

## STATISTICAL APPENDIX

### **Introductory Discussion**

This statistical appendix will attempt to prove the validity of the hypothesis, put forth in chapter 10, that “the Great Powers of the industrial era have been those nations that have collectively controlled the change in allocation of territory because the Great Powers are those nations that have controlled, within their territories, the global reproduction, production, and destruction machinery niches”. I will assume the validity of a further hypothesis, that “there is a distribution of political economic causal capability within the machinery sectors of the nation, from reproduction machinery niches to production machinery niches to destruction machinery industries, respectively”. Therefore, in this appendix I will present data concerning production and reproduction machinery industries, with some reference to destruction machinery industries.

The data to be used are based mostly on value added for the machinery industries, because most international data reports value-added. Some of the data are in gross output. Gross output is the final value of the machinery. Value-added is a measure of the value that is added by the machinery industries to goods that are used by the machinery industries but that do not originate with the machinery. The steel industry, for instance, creates the steel that is used by the machinery industry. When machinery is measured by gross output, the steel is included in the measure. When machinery is measured by value-added, the steel is not included.

In the following pages, I will construct a series of snapshots of the distribution of global machinery capability among nations in a particular year or series of years, using various sources. In addition, I will postulate a specific set of Great Powers for each time period discussed. At the end of the appendix, I will present graphs which will link all data points.

Three different categories will be used. Ideally, I would present data that showed disaggregated industrial output. In this way, I could construct series for machinery which was specifically reproduction, production, or destruction machinery, as described throughout this study. Instead, I will use data which are available from international agencies for the following categories:

- 1) For reproduction machinery, I will use data concerning machine tools. The American trade journal *American Machinist* calculated world production of machine tools starting in 1966. U.N. and other organizations regularly use the *American Machinist* data when discussing the global machine tool industry.
- 2) For production machinery plus reproduction machinery, I will use data, mostly from the U.N., concerning what are called the *nonelectrical machinery* industries. Starting with the International System of Industrial Classification, revision 2, in the 1960s, this category has the numerical label of 382. These types of machinery cover almost all of what I have labeled as the reproduction and production machinery industries. However, this category also covers military equipment such as tanks, artillery and guns, and some consumer machinery, such as

washing machines and refrigerators. To some extent, then, this category encompasses destruction machinery as well. I will refer to this category as *nonelectrical machinery*.

- 3) The broadest category of machinery, which encompasses all forms of machinery, is called the metal products or engineering industries. The International Standard Industrial Classification (ISIC) , Revision 1 included the categories 35 through 38 in metal products industries, and the U.N. regularly used this category in its reports. The metal products industries include metal products fabrication, non-electrical machinery, electrical machinery, transportation machinery, and precision instrumentation. These are the categories used for the data for 1948, 1953, and 1958. All of these categories became category 38 in Revision 2 of the ISIC, which will be used for the data for 1963. I will also refer to the category without metal fabrication as *general machinery*. I was able to restrict data to general machinery starting in 1970.

Data for the Soviet Union are particularly difficult to obtain. At times, as I will explain, it is necessary to calculate the Soviet share of world production of the various categories by making various assumptions and using auxiliary data sources.

The data will be presented for 1913 and 1925, 1938, World War II, 1948, 1953 and 1958, 1963, 1970 and 1975, and 1980, 1985, 1990, and 1995. The charts will use all years as data points, except for World War II, according to availability of data for particular categories of machinery.

## 1913 and 1925

In May 1927, the League of Nations held an International Economic Conference. As part of that conference, Dr. Karl Lange presented a memorandum on behalf of the German Machine Builders' Association (VDMA are the German initials). This memorandum discussed the state of the "mechanical engineering" industries, by which he meant the classes of machinery I have called nonelectrical machinery above. As Lange put it, however, "Owing to the inadequacy of the available statistical material, it is exceedingly difficult to compare the situation and development of the various branches of industry in the different countries" (League of Nations 1927, 58). Particularly before World War II, most international statistics dealt with easily comparable commodities such as oil and wheat. As the journal *Mechanical Engineering* put it at the time, the data "include what is understood to be the first analysis of the machinery industry of the world that has ever been published" (*Mechanical Engineering*, 1928, p.285).

The main finding of Lange's work is that the United States was dominant in world production. In 1913, the U.S. produced 50% of the world's machinery, and in 1925 the U.S. output comprised 57.6% of world production.

The following table shows Lange's findings (League of Nations 1927, 11):

Table 7. World Machinery Production in the Early 20<sup>th</sup> Century

1913 output		1925 output	
U.S.	50.0%	U.S.	57.6%
Germany:	20.6%	U.K.	13.6%
U.K.	11.8%	Germany	13.1%
Belgium	4.1%	France	2.8%
Russia:	3.5%	Russia	1.8%
Austro-Hungary	3.4%	Austro-Hungarian successor states	1.5%
France	1.9%	Switzerland	1.3%
Italy	1.3%	Italy	1.2%
Japan	.3%	Japan	1.0%
The rest	3.1%	The rest	6.1%

Thus, the U.S., Germany, and U.K. controlled 82.4% of world machinery production in 1913, and 84.3% in 1925. The U.S. could be considered a “superpower” in terms of machinery during this time period; the U.S., Germany, and U.K. were the Great Powers because they dominated the production of reproduction and production machinery.

### 1938

The next data point to be constructed is that of 1937-1938. This data point is more difficult in that there is no straightforward assessment of specifically machinery industries, as was carried out by Lange, for all countries. The following data sources shed light on the state of the world in 1937 and 1938.

