Kholm. Official figures (as Table B-1) for the populations of these provinces in 1914 (as Table B-1) are extrapolated (as column E) through 1918.
- L. War refugees from the occupied regions (as column G) added to the population under Imperial government control.
- M. The sum of J through L.

Table B-2, note 1. Populations of provinces leaving the Russian Empire in whole

	Bess- arabia	Vilno	Grodno	Kovno	Kur- liand	Lif- liand	Podolsk	Kholm	Est- liand	Kars	Total
	<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>
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

Table B-2, note 2. Populations of 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 B-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 Erivan provinces.

Table B-3. Population changes, 1914 to 1924: Soviet interwar territory

	Popul- ation Jan. 1 (A)	Crude birth rate (B)	Crude death rate		Estimated Births (E)	Estimated Deaths (F)	Normal deaths (G)	World War I
			Option 1	Option 2				military deaths (H)
			(C)	(D)				
<i>Annual figures</i>								
1914	136363	0.0437	0.0272	0.0272	5959	-3709	-3590	-208
1915	139203	0.0359	0.0288	0.0288	4997	-4009	-3665	-566
1916	141539	0.0271	0.0254	0.0254	3836	-3595	-3726	-590
1917	143729	0.0263	0.0291	0.0291	3780	-4183	-3784	-262
1918	144585	0.0347	0.0281	0.0302	5017	-4063	-3806	0
1919	142829	0.0317	0.0394	0.064	4528	-5627	-3760	0
1920	141072	0.0372	0.0484	0.0561	5248	-6828	-3714	0
1921	139068	0.0423	0.0448	0.0414	5883	-6230	-3661	0
1922	137684	0.0432	0.043	0.0471	5948	-5920	-3625	0
1923	137827	0.0505	0.0305	0.0287	6960	-4204	-3628	0
1924	140196	0.0472	0.0285	0.0224	6617	-3996	-3691	0

Balance over decade, Jan. 1, 1914, to Dec. 31, 1923:

Births	52156
Deaths	-49994
Normal deaths	-36958
Excess deaths	-13037
World War I military deaths	-1626
Other excess deaths	-11411
Net migration (calculated as a residual)	-1671

Sources:

- A. Table 3, column B.
- B. 1913-1919, Boiarskii (1948); 1920-1924, Andreev, Darskii, and Khar'kova (1991) mean fertility series.
- C. 1913-1917, Boiarskii (1948); 1918-1919, Adamets (2003) regional mortality series; 1920-1924, Andreev, Darskii, and Khar'kova (1991) high mortality series
- D. 1913-1917, Boiarskii; 1918-1924, Adamets (2003) simulated mortality series.
- E. Col. A multiplied by col. B.
- F. Col. A multiplied by col. C.
- G. Col. A multiplied by average mortality in 1914 and 1924 from cols C and D.
- H. Volkov (1930, p. 54-68).

Appendix C. Production by Sector of Origin

Table C-1 is based on 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.

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.

The upper part of Table C-1 belongs to Falkus; in the lower part, we adjust from material production to net national income by adding final services. 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 C-1 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. This is because 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.

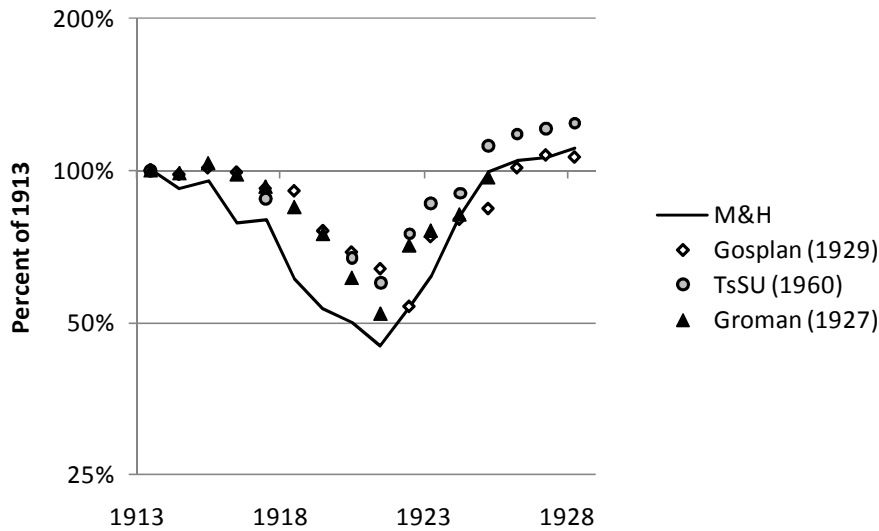
As described in the table, we adjust final services to Soviet territory in proportion to the adjustment of the net material product found by Falkus.

