THE EFFECT OF IMPORTS OF ANTI-FRICTION BEARINGS ON THE NATIONAL SECURITY

An Investigation Under Section 232
of the Trade Expansion Act of 1962, as amended
(19 U.S.C. 1862)

U.S. Department of Commerce
International Trade Administration
Office of Industrial Resource Administration
Strategic Analysis Division

July 1988

Sections of this report have been deleted because they contain company proprietary information. Such deletions are denoted by ------ or (deleted).

For information or comments concerning this report, please contact Brad Botwin, Director, Strategic Analysis Division (202) 482-4060. Copies are available for sale from the National Technical Information Service (NTIS) by calling (703) 487-4650 and requesting PB 93-192540.

TABLE OF CONTENTS

THE EFFECT OF IMPORTS OF ANTI-FRICTION BEARINGS ON THE NATIONAL SECURITY

This investigation was conducted under the policy supervision of the Department of Commerce's International Trade Administration

W. Allen Moore, Under Secretary for International Trade

Jan W. Mares, Assistant Secretary for Import Administration

Joseph A. Spetrini, Deputy to the DAS for Import Administration

John A. Richards, Director, Office of Industrial Resource Administration

* * * *

The analysis for the investigation was conducted by the Department of Commerce's Strategic Analysis Division and written by the following individuals:

Steven C. Goldman
Director
Strategic Analysis Division

Edward L. Levy, Program Manager
Section 232 Investigations

John A. Tucker
Trade & Industry Analyst

Craig A. Lewis
Trade & Industry Analyst

Karen A. Swasey
Trade & Industry Analyst

Camille M. Antinori
Trade & Industry Analyst

Jeanette Dykes
Trade & Industry Analyst

Special thanks are due to E. Lawrence Salkin of the Federal Emergency Management Agency for his role in calculating national security requirements for bearings; to David Henry of the Department of Commerce's Office of Business Analysis for his assistance in developing the sub-chapter on mobilization requirements; and to Douglas C. Lippoldt of the Department of Labor for his role in analyzing the skilled labor requirements of the bearings industry.

EXECUTIVE SUMMARY

Background

On July 17, 1987, the Anti-Friction Bearing Manufacturers Association (AFBMA) petitioned the Department of Commerce (DOC) to conduct an investigation under Section 232 of the Trade Expansion Act of 1962, as amended, to determine the effect of imports of ball and roller bearings on the national security.

Under this statute, the President has authority to adjust imports based on recommendations from the Secretary of Commerce. DOC has one year in which to complete its investigation and forward its report to the President.

In its petition, the AFBMA asserted that "the domestic bearings industry is in a state of serious decline ... (and unless action is taken) the domestic industry's ability to supply military and related commercial needs is seriously endangered."

The petitioner requested that quotas be established ranging from 0 percent to 34 percent of the U.S. market for the various bearing product categories. By statute, DOC must report findings and recommendations to the President by July 17, 1988.

The Significance of Bearings to Defense Manufacturing

Antifriction bearings are essential in any metal product with moving parts, and therefore are necessary for manufacturing defense products as mundane as motor vehicles and as sophisticated as high accuracy gyroscopes for missile guidance systems. Direct and indirect military consumption of bearings account for about one fifth of U.S. apparent consumption. For example, the KC-10 refueling aircraft uses an estimated 6000 bearings; the C-17 transport plane uses about 10,000 bearings and the average helicopter uses about 2500 bearings in its transmissions, gear boxes and rotor linkages. Accordingly, the Department considers a viable domestic bearings industry as a key element of the defense manufacturing base.

Methodology for the Investigation

The methodology for this investigation is based on a two-step process.

Step I

Compare total available supply of each product with anticipated demand during a specified national security emergency - a one year mobilization period followed by one year of a major conventional conflict.

Supply is the sum of the following elements:

- domestic mobilization capacity (developed from responses to our industry survey);
- importer and domestic inventories (also from industry survey); and
- reliable imports (embodied in the model of the 1984 NSC Stockpile Study).

Demand for each product is determined through an input/output analysis of end-use product requirements in the 1984 NSC Stockpile Study. (This approach was approved by the NSC, DOD and FEMA.)

Step II

In categories where a supply shortfall is found, determine whether imports have been a significant cause of the industry's inability to meet national security requirements.