The most comprehensive treatment of global production for the late 1930's was written by H.C. Hillmann for Arnold Toynbee's *Survey of International Affairs, 1939-1946* (Hillmann 1952). Both Paul Kennedy, in *Rise and Fall of Great Powers*, as well as

Klaus Knorr, in *The War Potential of Nations*, use Hillmann's figures in order to judge the relative strength of Great Powers in this period. Hillmann refers to capital goods as "the optical, engineering, metal goods, shipbuilding, vehicles, chemical, and part of the heavy industries (i.e., pig-iron and crude steel)" (Hillmann 1952, 491). Thus, the category of capital goods includes both general machinery, as well as the production of chemicals and metal. The output of capital goods industries can give a better indication of machinery production than other measures, such as manufacturing or industrial strength. Hillmann gives measures for manufacturing shares of world production (Hillmann 1952, 439):

USA	USSR	Germany	UK	France	Japan	Italy
35.1	14.1	11.4	9.4	4.5	3.5	2.7

He gives the shares for capital goods as the following (Hillmann 1952, 446):

USA	USSR	Germany	UK	France	Japan	Italy
41.7	14	14.4	10.2	4.2	3.5	2.5

We have some clues as the share of general machinery production in 1938 from U.N. studies. According to *Growth of World Industry, 1938-1961* (UN 1965), the share of metal products production in 1938, not including the U.S.S.R. and Eastern Europe, shows North America with 36.7% and Western Europe with 54.3%. It should be noted that the U.S. suffered a severe downturn in production in 1938. According to a U.N. study quoted in [Woytinsky and Woytinsky 1953], Germany constituted 32.4% of European production in 1938, and the U.K. constituted 26.5%. According to the U.N. study *Patterns of Industrial Growth, 1938-1958* (UN 1960, 448-69), in 1948 the U.S. accounted for 95% of metal products production in north America. According to the

U.N. study *The Engineering Industry and Industrialization* (UN 1968, 266-267), in the 1950s the U.S.S.R. constituted two thirds of metal products production for the U.S.S.R. and eastern Europe. I will assume that these percentages were similar in 1938, and that the U.S.S.R. accounted for 14% of world production of machinery, as Hillmann says it did for capital goods.

I arrive at the following figures for share of general machinery in 1938:

U.S.	27.5%
U.S.S.R.	14.0%
Germany	13.9%
U.K.	11.4%

Since there are no data for nonelectrical machinery as opposed to general machinery, I will assume that the shares for nonelectrical machinery for 1938 reflect those for general machinery.

The U.S., Germany, U.S.S.R. and U.K. were the Great Powers in 1938. They combined to produce 66.8% of the machinery in 1938. Note again that this was at a time when the U.S. was producing much less machinery than it was capable of producing, because of the depressed state of its economy. Judging from the American share of machinery in the 1920s and the 1940s, the capacity of the machinery sector in the U.S. was probably closer to the figure given by Hillmann for the share of the U.S. for capital goods in 1937, that is, 40%.

Another indication of the influence of the U.S., U.K., and Germany before World War II is the status of those countries as the dominant exporters of machinery. In 1928, approximately the year of the Lange report, the world share of exports of machinery were the following: U.S. at 34.2%, Germany at 23.7%, and U.K. at 21.6%. In 1936, the figures were 28.2%, 29.6%, and 21.1%, respectively. Thus, these three countries

accounted for 79.5% of exports in 1928, and 78.9% in 1936 (VDMA 1956). The USSR was a minimal exporter during this period.

Another indication of control over machinery production is available in the form of data concerning machine tool production. According to Hillmann, “traditionally, the world’s largest producers were the United States and Germany” (Hillmann 1952, 447). He states that at the start of World War II, the U.S. and Germany had approximately the same quantity of machine tools, while the U.K. had only half as much as Germany. This is confirmed by data from Woytinsky, who claims that in 1938 44.6% of machine tool production in Europe emanated from Germany, while 19% was produced by the U.K. (Woytinsky and Woytinsky 1953, 1150). Hillmann also asserts that the USSR had one third the quantity of machine tools of Germany.

According to this line of logic, then, the share among the Great Powers of machine tools in 1938 was the following:

U.S.:	28%
Germany:	28%
UK:	13%
U.S.S.R:	9%

The total for these four Powers is 78% of world production, but this is not including Asian, or specifically Japanese, production, and is a very rough estimate.

Knorr claims that before World War II, “Great Britain, France, Italy, Japan, and, to a diminishing extent, the Soviet Union were more or less dependent on imports from [the U.S. and Germany]” for machine tools (Knorr 1956, 190). Thus, the figures given above may have underestimated the level of American and German domination of world machine tool production in 1938.



## World War II

For the period of World War II, there do not seem to be any world-wide comparisons of machinery output. However, Knorr compiled a table of machine tool production for the years of World War II. In 1942, according to Knorr, the U.S. produced 307,000 machine tools; Germany produced 166,000 tools; the U.K. produced 96,000 tools; and Japan produced 55,000. The only year for which data were available for the USSR was 1940, at which time 50,000 machine tools were produced (Knorr 1956, 190). Both Knorr (Knorr 1956,193) and Hillmann (Hillmann 1953, 446) argued that machine tools in particular were, and would continue to be, critical to any country's war efforts.

The output of destruction machinery during World War II was prodigious. According to Harrison (Harrison 1988, 172), the volume of combat munitions produced by the belligerents in 1944, the year of largest production, was the following (in 1944 dollars):

USA	\$44 billion
Germany	\$17 billion
USSR	\$16 billion
UK	\$11 billion
Japan	\$6 billion

Since the five above-mentioned countries were the only effectively operating major nations at the time, and controlled most of the territory of the world either directly or indirectly, these five countries constituted the Great Powers of 1940 to 1945. They

also controlled the reproduction, production, and destruction machinery industries of the global political economy.