For subsequent years we estimate the real national income by sector of origin. Tables C-2, C-4, and C-7 to C-11 summarize the production branch data that we use. Our figures for agriculture (Table C-2) and large-scale industry (Table C-4) are based on series for agricultural and industrial commodities production in physical units, found in Appendixes D and E respectively.

Agriculture was the largest sector of the economy. It accounted for nearly half of all economic activity in 1913 and 1928, and more than half of employment. Our figures are the result of painstaking reconstruction of agricultural production, region by region and commodity

by commodity, detailed in Appendix D. In Table C-3 we compare our index with alternative Soviet-era index numbers collected by Poletaev (1998). Chart C-1 plots the aggregate indexes.

Chart C-1. Agricultural Production on Soviet Territory, 1913 to 1928: Alternative estimates, per cent of 1913



Source: M&H from Table C-2; other series from Table C-3.

For the mid and late 1920s, we come into agreement with the contemporaneous Gosplan index. For the war period, especially for 1916 and 1918 to 1920, our estimates fall well below the alternatives. It is difficult to identify the sources of disagreement because Soviet-era indexes after the late 1920s were typically published without detailed methodological explanation. The difference is most likely not in the original sources, set out and discussed in Appendix D, because they and we use the same. Most likely, the gap arises from the correction factors that we apply to the low-quality wartime data – particularly to grains. These are discussed in detail in Appendix D, and Table D-1 provides a full list of those used in our estimates.

For industry, data are of better quality (Davies et. al. 1993). We start with large-scale (“census”) production on Soviet territory. From Appendix E (Tables E-2 to E-13), we take 78 annual series of industrial products from Kafengaus (1994) and official figures for 1928 (TsSU 1929a). Of the 78 series, many of them incomplete, we actually make use of 60. For some of these, as they are listed in the Appendix, units are not specified or are apparently misspecified in the source. Our methodology for aggregating them is fortunately unit-free, and this saves some data that we would otherwise be unable to exploit.

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. A special study on the 1918 census (Drobizhev,

Sokolov, and Ustinov 1975, p. 43) gave it high marks for quality and argued that its results could be extrapolated to the whole country despite limited coverage (only 31 provinces). Applying value-added weights to each branch index, we obtain an index for large-scale industry (Table C-4).

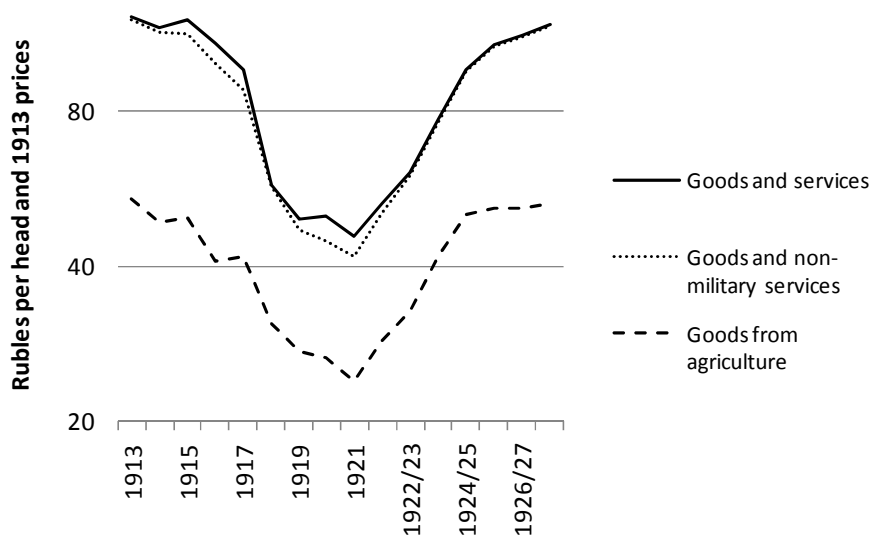
Our methodology makes no allowance for quality changes within our period. Prokopovich (1931) made the assumption that between 1913 and 1928 the average quality of Soviet industrial products declined by about one fifth. Quality change cannot have been all one way; the typical airplane of the late 1920s, 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 fit within the range proposed by Wheatcroft, Davies, and Cooper (1986, p. 267) based on deflated nominal values of gross output for 1926/27 and 1927/28: 2-6 per cent and then 18-23 per cent higher than in 1913.

