'Resource mobilization for World War II:
the USA, UK, USSR and Germany, 1938-45',
Economic History Review, 2nd ser.,
XLI no. 1 (May 1988)

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May 1988

Appendix A *Real Soviet munitions output in comparative perspective, 1940–44*

Table 1 above shows Raymond Goldsmith's estimate of the real munitions output of major belligerents before and during World War II. In the Soviet case this estimate was compiled 20 years before official publication of an index of munitions output; official publication of Soviet wartime munitions output in physical units was even longer delayed.

Under the circumstances, reexamination of Goldsmith's sources and methods, and comparison of his results with subsequently available information, are clearly in order.

Goldsmith reached his estimates as follows. First, the volume of each nation's overall combat munitions output relative to United States output in 1944 was estimated on the basis of comparing real output of principal munitions types. Second, each nation's real munitions output, expressed as a percentage of US 1944 munitions output, was extrapolated back over preceding years. For the USA, Canada, the UK and Germany backward extrapolation was based on time series of real output of principal munitions types; for Japan and the USSR such data were currently unavailable, so budget expenditure on munitions (an unofficial estimate in the case of Japan) deflated by an estimate of domestic price changes was used instead. Third, the resulting index was multiplied by US 1944 budget expenditure on munitions.

In the Soviet case, Goldsmith estimated Soviet 1944 munitions output to be about 40 per cent of United States output in the same year. He also proposed an index (1944 = 100) for Soviet munitions output which behaved as follows:

1938	1939	1940	1941	1942	1943	1944
12	20	30	53	71	87	100

Is Goldsmith's estimate for real Soviet munitions output consistent with subsequent officially published data? Let us take first the suggestion that Soviet 1944 munitions output was about 40 per cent of the United States level. Table A–1 shows that in 1944 Soviet production of armour and artillery firepower turns out to have substantially exceeded US output; tanks and self-propelled guns were produced at 141 per cent of US 1944 output, and there was also an imbalance in the Soviet favour for artillery both heavy (1700 per cent) and light (861 per cent) and artillery shells (138 per cent in 1943). However, Soviet infantry machine guns (55 per cent) and rifles and carbines (71 per cent) were produced at lower rates. In the case of military aircraft, one of the most complex and costly branches of arms manufacture, numbers produced by Soviet industry in

1944 reached only 35 per cent of United States output, and a lower ratio would be appropriate for comparison of value added since Soviet aircraft were on average smaller and lighter. Lastly, Soviet wartime shipbuilding (not shown in the table) was negligible compared to the huge United States effort in this direction – the USSR built only 74 ships of all types in 1941–4, more than half of them in 1941.

What about Goldsmith's view of Soviet munitions output growth? Rebased on 1940 = 100, Goldsmith's index can be compared with an official index of the combined real munitions output of four main commissariats (aircraft, tank, armament and ammunition industries) as follows:

	1940	1941	1942	1943	1944
Goldsmith:	100	170	230	270	320
Soviet:	100	140	186	224	251

Goldsmith's index thus suggests a rather more ambitious increase for 1944 over 1940 than the official Soviet index.

Since Goldsmith's index is end-year weighted, the discrepancy cannot be explained by a 'Gerschenkron effect'. However, there is good reason to think that the Soviet index substantially understates the true increase in real munitions output. For example, the number of military aircraft produced in 1944 represented a much greater increase over 1940 than either index would allow (400 per cent: see Table A-1), and the same was true for numbers of tanks and self-propelled guns (1036 per cent), artillery pieces (heavy artillery: 630 per cent over 1939, light artillery: 780 per cent), shells and mines (943 per cent in 1943) and infantry machine guns (385 per cent). Of the major lines of munitions output, only rifles and carbines (167 per cent) and shipbuilding (not shown in the table), which declined, fell below the 1944 performance suggested by either index.

Only in the case of aircraft production does a change in the composition of output from more to less complex and costly types seem likely to explain even a part of this kind of discrepancy (see further Harrison (1985), pp. 118–121). Thus, a serious question mark hangs over the official Soviet index of munitions output.

In summary, there is no absolutely compelling reason to reject Goldsmith's estimate of Soviet 1944 dollar spending on munitions on grounds of either level or rate of change. The level of munitions output implied is plausible. As a growth index it is probably more satisfactory than the official one; however, neither the official nor Goldsmith's index is likely to prove free of major defects.