## 1948

At the end of World War II, the machinery industries of Japan, and particularly Germany, were in ruins. The U.S. was by far the largest producer of machinery. In 1950, according the U.N. study *The Engineering Industry and Industrialization*, the industrialized countries constituted 82.9% of world production of general machinery and the developing countries 2.4% (UN 1968, 266-267). Thus, the world except the Soviet Bloc constituted 85.3% of the world total in 1948. The U.S.S.R. and eastern Europe (the Soviet bloc) constituted 14.7%, with the Soviet Union producing 10.1% of world general machinery. The U.N. study *Patterns of Industrial Growth* provides the totals for general machinery by region (UN 1960, 449), and the percentages of most countries for each region (UN 1960, 455 and 459). It does not discuss the percentages of the Soviet Union or Eastern Europe. I assume that the world except for the Soviet Bloc constitutes 85.3% of the world total in 1948, as provided in *The Engineering Industry and Industrialization*.

The following shares for general machinery result from my calculations:

U.S.:	49.5%
U.K.:	12.4%
U.S.S.R.:	10.1%
France:	3.7%
Germany:	3.2%
Japan:	.8%

I rate the U.S., U.K., and U.S.S.R. as Great Powers in 1948, who together constitute 72%.

In order to calculate shares of nonelectrical machinery, I assume that the Soviet Union also has 10.1% of nonelectrical machinery, since there is no available data from U.N. studies for the Soviet Union for this period. [Woytinsky and Woytinsky 1953] quote a U.N. study which shows comparative output for nonelectrical machinery for most countries. Their list does not include the Soviet Bloc, Asia, Africa, or Latin America. Using the U.N. study *The Engineering Industry and Industrialization* for the Soviet Bloc figure of 14.7% (UN 1968, 266-267) and *Patterns of Industrial Growth* for the other countries (UN 1960, 448-69), it appears that the list the Woytinsky's use constitutes 81.5% of world nonelectrical machinery production. This yields the following shares for nonelectrical machinery in 1948:

U.S.:	55.2%
U.S.S.R.:	10.1%
U.K.:	8.4%
France:	4.2%
Germany:	3.8%

The Great Powers of 1948, the U.S., U.S.S.R., and U.K., controlled 73.7% of world production of nonelectrical machinery.

According to data provided by [Woytinsky and Woytinsky 1953], the U.S. constituted 30.4% of the combined machine tool production of Europe and the U.S. in 1949. This figure is lower than expected because there was a significant post-war slowdown in the machinery industry in the U.S., because surplus military machine tools were released to industry. Using the 1947 share of machine tool production with the 1949 data for Europe, the U.K. looks to have 18.4% of combined U.S. and European production. Germany was destined to overtake the U.K. in machine tool production by about 1952, however (Woytinsky and Woytinsky 1953, 1150).

## 1953 and 1958

The 1950s were dominated by the U.S, in terms of machinery, with the U.S.S.R. attempting to catch up. During this time, the U.K. was barely a Great Power, and Germany reasserted its Great Power status.

For 1953, it is necessary to interpolate the USSR data. According to *The Engineering Industry and Industrialization*, the USSR produced 10.1% of engineering industry value-added in 1950, and 17.8% in 1958 (UN 1968, 266-267). This constituted 68% of the category of USSR and Eastern Europe. In 1953, according to the U.N. study *The Growth of World Industry, 1938-1961*, the USSR and Eastern Europe constituted 18.3% of world engineering production (UN 1965, 317). Assuming that the USSR produced 68% of this total, then the USSR engineering production constituted 12.4% of world production in 1953.

According to *Patterns of Industrial Growth*, West Germany's output constituted 22.4% of Western European production (including West Berlin and Saar), while the U.K.'s output constituted 36.9% (UN 1960, 448-69). Since *The Growth of World Industry, 1938-1961* reports that Western Europe produced 24.7% of world engineering production in 1953 (UN 1965, 317), then West Germany and the U.K. account for 5.5% and 9.1% of production, respectively. The U.S. accounted for 95% of North America's production, which was 51.8% of production, so that the U.S. itself accounted for 49.3% of global production in 1953.

The output of the Great Powers, in 1953, was therefore the following:

U.S.:	49.3%
U.S.S.R.:	12.4%
U.K.:	9.1%

The Great Powers in 1953 accounted for 70.8% of world engineering production.

The data for 1958 are more straightforward. According to *The Engineering Industry and Industrialization*, the following were the shares for engineering industries for the Great Powers (UN 1968, 266-267):

U.S.:	36.9%
U.S.S.R.:	17.8%
U.K.:	8.7%
W. Germany	8.3%

The Great Powers' share for 1958 constituted 71.7% of world engineering production.

Because of the paucity of data for the U.S.S.R. in the 1950s, I will assume the same world percentages for the U.S.S.R. for non-electrical machinery as for machinery as a whole. Only data for western Europe is available on a comparative basis from the OEEC, the predecessor of the OECD (OEEC 1961); I therefore used U.S. census of manufactures data for category 35, which is approximately (although not completely) compatible with the OECD definition of non-electrical machinery. The available data for the 1950s are in terms of deliveries and shipments, not value-added as in other years. The U.S. data are available for value-added. In order to estimate deliveries for the U.S. data, I used the OECD study, *The Engineering Industries in OECD Member Countries, 1963-1970*, and for 1963 found that value-added was 58% of shipments for the U.S. (OECD 1973, 16 and 22). Assuming this relationship in 1953 and 1958 using the U.S.

Census of Manufactures (US 1961, 35-2), I arrived at rough estimates of shipments with which to compare with those from Europe.

I assumed that the output of the U.S. plus Europe constituted the same share of world production for non-electrical machinery as for general machinery: 76.5% in 1953, and 65.2% in 1958. The following shows the major producers for non-electrical machinery for 1953:

USA:	54.1%
USSR:	12.4%
U.K.:	8.3%
W. Germany:	4.7%

The West German share of world machinery was 5.5% in 1953, indicating that shares of non-electrical and industrial machinery were similar. I would rate the U.K. as barely a Great Power in 1953, as both its nonelectrical and industrial machinery shares were approximately 9%. The share of the Great Powers (U.S., U.S.S.R, and U.K) in 1953 was 74.8%.