We combine our index of large-scale industry with the only available measure of small-scale production, a Soviet official index (Table C-5), using the associated 1913 weights of large and small industry to aggregate them. The nature of small-scale production made accounting for small industry very difficult, before and after the Revolution. One might argue that the Bolshevik anti-market policy gave craftsmen additional incentives to conceal their activities from the state after the Revolution, creating a problem of growing underreporting of small production. The only available check, based on employment data, does not support this view, however. Davies (1990, pp. 45-46) concluded: "The best estimate of the number of persons engaged in small-scale industry in terms of full-time equivalents is ... 2-2¼ millions in 1913 and 1½ millions or more in 1926/27": in other words, small industry employment in 1926/27 was most likely 66 to 75 percent of the 1913 level. The Soviet official measure puts small industry output in 1926/27 at 100 percent of 1913. Thus, it is unlikely that, by relying on the latter, we have understated the contribution of small industry in the 1920s. Finally, the weight of small industry in total industrial production is itself small (6.5 percent), so an error is unlikely to have noticeable aggregate effects.

Again, we compare our figures with those of others. Tables C-5 and C-6 report a range of alternatives, and Chart C-2 plots the aggregate index numbers.

For construction (Table C-7) 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. A test of this approach would be to estimate the employment trend in this sector and compare it to that of measured output. The main difficulty is that employment in the construction sector is, in the words of Davies (1990, p. 46), "extremely uncertain territory." The problem lies in coming up with a figure for 1913, which requires extrapolation from the 1897 census. Davies concluded: "It seems likely that the right comparison is ... between Gukhman's 965,000 for 1913 and the census figure of 542,000 in December 1926," i.e. a decline by 44 percent. Our production series suggest a smaller output decline, by 15 percent up to 1926/27 year. There is a gap, but it is favorable to the performance of the Soviet economy. Moreover, the gap is not large, given the heroic guesswork underlying Gukhman's figure for 1913.

Chart C-2. Industrial Production on Soviet Territory, 1913 to 1928: Alternative estimates, per cent of 1913



Source: M&H from Table 4; other series from Table C-6.

Turning to transport (Table C-8), railways are 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 mechanical road traffic which, although growing rapidly, remained insignificant in volume until after our period.

The coverage of trade and civilian services (Tables C-9 and C-10) is limited to employment in 1920 and the postwar years. Even employment series are lacking for the pre-Soviet period. We report these figures but we are unable to use them.

We measure military services by employment. Table C-11 shows two series for defense 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 C-11. Even at its 1920 peak, the Red Army was less than half the maximum size of the Imperial army.

It is necessary, but not easy, to account for military services of the anti-Bolshevik forces in 1918 to 1920. The sizes of the White armies are known approximately. Volkov (2002) reports figures for various armies for irregular benchmark dates. According to him, there were almost no White forces during the first half of 1918; by the end of the year the largest White army in 1918, that of Kolchak, had about 50 thousand soldiers. The Kolchak army peaked at 436

thousand in June 1919, and the Denikin army stood at about 250 thousand in July 1919. But their month-on-month variation was also large, by 25 to 80 thousand for the Kolchak forces and 30 to 82 thousand for the Denikin army. On the basis of these numbers we also make a token allowance for national insurgent forces in the Ukraine, the Caucasus, and Central Asia.

Table C-1. National income by sector of origin, 1913: Russian and Soviet borders and million rubles

	Russian Empire		Soviet territory	
	exc. Finland			
	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	100%	16439	100%
Corrected mid-year population, m	163.7	...	134.8	...
National income per head, rubles	123.8	...	122.0	...

Source: Rows down to "Net material product" are from 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.

Populations of January 1, corrected for double counting are from Table 2, adjusted to mid-year as Table 3.

National income per head is national income divided by corrected mid-year population.

Table C-2. Agriculture, 1913 to 1928: percent of 1913

	Livestock								Total
	Sheep and					Industrial crops		Total	
	Grains	Potatoes	Horses	Cattle	goats	Pigs	Flax			Cotton
Tons 000	Tons 000	Head 000	Head 000	Head 000	Head 000	Tons 000	Tons 000	% of 1913	
<i>Russian Empire exc. Finland and Poland</i>									
<i>Weight:</i>	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%	82%	77%	92%	78%	53%	57%	79.3%
1918	54%	71%	79%	69%	81%	61%	49%	60%	61.9%
1919	45%	74%	76%	62%	70%	45%	37%	31%	53.9%
<i>Russian Empire territory (exc. Finland and Poland) under government control</i>									
1913	100%	100%	100%	100%	100%	100%	100%	100%	100.0%
1914	83%	105%	104%	102%	98%	106%	67%	110%	92.2%
1915	87%	82%	95%	93%	100%	83%	55%	128%	88.1%
1916	72%	50%	91%	86%	114%	76%	55%	107%	74.8%
1917	74%	75%	76%	72%	85%	72%	43%	57%	73.0%
<i>Soviet interwar territory</i>									
<i>Weight:</i>	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%	79%	77%	87%	86%	58%	61%	80.1%
1918	53%	79%	76%	69%	77%	68%	40%	51%	61.2%
1919	44%	83%	74%	62%	67%	50%	30%	27%	53.2%
1920	38%	81%	71%	64%	50%	72%	28%	20%	50.1%
1921	31%	83%	65%	60%	49%	61%	31%	15%	45.0%
1922	53%	89%	53%	54%	39%	37%	34%	31%	53.9%
1923	52%	129%	56%	63%	56%	44%	33%	60%	62.1%
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 quantities see Appendix D, Table D-2.