Table A-1. *War production for supply of the ground and air forces of the USA, UK, USSR and Germany, 1940–4*

	1940	1941	1942	1943	1944
Military aircraft, thou.					
USA	23.2[a]		47.8	85.9	96.3
UK	15.0	20.1	23.6	26.2	26.5
USSR[b]	8.3	12.4	21.7	29.8	33.2
Germany	10.2	11.0	14.2	25.2	39.6
Tanks and self-propelled artillery, thou.					
USA	4.2[a]		27.0	38.5	20.5
UK	1.4	4.8	8.6	7.5	4.6
USSR	2.8	6.6	24.4	24.1	29.0
Germany	1.6	3.8	6.3	12.1	19.0
Heavy artillery (75 mm and over), thou.[c]					
USA[d]	0[a]		0.6	2.7	3.3
UK	1.9	5.3	6.6	12.2	12.4
USSR[e]	(8.9)[f]	–	49.1[g]	48.4	56.1
Germany	6.3	7.8	13.6	38.0	62.3
Light artillery (20–74 mm), thou.					
USA[d]	4.7[a]		20.5	19.1	7.7
UK	2.8	11.4	36.4	25.8	3.6
USSR	(8.5)[f]	–	77.9[g]	81.9	66.3
Germany	–	3.4	9.6	8.1	8.4
Infantry machine guns, thou.					
USA[h]	87[a]		662	830	799
UK	30	46	1510	1650	730
USSR[h]	(114)[e]	–	356	459	439
Germany	170	320	320	440	790

[continued]

Table A-1 [continued]. *War production for supply of the ground and air forces of the USA, UK, USSR and Germany, 1940-4*

	1940	1941	1942	1943	1944
Infantry rifles and carbines, mn.					
USA		0.4[a]	1.5	5.7	3.5
UK	0.1	0.1	0.6	0.9	0.5
USSR	1.5	–	4.0	3.4	2.5
Germany	1.4	1.4	1.4	2.2	2.6
Artillery shells, mn.					
USA		3[a]	77	92	96
UK[i]	10	23	50	37	22
USSR	14	–	73	132	–
Germany[i]	–	35	99	108	133

Sources: For Germany and the UK see Kaldor, 'German war economy', pp. 45-6. For the USSR see Harrison, *Soviet planning*, p. 250. For the USA see *War production achievements and the reconversion outlook* (U.S. War Production Board: Washington, D.C. 1945), pp. 106-9.

Notes:

a July 1940-December 1941
b Combat aircraft only.
c Excluding naval artillery
d Calibre not specified in source.
e Over 76 mm.
f 1939 (1940 is not available).
g This figure is not consistent with quarterly data.
h All machine guns.
i Over 20 mm.

Appendix B *The ratio of spending on munitions to spending on military pay: the USA, UK, USSR and Germany, 1939-45 (sources, methods and alternative estimates)*

This appendix constitutes full notes to estimates shown in Table 2 (A) for the ratio of spending on munitions compared to spending on military pay for the four powers, 1939-45.

USA The ratio of expenditure on armaments under the U.S war programme to pay of military and civilians in federal war agencies, measured in 1945 U.S. dollars, is calculated from Smith, *Army*, p. 5.

UK Pay and allowances of the UK armed forces are shown in *Statistical digest*, p. 200. Strangely, neither in the wartime *Finance Accounts* nor subsequently has there been published any series for wartime procurement of weapons at current or constant prices. In their absence I have deducted one quarter from reported war spending (Appendix C, Table C-2) for the cost of military construction and operations and, after further deducting pay and allowances, have attributed the residual to weapons procurement. The deduction of one quarter is not completely arbitrary, being based on the proportion of such expenditures to total planned military outlays in the Soviet 1941 national economic plan (Appendix C, Table C-3 (B), note [e]).

USSR Ratio of expenditure on munitions to that on men at constant 1937 rouble factor costs, derived from materials in Appendix C, Table C-3, note [e]. Expenditure on domestic munitions output is combined with expenditure on military goods supplied under Lend Lease in 1942-4, and the sum is divided by expenditure on military services.

Two alternative estimates may be derived from existing materials, both lower than the one shown in Table 2 (A).