Using the same methodology as for 1953, the following are the shares of largest producers of nonelectrical machinery in 1958:

U.S.:	36.5%
U.S.S.R:	17.8%
U.K.:	7.8%
W. Germany:	6.5%
France:	4.2%

I would rate the U.S., U.S.S.R, U.K., and Germany as Great Powers, although Germany (with 8.3% of general machinery) and the U.K. (with 8.7%) are clearly in a secondary tier of Great Powers. These four nations together produced 68.6% of world nonelectrical machinery output.

## 1963

For 1963, we have broad coverage by one U.N. study of the entire world machinery sector, contained in *The Growth of World Industry, 1960-1968* (UN 1971, 496-503). The following are the major producers:

U.S.:	35.3%
U.S.S.R.:	22.0%
U.K.:	6.7%
W. Germany:	6.6%

The statistic for the U.S.S.R. however, is inconsistent with other data. In the *Handbook of Industrial Statistics, 1988*, the Soviet Bloc as a whole is given the following percentages of world share for the components of general machinery in 1965: for nonelectrical machinery, 17.5%; for electrical machinery, 7.4%; and for transportation equipment, 7.4% (UNIDO 1988, 45). Assuming the U.S.S.R. constitutes about 75% of each figure, then the U.S.S.R. could not possibly constitute 22% of world production of the category which combines these subcategories. However, I will use the 22% figure, because of its use with a broad comparative study, and urge future research to clear up this inconsistency.

I would rate the U.S. and the U.S.S.R. clearly, and West Germany just barely as Great Powers in 1963, but not the U.K. This is because of the distribution of nonelectrical machinery.

For the U.S.S.R., I am using a figure published *Handbook of Industrial Statistics, 1988*, which states that in 1965 the “Centrally Planned Countries”, which refers mainly to the U.S.S.R. and eastern Europe, produced 17.5% of world nonelectrical machinery production (UNIDO 1988, 45). Since in future years the U.S.S.R. accounted for approximately 75% of the nonelectrical machinery production for this area, I will assume that the U.S.S.R. accounted for 75% of this region’s output in 1965 as well.

The O.E.C.D. constituted almost all of what is described as the “Developed market countries” in *Handbook of Industrial Statistics, 1988*, which produced 79.3% of nonelectrical machinery production in 1965 (UNIDO 1988, 45). I applied these percentages to 1963, and used *The Engineering Industries in OECD Countries, 1963-1967* (OECD 1973, 22) for value-added. As several countries, such as Italy, did not have data, I added 7% to the OECD total, since the proportion of the excluded countries in the value-added tables was 7% of the value of shipment of nonelectrical machinery in the O.E.C.D.

Here are the resulting percentages for major producers in 1963:

U.S.:	43.9%
U.S.S.R.:	13.2%
W. Germany:	11.1%
U.K.:	6.1%
Japan:	4.9%

Because the U.K. has only 6.1% of nonelectrical machinery production, and 6.7% of machinery production, I do not categorize the U.K. as a Great Power in 1963.

Germany, even though it has the same percentage as the U.K. of machinery, has 11.1% of nonelectrical machinery production. Therefore, I would rate Germany to be barely a



Great Power, but a Great Power nonetheless. These Great Powers controlled 63.9% of machinery production in 1963, and 68.2% of nonelectrical machinery production.

Starting in 1966, I have a continuous series concerning machine tools, compiled from various issues of the trade journal *American Machinist*. In 1966, as quoted in the U.N. study entitled *World Non-Electrical Machinery*, the U.S. produced 30.6% of world machine tool output, Germany 16%, and the U.S.S.R. 14.5% (UNIDO 1984, 79). Thus, Germany had regained its position as a major producer of reproduction machinery. The three Powers produced 61.1% of world production.

### **1970 and 1975**

For 1970 and 1975, the *Handbook of Industrial Statistics, 1988* contains data for nonelectrical machinery (ISIC 382) as well as for the other types of machinery: electrical, transportation, and instrumentation machinery (UNIDO 1988, 302-30). However, it only contains partial data concerning the U.S.S.R.

In 1970, there are no data for the U.S.S.R, but there are two pieces of information about the share of the Soviet Bloc as a whole: in 1965, the Soviet Bloc's output constituted 17.5% of nonelectrical world production, and in 1975 it constituted 27.6% (UN 1988, 45). Interpolating between the two numbers, I estimate that the Soviet Bloc produced 22.5% of world production in 1970. Value-added figures are available for the other Soviet bloc countries, except the German Democratic Republic (GDR) only has gross output. I took approximately half of the GDR's gross output to arrive at value-added. I filled in the required number for the Soviet Union so that 22.6% of world

production was accounted for by the Soviet Bloc. The following is the result, for nonelectrical machinery for 1970:

U.S.:	37.8%
U.S.S.R:	15.8%
Japan:	10.0%
Germany:	9.8%
U.K:	6.0%
France:	5.6%

I would rate the U.S., U.S.S.R., Japan and Germany as Great Powers, accounting for 73.4% of world production of nonelectrical machinery in 1970. Japan has entered the ranks of the Great Powers.

Using the same methodology for the Soviet Union (and GDR) as with nonelectrical machinery, I used the *Handbook of Industrial Statistics, 1988* to calculate data for electrical, transportation, and instrumentation machinery (UNIDO 1988, 302-30). Adding these to nonelectrical machinery, I arrived at the following shares for world general machinery production:

U.S.:	39.9%
U.S.S.R:	9.9%
Japan:	10.3%
W. Germany:	9.6%
U.K:	5.8%
France:	4.8%

The total for the U.S., U.S.S.R., Japan, and Germany was 69.7%.

For machine tool production, W. Germany actually takes the lead with 18.9% of world production in 1970, the U.S. output 18.5%, Japan output 14.2%, and the U.S.S.R. output 13.7%. These Powers totaled 65.3% of world production of machine tools.