- - -

In addition to this snapshot supply/demand review, the Department also analyzed current and prospective market trends to evaluate the industry's ability to meet national security requirements in the future.

Significant Industry Trends

Domestic shipments (in constant 1987 dollars) have declined from a high of $4.6 billion in 1979 to $3 billion in 1987.

Employment has declined from a high of 58,300 workers in 1979 to 43,000 workers in 1987.

Profitability (net before taxes) has declined from a high of 9.3 percent in 1980 to 3.8 percent in 1986 (last year for which data is available).

Since the late 1970s about 30 plants accounting for over $1 billion in production capacity have closed.

About half of the 31 domestic producers surveyed by DOC for this investigation depend on imported steel to varying degrees to manufacture finished bearings. Nine companies who import bearings quality steel do so because of a lack of domestic availability. Further, many domestic bearing manufacturers depend on imports of bearing components for their finished products. Therefore, the U.S. is more dependent on foreign sources to manufacture bearings than trade data indicate.

Import penetration varies significantly depending on the bearing category. In some product categories, U.S. manufacturers still control the domestic market. However, in other product lines foreign manufacturers dominate the market while import penetration is increasing and domestic shipments and production capabilities are declining.

DOC industry experts project that imports are likely to gain increased shares of the U.S. market -- the large European and Japanese international bearing corporations have consolidated their hold on home markets, and have increasingly turned their attention to the United States.

Supply Shortfall Analysis

Bearings-Surpluses/Shortfalls
and 1987 Import Penetration
(millions of 1982$)

	Mobilization Year	Year 1	Import Pen. (Unit/Value)
Regular Precision Bearings			
Ball under 30mm	- 72	- 41	(78%/58%)
Ball 30-100mm	-175	-130	(61%/43%)
Ball over 100mm	- 6	- 43	(49%/25%)
Integral Shaft	- 70	36	(33%/6%)
Thrust	16	41	(8%/4%)
Other Ball	110	60	(26%/10%)
Tapered Roller	372	905	(38%/20%)
Spherical Roller	77	147	(75%/18%)
Cylindrical Roller	22	- 23	(27%/21%)
Needle Roller	- 21	-150	(7%/9%)
Other Roller	- 33	-221	(49%/24%)
Superprecision Bearings			
Ball under 30mm	7	18	(71%/33%)
Ball 30-100mm	64	38	(13%/11%)
Ball over 100mm	87	83	(6%/10%)
Cylindrical Roller	132	190	(36%/11%)

Projected supply can meet national security requirements in the following eight categories. Therefore, it was determined that imports do not threaten to impair the national security in these product lines at the present time:

- thrust bearings
- other ball bearings
- tapered roller bearings
- spherical roller bearings
- superprecision ball bearings under 30mm
- superprecision ball bearings 30-100mm
- superprecision ball bearings over 100mm
- superprecision cylindrical roller bearings

Supply shortfalls exist in seven of the fifteen categories under investigation:

- integral shaft bearings
- regular cylindrical roller bearings
- needle roller bearings
- other roller bearings
- regular ball bearings under 30mm
- regular ball bearings 30-100mm
- regular ball bearings over 100mm

A further review of supply availability and market trends in these categories was conducted. In five of the seven categories, it was determined that imports do not threaten to impair the national security at the present time:

Integral shaft bearings: In 1987, imports accounted for about 33 percent of the units but only 6 percent of the value of U.S. consumption. It was therefore determined that imports are not a significant factor relating to the industry's inability to meet national security requirements.

Regular cylindrical roller bearings: The Department's survey of bearing manufacturers identified adequate surplus production capacity of superprecisison cylindrical roller bearings to cover projected shortfalls in the regular precision category.

Needle roller bearings: In 1987, imports accounted for less than 10 percent of the units and value of U.S. consumption. It was therefore determined that imports do not have a significant impact on the industry's inability to meet national security requirements.

Other roller bearings: Imports account for about half of U.S. consumption in the 'catch all' basket for roller bearings that are not classified under one of the other categories. However, mounted roller bearings account for nearly 70 percent of this category and many of these are tapered roller and spherical bearings with cast or forged mountings attached. There is excess production capacity to manufacture tapered roller and spherical bearings that could be used to eliminate the projected shortfall in this category.