(i)

The ratio of Soviet expenditure on armament (*vooruzhenie*) to spending on material consumption of military personnel, both measured in current roubles, may be calculated from officially reported shares in national income available (material products concept) for 1940 and 1942-5, cited in Harrison, *Soviet planning*, p. 151, with the following result:

1940	1942	1943	1944	1945
1.8	2.1	3.0	2.2	2.6

The reasons for the extent of the discrepancy between this series and that shown in Table 2 (A) must include different price weights and different expenditure concepts, but these seem unlikely to account for more than a small part of it - especially in 1940.

(ii)

The budget defence allocation of the Red Army for 1941-5, derived by Frank Doe, *Understanding the Soviet view of military expenditures* (U.S. Defence Intelligence Agency: Washington, D.C., 1982), p. 10, also yields a divergent ratio of spending on armaments and combat materiel to spending on military pay and allowances:

1941	1942	1943	1944	1945
1.8	1.4	1.3	1.4	0.7

Doe's ratio is much lower than either that given in Table 2 (A) on the basis of independent western estimates, or that given above on the basis of officially reported national income shares, and only a little higher than the German ratio for comparable years.

On the surface Doe's lower ratio may seem more comparable with the other countries' series, being obtained like them from budgetary sources. However, in the Soviet case budgetary spending on munitions may be understated (and the discrepancy between budgetary and national income proportions explained) by the practice of including in explicit budgetary spending only the *net* increment to the stock of armament; see Peter Wiles and Moshe Efrat, *The economics of Soviet arms* (London, 1985); Wiles and Efrat believe that use of the 'weapons write-off' to understate military spending became marked in the early 1960s, but may well have been practised since the Revolution (pp. 72-4). In wartime the weapons write-off, and the gap between gross and net weapons acquisition were naturally exceptionally large. So is the gap between the role of Soviet weapons acquisition measured in the two sources. The gap is at its widest in 1945 when the Soviet armed forces (and

also, presumably, their combat stocks) contracted rapidly.

I conclude that the budgetary source understates the cost of Soviet munitions procurement and prefer the sources actually used for Table 2 (A) as providing greater comparability with other countries' data.

Germany Ratio of internal Wehrmacht expenditures on munitions to military pay, when both are measured in 1939 Reichsmarks; calculated from Klein, *Germany's preparations*, p. 91. During the war German military agencies began to procure significant quantities of industrial goods in occupied territories; their inclusion would increase the 1942 ratio of spending on armament to spending on military pay to approximately 1.2; see ibid., p. 92.

Appendix C *The mobilisation of net national product for war: USA, UK, USSR and Germany, 1938-45*

This appendix shows how comparable measures of national income and military spending were derived for the four powers, and how the role of wartime international transfers was taken into account (including correcting for their double counting in the Allies' military budgets), in compiling Tables 3 and 6 in the text. Under Table C-3 will also be found the origin of the Soviet employment shares reported in Table 5.

The most important analytical problem was how to account for the role of international transfers to the UK and USSR from the United States, and to Germany from her occupied territories. If our objective is to measure each economy's domestic resource mobilisation, then in principle foreign supply should be netted out of military spending as well as out of national income. In the case of the United States, Lend-Lease transfers should be attributed to United States military spending, not those of her allies. On the other hand, if our objective is to measure each country's willingness and capacity to divert resources available from any source, domestic or foreign, to its own accumulation of national military assets, then the utilisation of foreign supply for military purposes should be included in military spending.

In the case of the USA, UK and USSR, however, there is no obvious method for determining what proportion of each country's net imports was used to supply military spending. Each country imported both military and civilian goods in wartime, but civilian goods were often crucial to military supply or, if intended for civilian utilisation, they helped to free domestic resources for military purposes.

In practice, for each country in each year I have chosen to calculate two measures of national income mobilisation. Measure (I) shows the *national utilisation* of resources supplied to the war effort, irrespective of origin, in proportion to the national product. This is the measure appropriate to study of national priorities. For the UK, USSR and Germany it is the traditional measure: the ratio of officially reported (for the USSR, estimated) defence expenditures to national income; for these countries it constitutes the upper bound on national income mobilisation. For the USA it means deducting those federal expenditures which supplied the war effort of other nations, and is the lower bound on measured mobilisation of national income.