For 1975, much the same methodology is performed as for 1970. Soviet Bloc production for the different machinery categories was taken into account, and the figures

for the Soviet Union and GDR were thereby calculated. In 1975, unlike 1970, the Soviet Union has gross output figures available in the *Handbook of Industrial Statistics, 1988*.

The value-added calculated is generally compatible with these gross output figures. The shares for nonelectrical machinery were as follows:

U.S.:	27.3%
U.S.S.R:	21.7%
Japan:	9.6%
Germany:	9.6%
France:	6.4%
U.K:	5.2%

The four Great Powers constituted the producers of 68.2% of world nonelectrical machinery production.

The shares for general machinery were as follows, in 1975:

U.S.:	28.8%
U.S.S.R:	12.1%
W. Germany:	9.9%
Japan:	9.8%
France:	5.8%
U.K:	5.1%

The four Powers produced 60.6 of world general machinery production in 1975.

The U.S. regained a slim lead in machine tool production in 1975, with 17.9% of production to W. Germany's 17.6%. The U.S.S.R. had 14.5%, while Japan slipped temporarily with 7.7% of world machine tool production in 1975.

## 1980, 1985, 1990, and 1995

The data for the 1980s and 1990s is presented for almost all countries in the statistical annex of the *Industrial Development Global Report, 1997*, as compiled by the U.N. Industrial Development Organization (UNIDO 1997, 117-243). The problem, once again, is the Soviet Union.

For 1980 and 1985, I took one half of the gross output value for the Soviet Union and used that figure for the value-added figure. This led to a conflict with the earlier methodology; that is, the value-added for the Soviet Bloc did not add up to the percentage given for Soviet Bloc as a whole elsewhere in the report (UNIDO 1988, 45). I stayed with the value-added as one-half of gross output because gross output seems to be a more basic piece of data than percentage for the Soviet Bloc. Value-added almost never rises above 50% of gross output.

For 1995, Russian data are actually available. However, by 1995 Russian output only constitutes 0.5% of world general machinery production, 1.1% of nonelectrical machinery production, and an equally small proportion of machine tool production (the figure is not even listed by *American Machinist* for 1995). For 1990, I turned to *World Engineering Industries and Automation, 1994-1996*, a publication of the U.N. Economic Commission for Europe (UN 1996). This publication uses the exchange rate of .572 dollars per ruble (UN 1996, ix). Using this exchange rate, I used data for metal products (that is, general machinery plus metal fabrication) and for nonelectrical machinery in rubles to calculate that the U.S.S.R. in 1991 only produced 3.9% of general machinery

and 3.6% of nonelectrical machinery (UN 1996, 145-6). The data for 1990 are of similar magnitudes.

Starting in 1990, Germany includes both West and East Germany, adding about 2% to Germany's share of world production.

I have also included a calculation of what I list as the "Euro Big 4". This includes Germany, France, Italy, and the U.K. While the European Community, then the European Union, has been discussed as a potential political unit, it may be useful to consider the four biggest industrial countries within Europe. These are the countries which have the greatest potential to work together as a political unit. These four countries together would constitute the second most powerful Great Power.

With these considerations in mind, the following are the estimates for world production of general machinery for 1980-1995:

Table 8. World General Machinery Production, 1980-1995

	1980	1985	1990	1995
U.S.	29.2%	36.0%	29.1%	28.6%
Japan	11.8%	15.4%	22.0%	23.3%
Germany	10.4%	8.6%	15.4%	14.4%
U.S.S.R	11.9%	10.2%	3.9%	0.5%
U.K	5.7%	3.8%	4.9%	3.7%
France	5.2%	4.8%	4.8%	4.1%
Italy	3.1%	2.0%	3.0%	2.2%
China	2.1%	2.1%	1.3%	2.1%
Great Powers	63.3%	70.2%	66.5%	66.3%
Euro Big 4	24.4%	19.2%	28.1%	24.4%

The Great Powers in 1980 and 1985 are the U.S., U.S.S.R., Japan, and Germany.

The Great Powers in 1990 and 1995 are the U.S., Japan, and Germany.

For nonelectrical machinery and machine tools, the data are the following:

Table 9. World Nonelectrical Machinery Production, 1980-1995

	1980	1985	1990	1995
U.S.	26.6%	29.2%	25.6%	26.4%
Japan	10.1%	13.6%	22.4%	25.5%
Germany	8.9%	8.6%	16.5%	15.3%
U.S.S.R	22.0%	20.5%	3.9%	0.5%
U.K	5.4%	3.8%	5.3%	4.3%
France	4.1%	3.0%	4.4%	3.3%
Italy	2.4%	2.2%	3.6%	3.0%
China	3.4%	2.7%	1.8%	2.5%
Great Powers	67.6%	71.9%	64.5%	67.2%
Euro Big 4	20.8%	17.6%	29.8%	25.9%

Table 10. World Machine Tool Production, 1980-1995

	1980	1985	1990	1995
U.S.	26.6%	12.5%	8.7%	11.7%
Japan	14.3%	24.4%	28.0%	23.5%
Germany	17.6%	14.6%	22.4%	22.6%
U.S.S.R	11.4%	13.9%	11.7%	---
U.K	---	2.0%	4.3%	2.7%
France:	---	2.0%	3.0%	2.5%
Italy	---	5.1%	9.5%	8.5%
China	---	2.1%	3.0%	4.9%
Great Powers	61.2%	65.4%	59.1%	57.8%
Euro Big 4	---	23.7%	39.2%	36.3%

## Conclusion

It is extraordinary that only three or four countries, throughout the twentieth century, have controlled approximately two-thirds of the global production of critical machinery categories – general machinery, nonelectrical machinery, and machine tools. While research is needed to further refine these measures, the theoretical framework as elaborated in this study has made possible an objective standard with which to determine the set of Great Powers in a particular time period, and to show the source of the international influence which those Great Powers are able to project.