Regular ball bearings over 100mm: The Department's survey of bearing manufacturers identified adequate surplus production capacity of superprecision ball bearings over 100mm to cover the projected shortfall in the regular precision category.

- - -

The Department's analysis indicates that shortfalls which can be attributed to high levels of import penetration exist in two of the fifteen bearing categories under review.

Regular Precision Ball Bearings Under 30mm

A shortfall of $71 million (1982 dollars) is projected for the mobilization year and a $40 million shortfall during the war year. Surplus superprecision production capacity would reduce but not eliminate these shortfalls. This category accounted for 12 percent of the volume and 3 percent of the value of U.S. consumption in 1987.

In 1987, imports accounted for 58 percent of the value and 78 percent of the volume of domestic consumption. From 1982-87, U.S. shipments fell 22 percent by value and 17 percent by volume. During the same period, imports rose 41 percent by value and 79 percent by volume. Major import sources are Japan, Thailand and Singapore (imports from the latter two countries entirely reflect activity by Japan's Minebea). From 1984-87, half of the U.S. firms producing these bearings discontinued production leaving five remaining companies (three of which are foreign-owned).

Regular Precision Bearings 30-100mm

A shortfall of $174 million is projected for the mobilization year followed by a shortfall of $129 million in the war year. Surplus superprecision production capacity would reduce but not eliminate these shortfalls. This category accounted for 13 percent of the volume and 9 percent of the value of U.S. consumption in 1987.

In 1987, imports accounted for 43 percent of the value and 61 percent of the volume of domestic consumption. From 1982-87, U.S. shipments fell 8 percent by value and rose 1 percent by volume. During this period, imports rose 38 percent by value and 50 percent by volume. Major import sources are Japan, Canada, Italy and West Germany. Defense uses are pervasive and range from ground transportation to ordnance equipment.

Key USG Actions Affecting Bearings

Before reaching a decision regarding a national security threat posed by imports, it is important to consider what steps the Government has and is taking to address the industry's problems.

DOD currently has in place a Federal Acquisition Regulation (FAR) requiring domestic procurement of ball bearings under 30mm used in military products. DOD has published draft regulations to expand the existing FAR to cover all bearings used in military products. DOD is also undertaking a number of other initiatives to help improve the industry's production base and ability to meet national security requirements.

* * *

Findings

The Department's investigation finds that, at the present time, the domestic bearings industry would be able to meet most but not all national security requirements in the event of a major conventional war. Further, imports continue to pose significant challenges to domestic manufacturers in a number of product lines which could lead to the further erosion of domestic production capabilities. The Administration is currently taking a number of steps to improve the bearing industry's production capabilities including the DOD draft Federal Acquisition Regulation (FAR) that will require domestic procurement of all defense related bearings.

Recommendations

The Secretary of Commerce recommends that the President defer making a finding in this investigation or taking any action under Section 232 until the effect of these initiatives on the bearing industry's ability to meet national security requirements has been evaluated by the Departments of Commerce and Defense.

I. INTRODUCTION

On July 17, 1987, the Anti-Friction Bearing Manufacturers Association (AFBMA) of Washington, D.C., petitioned the Secretary of Commerce to conduct an investigation under Section 232 of the Trade Expansion Act of 1962, as amended, to determine the effect of imports of ball and roller bearings on the national security. The Act states that:

> The Secretary shall report the findings of his investigation ... with respect to the effect of the importation of such article.... The President shall take such action, and for such time, as he deems necessary to adjust the imports of such article ... so that such imports will not threaten to impair the national security ....

In its petition, the AFBMA asserted that " the domestic bearings industry is in a state of serious decline ... (and unless action is taken) the domestic industry's ability to supply military and related commercial needs is seriously endangered." The petitioner requested that quotas be established ranging from 0 percent (i.e. embargo) to 34 percent for the various bearing product categories. A comprehensive summary of the allegations set forth in the petition is attached at Tab A.

The Department of Commerce (DOC) reviewed and accepted the AFBMA petition, and announced its initiation of this investigation in the Federal Register on August 4, 1987 (copy attached at Tab B). By law, the Secretary of Commerce had one year from the date of receipt of the AFBMA petition in which to conduct an investigation and forward a report to the President.