Measure (II) shows the *domestic finance* of resources supplied to the war effort, irrespective of utilisation, in

proportion to the national product. This is the measure appropriate to the study of domestic mobilisation. It is assumed that domestic supply of military spending was eased by the full amount of net imports (for the USA it means crediting her domestic war effort in full with her resources transfered to her allies' fighting strength). For the UK, USSR and Germany net imports are deducted from reported military spending, resulting in the lower bound of measured national income mobilisation. For the USA the traditional measure of reported defence expenditure is used, resulting in the upper bound.

The difference between measures (I) and (II) is quantitatively important for all four countries, rising to about one sixth of British, Soviet and German national income at the wartime maximum.

Key to national income definitions:

The western system of national accounts:

GNP — Gross national product (goods and services) at market prices

NNP — Net national product (goods and services) at factor cost

NNP = GNP - capital depreciation - net indirect taxes

NDP — Net domestic product (goods and services) at factor cost

NDP = NNP - net investment income from abroad

The Soviet material product system of accounts:

NI_P — National income (goods, including intermediate services) produced at transfer prices

NI_P = NNP - final services + net indirect taxes

NI_A — National income (goods, including intermediate services) available at transfer prices

NI_A = NI_P - exogenous losses + net imports

Table C-1. *The mobilisation of net national product for war: the USA, 1939-45*

	$ billion:			Per cent of NNP:	
	NNP at factor cost	Military spending	Net exports	Resources mobilised for war	
				(I)[a]	(II)[b]
1939	72.9	1.3	0.9	1	2
1940	78.7	2.2	1.4	1	3
1941	96.3	13.8	1.8	13	14
1942	123.5	49.6	5.3	36	40
1943	151.4	80.4	9.3	47	53
1944	165.7	88.6	10.3	47	54
1945	171.2	75.9	-	-	44

Sources: For net national income (national product at factor cost) and federal spending on 'national security' see *Historical statistics*, pp. 139, 142 (series F7 and F83). National accounts for this period give data for 'cash' trade only, excluding military transfers to the European Allies (the latter were included in final demand under federal war spending). Net exports including the latter are given for 1939-44 only in *American industry*, p. 52.

Notes:

a Military spending minus net exports as share of NNP.

b Military spending as share of NNP.

Table C-2. *The mobilisation of net national product for war: the UK, 1938-45*

	£ million:			Per cent of NDP:	
	NDP at factor cost	Military spending	Net imports	Resources mobilised for war	
				(I)[a]	(II)[b]
1938	4562	327	244	7	2
1939	4742	763	400	16	8
1940	5365	2600	950	48	31
1941	6580	3643	950	55	41
1942	7349	3945	750	54	43
1943	7828	4452	760	57	47
1944	8034	4481	730	56	47
1945	8147	3827	900	47	36

Sources: NDP at factor cost and net imports of goods and services from Feinstein, *National income*, Tables 1 and 2. Military spending from Hancock and Gowing, *British war economy*, pp. 75, 347.

Notes:

a Military spending as a share of NDP.

b Military spending minus net imports as a share of NDP.

The mobilisation of national product for war: the USSR, 1940 and 1942-44

Table C-3 below comes in two parts. Part (A) shows preliminary calculation of national income mobilisation based on official Soviet concepts and measures. Part (B) shows the derivation of estimates actually used in Table 3 of the paper's text; these are based on western national income concepts and independent estimates of national income and military spending.

The results differ substantially. According to part (A) the share of the Soviet national income mobilised for war (on a national utilisation basis) peaked in 1943 at two thirds. According to part (B), the peak came in 1943 when no less than three quarters of Soviet national income was committed to the war effort, but the 1942 mobilisation was hardly less formidable. Moreover, when external supply is taken into account and the measure of mobilisation converted to a domestic finance basis, 1942 proves to have been the year of peak Soviet domestic economic effort.

There are two identifiable reasons for this divergence: the use of different income and spending concepts, and of different price weights. In part (A), national income and its utilisation are based on the material product system of accounts; national income is measured using 'comparable' prevailing or transfer prices, probably of 1926/27, while its utilisation is probably based on current prevailing prices. In part (B) national income and expenditure are based on the western system of national accounts, and are measured using constant factor costs of 1937. Other reasons for discrepancy may also be present, arising from the lack of full explanation of Soviet statistical conventions applying to wartime national accounts.