The following charts summarize the data presented above. General machinery, nonelectrical machinery, and machine tools are presented in pairs. The first chart of each pair shows the Great Powers in line graph form, in order to be able to compare each Great Power individually. The second chart of each pair presents all of the Great Powers together, in order to show the dominance of the Great Powers in terms of global production.

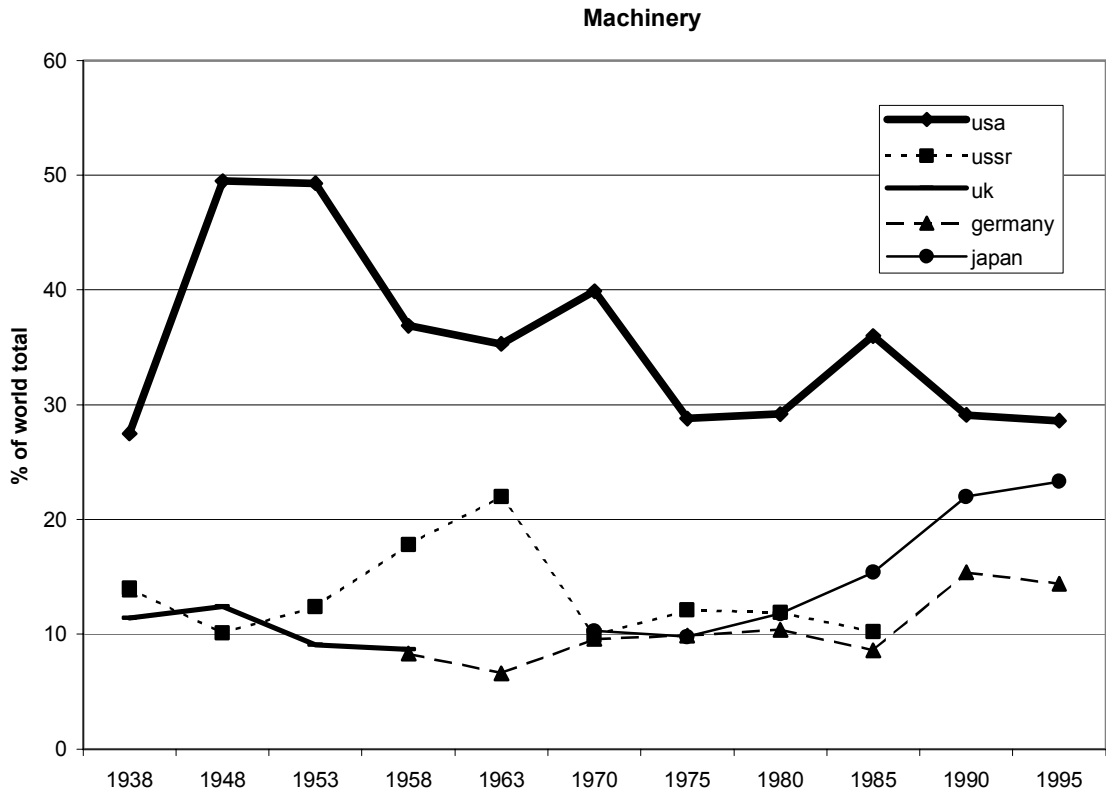


Fig. 59. General machinery by individual Great Power.

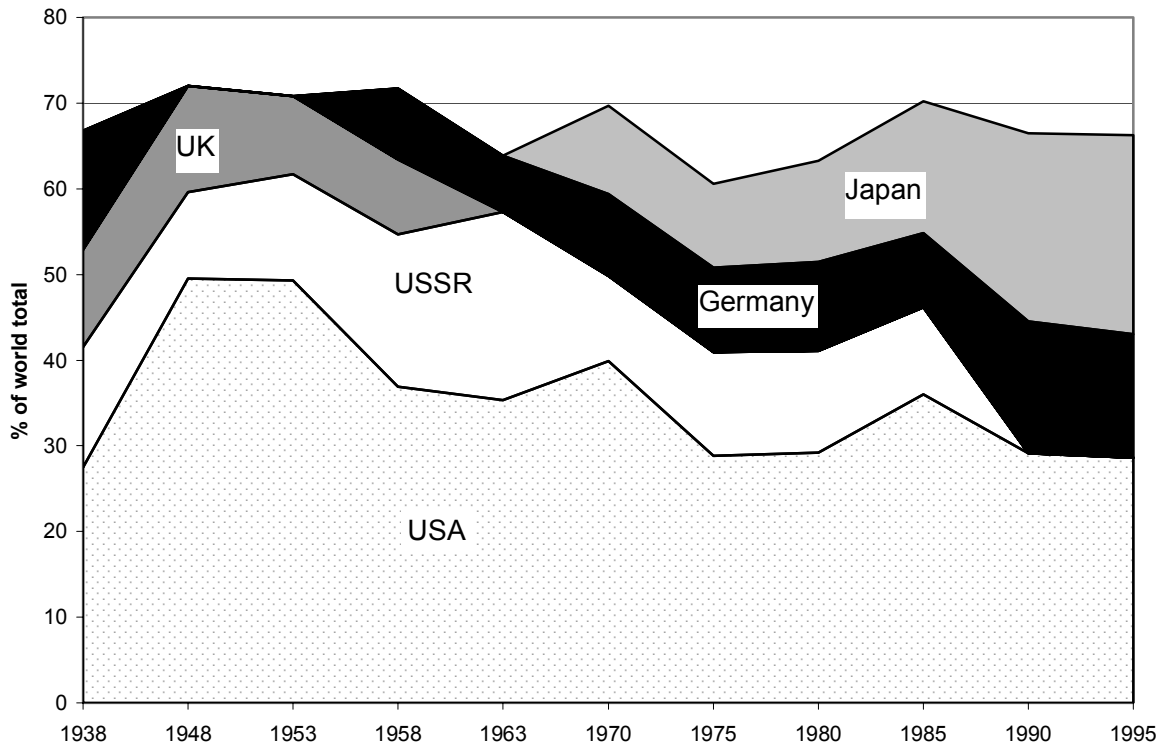


Fig. 60. General machinery of Great Powers collectively.