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 C-3. Agriculture, 1913 to 1928, alternative estimates: Soviet territory, percent of 1913

	Groman	Gosplan	TsSU (1960)		Varzar	TsSU (1987)	
	(1927)	(1929)	Total	Crops	(1929)	Grains	Meat
	Total	Total			Grains		
1913	100	100	100	100	100	100	100
1914	99	98	...	...	82	...	...
1915	103	101	...	...	82	...	...
1916	98	99	...	...	70	...	...
1917	93	92	88	81	68	71	105
1918	85	91	...	...	68	65	102
1919	75	76	...	...	68	66	100
1920	61	69	67	64	46	59	63
1921	52	64	60	55	38	47	80
1922	71	54	75	75	49	66	54
1923	76	74	86	84	61	74	63
1924	82	80	90	82	56	67	83
1925	97	84	112	107	80	95	93
1926	...	101	118	114	85	100	102
1927	...	107	121	113	...	95	110
1928	...	106	124	117	...	96	120

Source: Groman (1927, p. 47), Poletaev (1998, pp. 186-256).

Table C-4. 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 E, Tables E-2 to E-13.

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

Table C-5. Industry gross value of output, 1913 to 1927/28, alternative estimates: Soviet Union, billion prewar rubles

	Large-scale			Small-scale
	(A)	(B)	(C)	(D)
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 and D. Akademii nauk (1960, p. 198), citing *Planovoe khoziaistvo* 1929, no. 5, p. 191.**Table C-6. Industry gross value of output, 1913 to 1927/28, alternative estimates: Soviet Union, 1913=100%**

	Large scale industry				All industry			
	Gosplan (1929)	TsUNKhU (1939)	TsSU (1957)	Maevskii (1957)	Gosplan (1929)	TsSU (1964)	Nutter (1962)	
Prices	1926/27	1926/27	1926/27	1926/27	1913	1926/27	1913	1928
1913	100	100	100	100	100	100	100	100
1914	101	101	...	102	100	...	110	113
1915	110	114	...	118	103	...	107	109
1916	116	122	...	120	109	...	111	112
1917	75	63	63	85	76	71	92	92
1918	34	35	...	...	43	...	40	43
1919	15	26	...	...	23	...	24	21
1920	13	14	14	...	20	22	22	19
1921	17	20	21	...	25	31	24	21
1922	23	26	...	...	30	41	34	34
1923	33	39	...	...	40	...	43	43
1924	41	46	46	...	48	51	53	52
1925	62	76	75	...	67	73	73	75
1926	90	108	108	...	90	98	91	91
1927	105	124	122	...	104	111	101	98
1928	127	154	152	...	120	132	103	100

Source: Poletaev (1998, pp. 186-256).

Table C-7. 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 E-2 and E-6. The total is the unweighted mean of the component series in each year.

Table C-8. Rail and water transport, 1913 to 1927/28: physical units

	Railways			Water-ways	Rail and waterways, total	
	Freight	Pass-engers	Convent-ional*		Ton/km	% of
	Ton/km billion	Person /km, bn	Ton/km billion				Ton/km billion	1913
<i>Russian Empire exc. Finland and Poland</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	96.1	49.5	145.7	...	...	136.8%
1917	63.0	22.0	85.0	...	...	79.8%
<i>Soviet interwar territory</i>						
1913	65.7	25.2	90.9	29.0	119.9	100.0%
1914	61.1	32.7	93.8	...	...	103.2%
1915	73.6	45.2	118.8	...	...	130.6%
1916	88.7	42.1	130.8	...	...	143.8%
1917	61.1	18.7	79.8	15.0	94.8	79.0%
1918	13.8	8.2	22.0	3.3	25.2	21.0%
1919	17.5	10.4	27.9	4.2	32.0	26.7%
1920	11.4	6.7	18.1	2.7	20.8	17.4%
1921	14.0	8.3	22.3	3.3	25.6	21.3%
1922	18.0	10.6	28.6	4.3	32.9	27.4%
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%

Note:

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

Sources:

Russian Empire: All figures are from Westwood (1990, pp. 305, 309) except 1916. For 1916 we interpolate railway freight on the figure for Soviet territory, taking into account the divergent trends of Russian and Soviet railway freight in 1917 relative to 1915. The figure for passenger transport is then interpolated on freight transport, again adjusting for the different trends of freight and passenger transport across adjacent years.