Table C-3. *The mobilisation of national product for war: the USSR, 1940 and 1942-44*

(A) *Soviet official sources: the material product system of accounts*

	Per cent of real 1940 national income produced:		Per cent of NI_P at current prices:
	NI_P[a]	Military spending[b]	Resources mobilised for war (I)[c]
1940	100	15	15
1942	66	38	57-8
1943	74	50	67
1944	88	47	53

(B) *Independent sources: the western system of national accounts*

	Billion 1937 roubles:			Per cent of NNP:	
	NNP at factor cost[d]	Military spending[e]	Net imports[f]	Resources mobilised for war (I)[g]	(II)[h]
1940	236.9	46.5	-	20	20
1942	134.5	101.0	12.0	75	66
1943	156.7	119.5	27.9	76	58
1944	189.5	130.1	31.3	69	52

Notes and sources for Table C-3:

a The official index, cited in Harrison, *Soviet planning*, p. 151.

b Officially reported military spending as a share of national income in 1940 (15 per cent) and 1942 (57-8 per cent) is cited in Harrison, *Soviet planning*, p. 152. I deduce that these are shares of national income produced (NI_P), not available (NI_A), from the fact that they are given together with other information, clearly intended to be comparable, on the mobilisation for war of national income by sector of origin (industry, construction, transport and agriculture). These are multiplied by the index of real NI_P to estimate real military spending in 1940 and 1942 as 15 and 38 per cent of 1940 NI_P respectively.

For 1943 and 1944 other information must be taken into account. Officially reported military spending *on munitions and military pay alone* (i.e. excluding the costs of military construction and operations), as a share of NI_A, is cited in Harrison, *Soviet planning*, p. 151 as follows:

1940	1942	1943	1944
11	40	44	35

This can be translated into an index of real spending on military pay and munitions by multiplication with an index of real NI_A. The latter is obtained from the official index of NI_P, increasing it by 6 per cent in 1942 and 12 per cent in each of 1943 and 1944 to allow for the availability of net imports (see the next column in the table). Indices of NI_A and real spending on munitions and military pay are then found as follows:

	National income available	Spending on military pay and munitions, per cent of 1940 NI_A
1940	100	11
1942	70	28
1943	83	37
1944	99	35

Comparing our 1942 estimates of real total military spending (38 per cent of 1940 national income) and spending on munitions and military pay alone (28 per cent) suggests a difference of 10 per cent of 1940 national income attributable to the cost of military construction and operations in 1942. Total military

spending exceeded pay and munitions costs in the ratio of 1:1.35 (this is virtually the same as the ratio of 1:1.36 obtained from a 1940 comparison); real military spending in 1943 and 1944 is therefore estimated by adjusting pay and munitions costs in this proportion.

c Military spending as share of national income produced. For 1940 and 1942 official data are cited in Harrison, *Soviet planning*, p. 152. For 1943-4 see notes [a, b].

d For 1940 see Moorsteen Powell, *Capital stock*, Table T-47 (pp. 361-2) and Appendix P ('Gross and net national product', pp. 619-41); for 1942-4 see Powell, 'War years', Table T-47-X (p. 25).

The Moorsteen-Powell index of NNP at 1937 factor cost shows a much larger decline in national income over 1940-2 (43 per cent) than that admitted by the official index of national income produced, which is probably calculated at 1926/27 price weights (note [a]: 34 per cent). Powell speculates (*War years*, p. 7) that the differences are reasonably attributable to differences in price weights and differences in the concept of income. This opinion is perhaps strengthened by subsequently published national income accounts for 1940 and 1944-5 at prevailing prices of 1940 (*Po edinomu planu* (Moscow, 1961), pp. 105-6), which show national income available and produced as only 80 per cent and 62 per cent respectively of the 1940 level - well below the conventionally cited index.

e Moorsteen and Powell's measures of defense activity are too narrowly based to be of use here; see their *Capital stock*, Table P-1 (p. 622), rows 2B ('Munitions industries') and 7D ('Military services') for 1940; and Powell, *War years*, Table P-1-W (p. 31) for 1942-4 (but here there is no separate series for munitions industries, which are counted jointly with the civilian sector). Instead, I rely on Bergson's estimates for 1940, extrapolating them through 1942-4, and using Bergson's 1944 estimates as a cross-check.