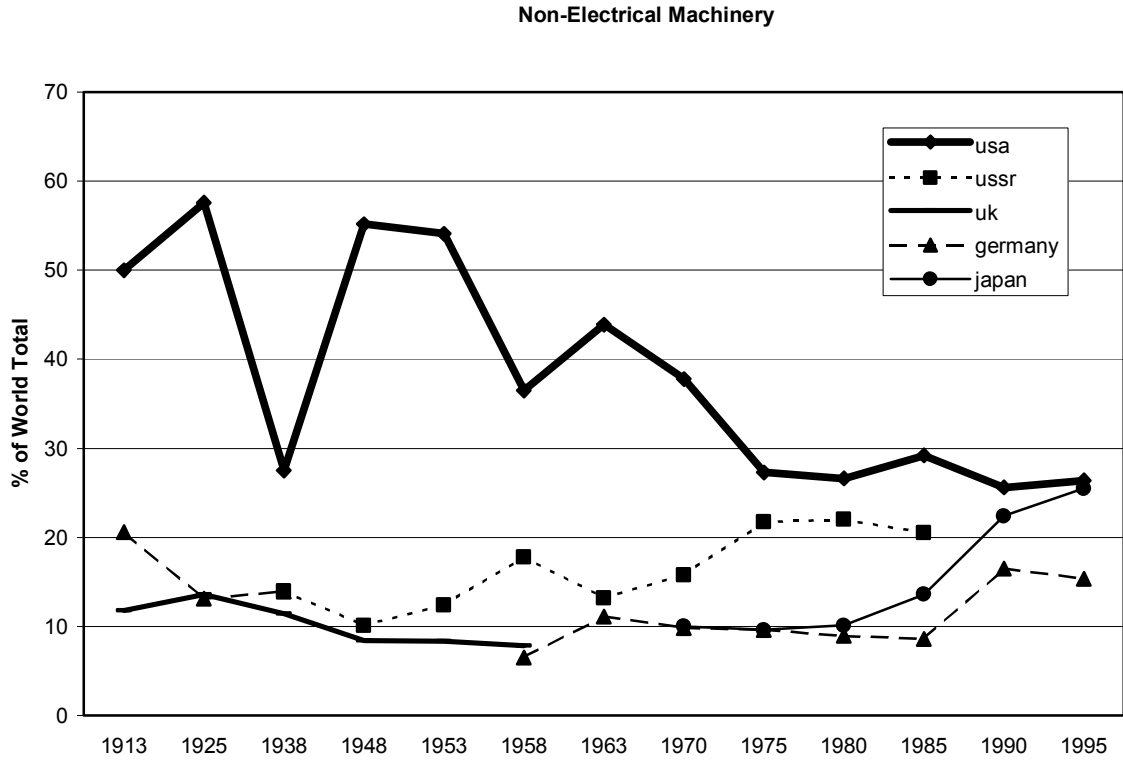


Fig. 61. NonElectrical machinery by individual Great Power.

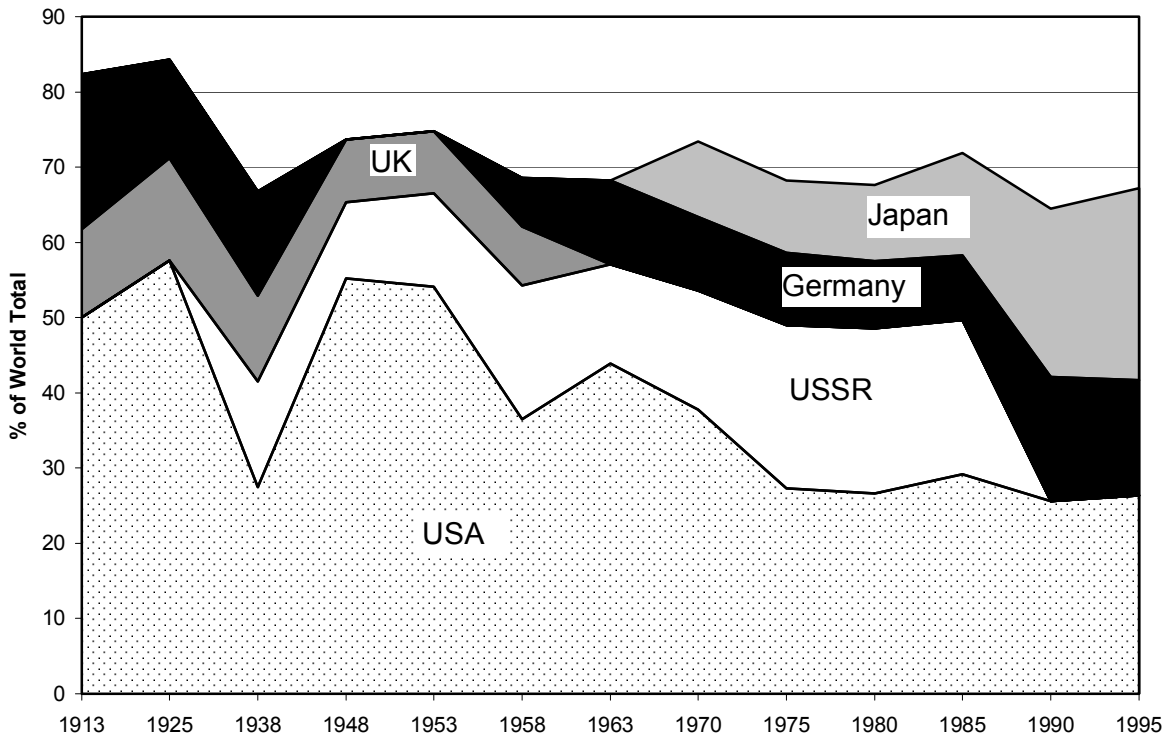


Fig. 62 – NonElectrical machinery of Great Powers collectively.