Soviet territory: Figures for 1913 in real terms from Westwood (1990, pp. 305, 309) are extrapolated through subsequent years as follows. For railway freight we use index numbers from Poletaev (1998, unpublished appendix) that closely match series reported by Westwood. For railway passenger transport we use 1913-based index numbers reported by Poletaev for 1922 through 1928; for the intervening years, we interpolate up to 1917 on passenger transport in the Russian Empire and, from 1918 to 1921, on freight transport, taking into account the divergent trends of freight and passenger transport from 1917 to 1922/23. We ignore the index number for passenger traffic in 1917 cited by Poletaev which, translated into real terms, gives a figure for Soviet territory as large as that for the entire Russian Empire. For water transport we have figures in real terms only for 1913, 1917, 1923/24, and 1927/28. We interpolate missing years on railway freight transport, again adjusting for the different trends across benchmark years.

Table C-9. 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 C-10. 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:

1920-1923: Employment in medical services is based on TsSU (1927, pp. 104-5).

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

1923-1927: TsSU (1929a).

Table C-11. Military services, 1913 to 1927/28: persons employed

	Armed forces		Anti-	Total
	of Russia and USSR		Bolshevik	
	(A)	(B)	forces	
	000	000	000	000
<i>Russian Empire exc. Finland and Poland</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	300	2167
1920	3050	4139	75	4214
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 2. 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.

Appendix D. Agriculture

Table D-1 reports the corrections we apply to the original agricultural data as published at the time, and table D-2 presents our final corrected series.

The basic source for pre-revolutionary figures on Russian agriculture is an official summary of Russian economic development during World War I (Narkomfin 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.¹⁰ We interpolate missing figures from trends in neighboring regions. To move from Imperial to Soviet territory, we use 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. For grains, potatoes, and flax fibers, figures exist only for particular districts of 34 Russian provinces. These report average yields per unit of area in 1918 and 1919, and cropped areas in 1917 and 1919. For these regions, cropped areas multiplied by yields give output (for 1918 we use the average of areas cropped in 1917 and 1919). We extend the regional figures to the entire Empire and Soviet territories on the basis of these districts' share in national output figures of 1917.

For livestock, too, figures exist only for the same districts of the 34 regions. Because national livestock figures in 1917 are not known, we have difficulty extending the regional figures to the country as a whole. As an approximation, we use the average of the regional shares of grains, potatoes, and flax fibers.

Territorial adjustments are not the only obstacle to comparability of agricultural statistics before and after the Revolution. In addition, there was widespread underreporting. To compensate for this, we apply various corrections to the pre-revolutionary statistics, as shown in Table D-1. These, especially those applied to grains, are the most likely source of the divergence between our own aggregate series and the estimates of the 1920s, mentioned in Appendix C.

We start with grains, to which we apply two correction factors. Many contemporary statisticians and economists believed that peasants tended to underreport yields and sown areas, particularly before the Revolution. From the mid-1920s, Gosplan statisticians applied a

¹⁰ 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.

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 1917.

In the early 1920s, however, Soviet statisticians applied a smaller correction factor, namely 10-12%. They applied this both to the pre-revolutionary grain statistics and to the contemporary Soviet figures, in the belief that the pre-revolutionary problem of underreporting had been carried over into the Soviet registration system. Thus, grain figures for 1918 and 1919 appeared in the 1921 source that we use, already multiplied by 1.11 (not 1.19). For consistency with the grain figures of the later 1920s, multiplied by 1.19 (not 1.11), therefore, we apply a further adjustment factor of 1.072 (1.19 divided by 1.11). We do not adjust the 1920 figure because, at the time it was published in 1924, Soviet statistics had already switched to a 1.19 correction.

The further problem of wartime underreporting deserves special mention. Under the policy of compulsory grain requisitions from 1918 to 1920, peasants had stronger incentives to conceal harvests than in peacetime. Contemporary statisticians were well aware of the issue and introduced further corrections for it from the early 1920s. These corrections are already in our data. The original TsSU (1921b) correction factor was 1.25, which was the product of multiplying the 10-12 percent adjustment for peacetime underreporting, discussed above, and a further 10-15 percent correction for wartime underreporting of yields.

Alternative views from the 1920s, reviewed by Kabanov (1988), suggested larger corrections of wartime yields, in a range that varied up to 40 percent. In the early 1920s, TsSU did not support such larger adjustments. At this time TsSU remained a relatively independent organization, with highly qualified statisticians still in charge. In the late 1920s, however, higher agricultural figures for 1918 and 1919 began to appear in official publications. It is likely that these responded to political requirements of the time, rather than changes in expert assessment. The official line blamed the grain procurement difficulties on the peasants' concealment of harvests and hoarding of stocks, and applied the same logic to the grain figures of 1918 and 1919.