The starting point is Bergson, *Real national income*, p. 70 where are found data (all in prevailing prices of 1937) for 1940 national income generated in military services (8.0 billion roubles), the munitions industries (26.8 billion roubles), and other military procurements (i.e. military construction and operating expenditures: 11.0 billion roubles). Expenditure on military services for 1940 is then adjusted upward by a factor of 20 per cent to allow for Bergson's understatement of Soviet 1940 force levels (at the time a figure for military personnel of 4.2 million was current for the first half of 1941, leading Bergson to

adopt 3.5 million as his estimate for the 1940 annual average; subsequent Soviet sources have made clear that 4.2 million is the figure applicable to 1940 - see Harrison, *Soviet planning*, p. 138). These are then converted from prevailing prices to factor cost of 1937 by the ratio of factor cost to prevailing prices for the same expenditure categories in 1937 (Bergson, *Real national income*, p. 130), and extrapolated through 1942-4 by various means.

Expenditure on military services at 1937 rouble factor cost for 1942-4 is estimated by applying an index based on currently accepted series for Soviet force levels in 1942 and 1944 (Harrison, *Soviet planning*, p. 138, interpolating a figure for 1943) to 1940 expenditure.

	1940	1942	1943	1944
Military personnel, million:				
	4.2	10.9	(11)	11.2
Expenditure on military services, billion 1937 factor cost roubles:				
	8.2	21.2	21.4	21.8

The 1944 figure is somewhat below Bergson's (27.4 billion roubles at 1937 prevailing prices), the difference being explained by a lower estimate of military personnel (11.2 rather than 12 millions) and by conversion to factor cost.

Wartime expenditure on domestically produced munitions is obtained by applying the official index of munitions industry output (Harrison, *Soviet planning*, p. 119) to 1940 expenditure, as follows.

	1940	1942	1943	1944
Real munitions production:				
	100	186	224	251
Expenditure on domestic munitions production, billion 1937 factor cost roubles:				
	27.2	50.6	60.9	68.3

The 1944 figure is close to Bergson's (70.6 billion roubles at prevailing prices of 1937).

Since all Soviet 1940 expenditure on munitions was met from domestic production, this measure necessarily excludes wartime Soviet expenditure on Allied munitions imported under Lend Lease. The dollar value of military goods supplied to the USSR under Lend Lease (Harrison, *Soviet planning*, p. 259) can be multiplied by the

exchange rate of six 1937 factor cost roubles to the dollar proposed by Bergson (*Real national income*, p. 99n) to give the following series (in billion roubles at 1937 factor cost).

	1940	1942	1943	1944
Expenditure on military goods supplied under Lend Lease:	–	5.1	8.6	9.0

The 1944 figure is larger than Bergson's (6.5 billion roubles), reflecting a broader definition of military goods.

Finally, a series for other military procurement in wartime must be estimated. For 1944 Bergson uses what he calls 'freehand extrapolation', and proposes that this category may have been a smaller share of military outlays in 1944 than in 1940, given the probable decline of military construction in wartime (ibid., pp. 369–70). Such a proportional decline seems unlikely in the extreme, given the likely escalation of transportation and fuel costs under combat conditions, and taking into account the Red Army's complicated, usually lengthening supply lines in 1942–4. Therefore, I propose to keep other military procurement as a constant proportion of total real military spending over 1942–4, with the proportion given as not less than that incorporated in the 1941 national economic plan, 23.9 per cent (Bergson, ibid., p. 366). This yields other military outlays as follows (in billion roubles at 1937 factor cost).

	1940	1942	1943	1944
Other military procurement:	11.2	24.1	28.6	31.1

Here the 1944 figure is substantially larger than Bergson's (20 billion roubles), the difference reflecting mainly his too-conservative assumptions.

f Net imports are identified with foreign aid to the USSR in wartime. This heading is estimated from the dollar value of annual shipments to the USSR under Lend Lease, broken down into military, industrial and agricultural goods (Harrison, *Soviet planning*, p. 259), with an allowance for net imports from other Allied sources. Dollar values are converted into 1937 rouble factor cost at exchange rates proposed by Bergson, *Real national income*, pp. 99–100n (six roubles to the dollar for military goods, 5.4 roubles for industrial goods, 19 roubles for agricultural goods and 8 roubles as an

average applicable to all other shipments). For United States shipments this gives the following estimates (in billion roubles at 1937 factor cost):

	1940	1942	1943	1944
Military goods:	–	5.1	8.7	9.0
Industrial goods:	–	1.7	4.6	7.3
Agricultural goods:	–	3.6	11.2	11.0

In 1944, Bergson estimates that non-US shipments to the USSR amounted to another $500 million (ibid., p. 99). Assuming that these followed the same course in 1942-3 as the dollar value of US shipments, and using Bergson's exchange rate, we obtain the following series for net imports not from the United States (in billion roubles at 1937 factor cost).