Machine Tools

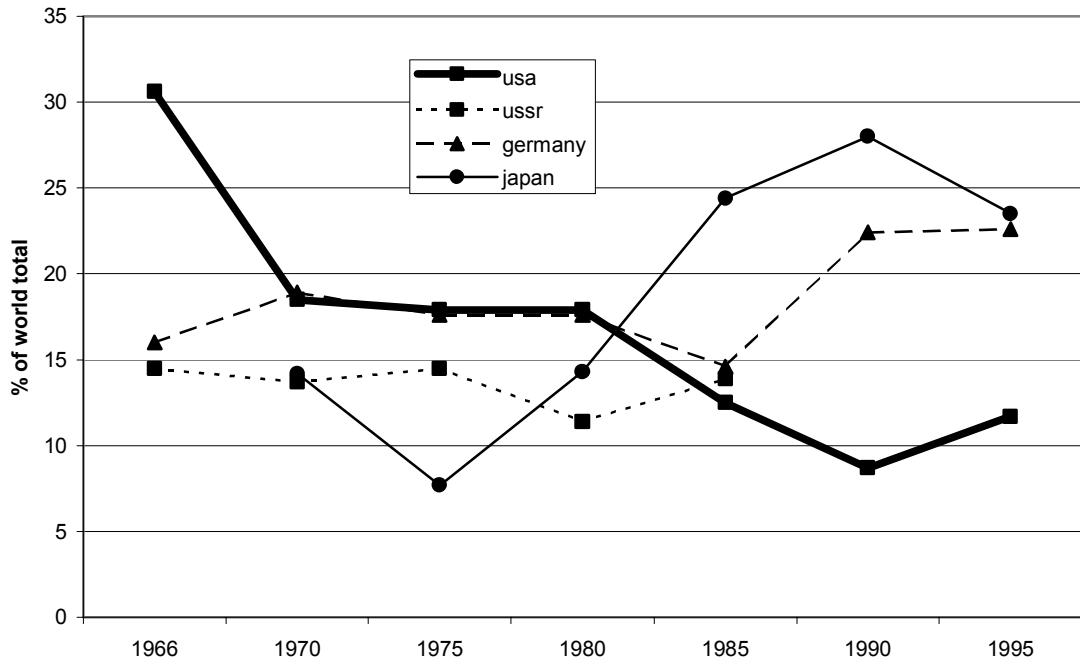


Fig. 63. Machine tools by individual Great Power.

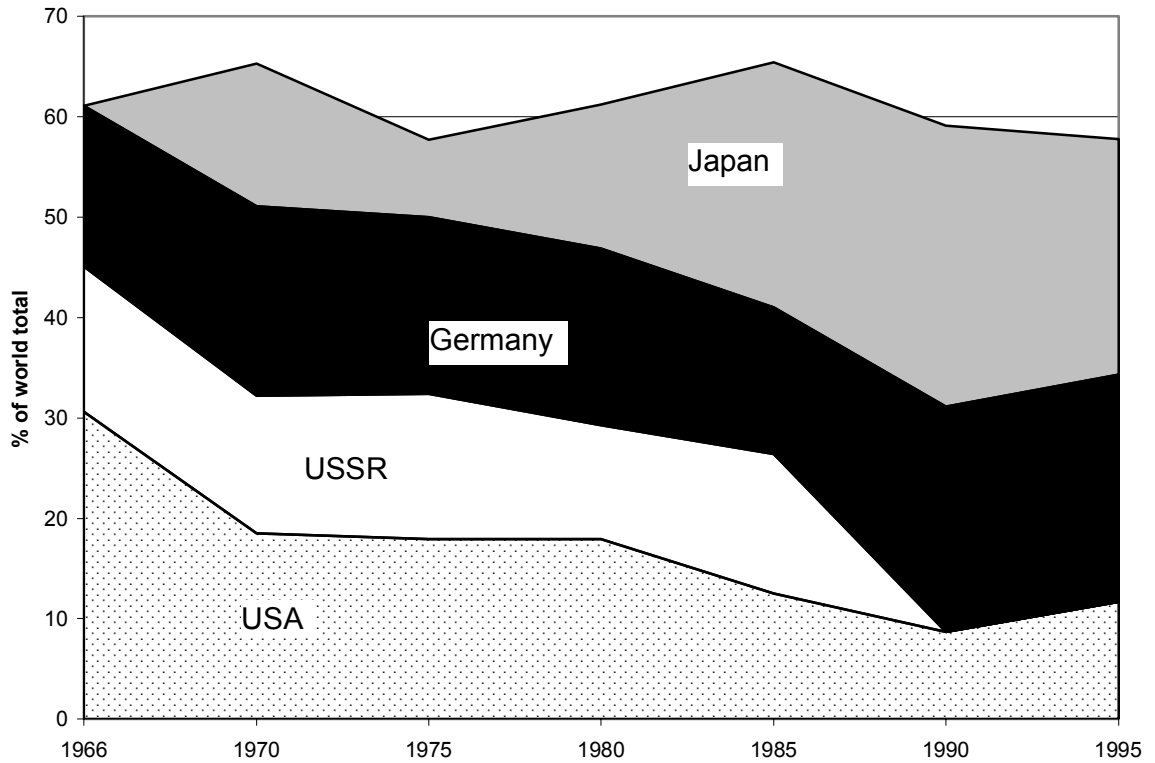


Fig. 64. Machine tools of Great Powers collectively.