To summarize, we reject the further upward correction of the figures published in the early 1920s as driven by ideology rather than scholarship. In fact, larger adjustments would imply the concealment not only of yields but also of areas under crops. The latter is less likely because cropped areas were more easily observable.

We apply further corrections to the potato harvests reported for the same years. At this time official figures included only field-grown potatoes, omitting those grown on the side, in "subsidiary" farming 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.

Finally, livestock-breeding accounted for almost one third of agricultural production in 1913. The 1916 agricultural census revealed underreporting of livestock on a large scale. This was brought to light by Vainshtein (1960); before his work, no corrections were made. We follow him 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 we apply to sheep and goats (1.504) is the arithmetic mean of the three Vainshtein correction factors for other livestock.

Table D-1. Correction factors for agriculture

	Period	Factor
Grains	1913-1917	1.19
Grains	1918-1919	1.072
Potatoes	1913-1919	1.283
Horses	1913-1919	1.199
Cattle	1913-1919	1.416
Pigs	1913-1919	1.897
Sheep and goats	1913-1919	1.504

Sources:

For discussion of the underreporting of agricultural production in peacetime and wartime, see the text of this appendix. Correction factors 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.

Table D-2. Agriculture, 1913 to 1928: physical units

	Livestock						Industrial crops				
	Grains	Potatoes	Horses	Cattle	Sheep and goats	Pigs	flax	hemp	flax	hemp	cotton
					Head		fibre	fibre	seed	seed	
	<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 exc. Finland and Poland</i>											
1913	99176	32699	39099	69495	110034	25948	861	...	...	...	199
1914	82155	34225	40606	70831	107821	27581	579	...	...	...	218
1915	93212	28958	38344	67462	112540	23790	512	...	...	...	255
1916	79406	19431	36100	61092	127281	20832	498	...	...	...	212
1917	80912	26091	31978	53541	101166	20141	460	...	...	...	113
1918	53437	23109	30911	48245	89312	15958	420	...	...	...	120
1919	44654	24246	29844	42948	77459	11774	315	...	...	...	62
<i>Russian Empire territory (exc. Finland and Poland) under government control</i>											
1913	99176	32699	39099	69495	110034	25948	861	...	...	...	199
1914	82155	34225	40606	70831	107821	27581	579	...	...	...	218
1915	86002	26714	37299	64803	110398	21526	475	...	...	...	255
1916	71413	16276	35458	59856	125797	19672	471	...	...	...	212
1917	73873	24391	29724	49768	94036	18722	368	...	...	...	113
<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	28078	47012	88829	17685	539	...	...	...	141
1918	46920	20291	27141	42361	78421	14011	369	...	...	...	120
1919	39209	21289	26205	37711	68013	10338	277	...	...	...	62
1920	34111	20863	25412	39101	51030	14830	263	257	...	...	46
1921	27668	21343	23331	36818	49721	12491	286	216	...	...	34
1922	46971	22889	18875	33031	40022	7637	319	291	279	257	72
1923	45895	33089	20035	38567	56745	9105	305	316	312	313	140
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

Note:

All figures in the original sources cited below have been multiplied by the correction coefficients in Table D-1, for reasons given in the text.

(Table D-2 cont.) Sources:

Russian Empire territory exc. Finland and Poland:

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 Narkomfin (1922).

1913-1917: cotton is from Narkomfin (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.

1918-1923: cotton is from Narodnoe khozyastvo za 70 let (1987).

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).

Appendix E. Large-Scale Industry*

Table E-1. Large-scale industry, 1913 to 1917: the Russian Empire, physical units

	Coal	Anth- racite	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); Narkomfin (1922).

Table E-2. 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).

* Not for publication.

Table E-3. Large-scale industry on Soviet territory, 1913 to 1927/28: Mining, physical units

	Coal and lignite	Anth- racite	Lignite	Oil	Peat	Coke	Iron ore	Copper ore	Manga- nese	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 E-2.

Note: * Units not reported.

Table E-4. 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 E-2.

Table E-5. 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 E-2.

Table E-6. 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 E-2.

Table E-7. 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
	Tons	Tons	Boxes 000	Pairs 000	Tons	*	*	*	*	*
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 E-2.

Note: * Units not reported.

Table E-7 (continued).

	Gasoline	Lighting oil	Solar oil	Residual oils	Matches
	Tons 000	Tons 000	Tons 000	Tons 000	Boxes 000
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 E-2.

Table E-8. 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>	<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 E-2.

Table E-9. 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 E-2.

Table E-10. 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 E-2.

Table E-11. Large-scale industry on Soviet territory, 1913 to 1927/28: Woollen textiles, physical units

	Un-bleached		Finished
	Yarn	cloth	fabric
	<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 E-2.

Table E-12. 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 E-2.

Table E-13. 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 E-2.