	1940	1942	1943	1944
Non-US Lend Lease shipments:	–	1.6	3.4	4.0

The total from all sources implied for 1944 (31.1 billion roubles) is at the lower end of the range proposed by Bergson (30-35 billion roubles).

g Military spending as per cent of NNP.

h Military spending, less net imports, as per cent of NNP.

Note on derivation of the Soviet Group I workforce share in 1940 and 1943 (Table 5) from national income data

In 1940 manual workers in engineering and metalworking (including the defence industries), metallurgy and chemicals amounted to 36.3 per cent of the manual workforce in industry (*Promyshlennost'*, p. 24), and employment in industry and construction amounted to 23 per cent of total civilian employment in the economy. Thus, a workforce share of Group I industries of 8.35 per cent is implied.

In absence of any published information on the wartime distribution of the Soviet working population between war and nonwar employment, Soviet 1943 employment on a Group I basis must be estimated from national income and other data. Since Group I industries on the British definition included defence plant and supporting heavy industries, including the fuels sector, but not the industries supplying military subsistence, we try to approximate this as Soviet expenditure on domestically supplied munitions and other military procurement (construction and operations).

In 1940 these came to 16.2 per cent of NNP at 1937 rouble factor cost. For this share of NNP to be produced by not more than 8.35 per cent of the workforce implies a not unreasonable rouble productivity differential of Group I workers over other employees of at least 112 per cent. In 1943, expenditure on domestically supplied munitions and other military procurement came to 57.1 per cent of NNP; applying the same productivity differential as in 1940 suggests a Group I workforce share of 38.6 per cent. However, by 1943 a considerable increase in the labour productivity differential for industrial compared nonindustrial workers had taken effect in relation to 1940 (Harrison, *Soviet planning*, p. 142); some of this no doubt reflected the changing industrial structure, but a large part was contributed by the shift to serial production of complex weapons, realisation of economies of scale and labour-saving innovation in the munitions industries themselves. For workers in munitions and related industries a rise in their relative productivity of at least 40 per cent would be a reasonable assumption. Applying a productivity differential of 3.0 to the 1943 expenditure share of domestically produced munitions and other military procurement yields the workforce share of 31 per cent reported in Table 5.

This 1943 workforce share is within the range (28.2-34.4 per cent) suggested by Harrison, *Soviet planning*, p. 162n, but the reasons are largely coincidental. The present estimate is based on broader coverage of military expenditures, a different national income concept and a different assumption about the productivity differential of war over nonwar employment and its behaviour through time.

Table C-4. *The mobilisation of national product for war: Germany, 1938-43*

	Reichsmarks, billion:			Per cent of NNP:	
	NNP at factor cost[a]	Military spending	Net imports	Resources mobilised for war	
				(I)[b]	(II)[c]
1938	106	17	-1	17	18
1939	119	30	1	25	24
1940	121	53	9	44	36
1941	126	71	15	56	44
1942	132	91	22	69	52
1943	147	112	24	76	60

Source: Klein, *Germany's preparations*, p. 256.

Notes:

a GNP at market prices is adjusted to NNP at factor cost by a deduction of 8 per cent - the share of capital depreciation and indirect taxes in 1938 GNP within pre-1939 boundaries - see Klein, *Germany's preparations*, p. 251.

b Military spending as a share of NNP. Estimates accepted in modern German publications differ little from those based on Klein's work, although almost thirty years have passed since the latter's appearance. For example, when national income is returned to a GNP basis, alternative estimates of the per cent share of military spending (measure (I)) may be compared as follows (see Michalka, ed., *Weltmachtanspruch*, p. 396):

	1938	1940	1943
Klein	14.8	40.2	70.0
Michalka	15.7	40	70

c Military spending minus net imports as a share of NNP.