Table E-14. Large-scale industry on Soviet territory, 1913 to 1927/28: Paper and printing, physical units

	<u>Cartons</u>
	<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 E-2.

Appendix F. Comparative and Long-Run Data*

Table F-1. GDP in 1913, 1917, and 1928: selected European countries in international dollars at 1990 prices and per cent

	GDP per	GDP, total, per	
	head, \$	cent of 1913	
	1913	1917	1928
United Kingdom	4921	113%	109%
Belgium	4220	84%	127%
Germany	3648	76%	111%
France	3485	79%	126%
Austria	3465	67%	104%
Finland	2111	77%	144%
Hungary	2098	75%	125%
Czechoslovakia	2096	...	148%
Romania	1741	...	77%
Greece	1592	55%	161%
Bulgaria	1534	...	99%
Russia	1488	80%	110%
Turkey	1213	75%	85%
Yugoslavia	1057	...	128%

Source:

All figures are from or based on estimates by Angus Maddison at <http://www.ggd.net/maddison/>, except as follows: UK (1917) from Broadberry and Howlett (2005, p. 208); Germany (1917) from Ritschl (2005, p. 45, midpoint of columns VI and VII); France (1917) from Hautcoeur (2005, p. 171); Austria and Hungary (1917) from Schulze (2005, p. 83); USSR (1917 and 1928) from Table 8; Turkey (1917) is based on the statement by Pamuk (2005, p. 120) that "by 1918 the GDP of the empire had declined had declined by at least 30 per cent, and perhaps 40 per cent or more, from its prewar level."

* Not for publication.

Table F-2. Ln GDP per capita in 1913 and average annual GDP per capita growth in 1913 to 1928: selected countries

	Annual average growth of GDP per head 1913-1928	Natural log of GDP per head in 1913 and 1990 GK\$	Great War dummy		Annual average growth of GDP per head 1913-1928	Natural log of GDP per head in 1913 and 1990 GK\$	Great War dummy
United Kingdom	0.57%	8.50127	1	Spain	1.52%	7.62852	0
Belgium	1.31%	8.34759	1	Australia	0.37%	8.54811	1
Germany	0.76%	8.20194	1	New Zealand	-0.01%	8.54714	1
France	1.60%	8.15622	1	Canada	1.01%	8.39999	1
Austria	0.36%	8.15047	1	United States	1.43%	8.57565	1
Finland	1.66%	7.65492	1	Argentina	0.82%	8.24197	0
Hungary	0.94%	7.64874	1	Brazil	2.37%	6.69827	1
Czechoslovakia	2.34%	7.64779	1	Chile	0.73%	8.00236	0
Romania	-2.34%	7.46222	1	Colombia	1.25%	7.11964	0
Greece	2.26%	7.37275	1	Mexico	0.46%	7.45703	0
Bulgaria	-1.53%	7.33563	1	Peru	3.54%	6.93925	1
Russia	-0.24%	7.30519	1	Uruguay	1.10%	8.10470	1
Turkey	-0.88%	7.10085	1	Venezuela	6.79%	7.00670	0
Yugoslavia	1.45%	6.96319	1	India	0.32%	6.51175	1
Denmark	1.34%	8.27180	0	Indonesia and Timor	1.71%	6.77308	0
Italy	1.08%	7.84932	1	Japan	2.41%	7.23490	1
Netherlands	2.30%	8.30623	0	Philippines	2.29%	6.89568	1
Norway	1.59%	7.80262	0	South Korea	2.10%	6.76734	1
Sweden	1.56%	8.03041	0	Taiwan	2.72%	6.59578	1
Switzerland	2.46%	8.35843	0	Malaysia	2.89%	6.80240	1
Ireland	0.00%	7.91425	1	Sri Lanka	0.12%	7.11802	1
Portugal	1.08%	7.13090	1				

Source:

Rows from the UK to Yugoslavia as Table F-1; all other GDP figures are from or based on estimates by Angus Maddison at <http://www.ggdc.net/maddison/>.

Table F-2, note 1. Regression results

Dependent variable is GDP per head growth, 1913 to 1928 in natural logs

	1	2	3	4	5	6	7	8
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
In GDP per capita in 1913	-0.005*	-0.006*	-0.006*	-0.007**	-0.004*	-0.005**	-0.005*	-0.005*
	0.003	0.003	0.003	0.003	0.003	0.002	0.003	0.002
World War I dummy		-0.009*		-0.009		-0.004		-0.004
		0.005		0.005		0.003		0.003
Soviet Union dummy			-0.018***	-0.015***			-0.016***	-0.015***
			0.003	.003			0.002	0.002
Constant	0.054**	0.068**	.057**	0.07**	0.045**	0.053***	0.049**	0.055***
	0.024	0.027	0.025	0.027	0.020	0.019	0.020	0.019
Excluding outliers (Venezuela and India)	No	No	No	No	Yes	Yes	Yes	Yes
R-squared	0.06	0.14	0.14	0.17	0.05	0.08	0.10	0.12
N	43	43	43	43	41	41	41	41

Note: robust standard errors are reported

Table F-3. Real national income per head in the former Russian Empire and USSR, 1885 to 2006

	Maddison, inter-					Maddison, inter-			
	Gregory, rubles of 1913	M&H, rubles of 1913	national dollars of 1990	Harrison, rubles of 1937		Gregory, rubles of 1913	M&H, rubles of 1913	national dollars of 1990	Harrison, rubles of 1937
1885	72.5	...	...	...	1915	...	119.9	...	...
1886	69.7	...	...	...	1916	...	106.6	...	...
1887	81.5	...	...	...	1917	...	93.6	...	...
1888	78.4	...	...	...	1918	...	57.3	...	...
1889	72.9	...	...	...	1919	...	49.4	...	...
1890	72.6	...	...	...	1920	...	49.6	...	...
1891	66.5	...	...	...	1921	...	45.4	...	...
1892	72.8	...	...	...	1922	...	52.7	...	...
1893	82.5	...	...	...	1923	...	60.7	...	...
1894	93.8	...	...	...	1924	...	76.9	...	...
1895	86.8	...	...	...	1925	...	96.1	...	...
1896	95.6	...	...	...	1926	...	107.9	...	...
1897	94.0	...	...	...	1927	...	112.4	...	...
1898	96.5	...	...	...	1928	...	118.2	1370	...
1899	102.4	...	...	...	1929	...	...	1386	...
1900	100.2	...	1237	...	1930	...	...	1448	...
1901	102.7	...	...	...	1931	...	...	1462	...
1902	111.6	...	...	...	1932	...	...	1439	...
1903	103.9	...	...	...	1933	...	...	1493	...
1904	114.9	...	...	...	1934	...	...	1630	...
1905	101.7	...	...	...	1935	...	...	1864	...
1906	97.2	...	...	...	1936	...	...	1991	...
1907	93.4	...	...	...	1937	...	...	2156	...
1908	102.0	...	...	...	1938	...	...	2150	...
1909	105.9	...	...	...	1939	...	...	2237	...
1910	113.0	...	...	...	1940	...	...	2144	1309
1911	104.4	...	...	...	1941	...	...	...	...
1912	112.8	...	...	...	1942	...	...	...	...
1913	118.5	122.0	1488	...	1943	...	...	...	1363
1914	...	116.5	...	...	1944	...	...	...	...
					1945	...	...	...	1226

Table F-3 (continued)

	Maddison, inter-				Maddison, inter-				
	Gregory, rubles of 1913	M&H, rubles of 1913	national dollars of 1990	Harrison, rubles of 1937	Gregory, rubles of 1913	M&H, rubles of 1913	national dollars of 1990	Harrison, rubles of 1937	
1946	1913	...	1976	...	...	6363	...
1947	2126	...	1977	...	...	6454	...
1948	2402	...	1978	...	...	6559	...
1949	2623	...	1979	...	...	6472	...
1950	2841	...	1980	...	...	6427	...
1951	2806	...	1981	...	...	6432	...
1952	2937	...	1982	...	...	6535	...
1953	3013	...	1983	...	...	6684	...
1954	3106	...	1984	...	...	6708	...
1955	3313	...	1985	...	...	6707	...
1956	3566	...	1986	...	...	6921	...
1957	3576	...	1987	...	...	6950	...
1958	3777	...	1988	...	...	7040	...
1959	3669	...	1989	...	...	7109	...
1960	3945	...	1990	...	...	6890	...
1961	4098	...	1991	...	...	6419	...
1962	4140	...	1992	...	...	5470	...
1963	3985	...	1993	...	...	4928	...
1964	4439	...	1994	...	...	4247	...
1965	4634	...	1995	...	...	4025	...
1966	4804	...	1996	...	...	3911	...
1967	4963	...	1997	...	...	3995	...
1968	5202	...	1998	...	...	3907	...
1969	5225	...	1999	...	...	4098	...
1970	5575	...	2000	...	...	4454	...
1971	5667	...	2001	...	...	4741	...
1972	5643	...	2002	...	...	5006	...
1973	6059	...	2003	...	...	5397	...
1974	6176	...	2004	...	...	5852	...
1975	6135	...	2005	...	...	6264	...
					2006	...	...	6766	...

Sources:

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

M&H, 1913-1928 (Soviet interwar territory): Table 5.

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

Harrison, 1940, 1943, and 1945 (Soviet controlled territory): GDP from Harrison (1996, p. 92); population from Harrison (1996, p. 104), and Andreev, Darskii, and Khar'kova (1990, pp. 25-27).

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