The Department conducted this investigation with assistance from the interagency community including the Departments of Defense, Labor, and Justice, the National Security Council and the Federal Emergency Management Agency. In order to obtain data regarding the industry's ability to supply product during a national security crisis, the Department conducted a survey of all identifiable producers and importers (copies attached at Tab C). Additional information was gathered from public comments received in response to our Federal Register notice (summary attached at Tab D), from previous government and private studies of the industry, and from additional independent research.

Based on information contained in the petition and on further analysis of trade and industry statistics, it was decided to divide the bearings industry into fifteen product categories: eleven categories of standard bearings and four categories of superprecision bearings. Individual product findings for each category were made based on the following methodology.

Investigation Methodology

A Section 232 investigation is conducted to determine the effect of imported articles on the national security. An investigation includes examination of the effects of imports on all phases of U.S. productive capacity necessary to meet requirements for the article derived from a selected emergency scenario.

The Department's Section 232 regulations (found at 15 CFR 359) provide the following factors for consideration in determining the effect of imports on the national security:

a) domestic production needed for projected national defense requirements;

b) the capacity of domestic industries to meet projected national defense requirements;

c) the existing and anticipated availabilities of human resources, products, raw materials, production equipment and facilities, and other supplies and services essential to the national defense;

d) the growth requirements of domestic industries to meet national defense requirements and the supplies and services including the investment, exploration and development necessary to assure such growth; and

e) any other relevant factors.

Two-step Review

After evaluating the importance of the bearings industry to national security and assessing the significance of the above factors, the Department followed a two-step procedure to reach findings for each product category of bearings under investigation.

1) Compare total available supply of each product (based on domestic mobilization capacity, importer and domestic inventories and reliable imports) with demand for each product disaggregated from the overall bearings requirements needed to conduct one year of a major conventional war preceeded by a one year mobilization;

2) In categories where a supply shortfall was found, determine whether the trend and severity of import penetration was a significant cause of the identified supply shortfall.

Supplementary Analysis

In addition to the quantitative supply/demand assessment described above, the Department also analyzed a number of other factors pertaining to the industry's ability to meet national security requirements. These included: industrial organization, labor availability and existing government initiatives that support the industry's production capabilities. This analysis was also taken into account in reaching our findings and recommendations.

Report Outline

This report begins with a description of the bearings industry and the products under review. This is followed by an assessment of the industry's international competitiveness. We next present an analysis of the impact of existing government programs on the industry's ability to meet emergency requirements. Recent market trends are then discussed with an emphasis on imports.

A national security assessment follows applying the two-step process identified above to each product category under investigation. The investigation concludes with determinations of whether imports threaten to impair national security for each of the 15 bearing categories under investigation.

Importance of the Industry to National Security

As recently as January of this year, President Reagan reasserted his belief that a vibrant defense industrial base is essential to the national security. The President stated that:

> the maintenance of a broad technologically superior mobilization base is a fundamental element of U.S. defense policy ... (M)aintenance of this capability supports deterence and provides the ability for a timely and flexible response to the full range of possible threats.1

Antifriction bearings are essential components in any metal product with moving parts, and therefore are necessary for the functioning of defense products as mundane as motor vehicles and as sophisticated as high accuracy gyroscopes for missile guidance systems and in 'noise-quiet' applications for nuclear submarines.

---

1. National Security Strategy of the United States, The White House, January 1988, p.21.

Several recent government studies have concluded not only that bearings are essential to defense readiness, but that the current situation with regard to availability of bearing supplies and productive capacity poses potential threats to that readiness. The Industrial College of the Armed Forces, for example, in a study of aircraft engine main shaft bearings, concluded that:

> bearings are critical assets which directly affect aircraft readiness rates and the strategic airlift and tanker fleets face a far more serious problem than do other aircraft. The requirements for bearings to support these types of aircraft will rise as much as 500 percent during an intense conflict.2

The June 1986 Joint Logistics Commanders study of the bearing industry also noted that shortages of defense bearings have become commonplace even during peacetime.

> Although most bearings that are required for peacetime operating stocks are on hand, isolated shortages of one or more bearing types exist for several of our most modern and critical airlift and fighter aircraft. All services are experiencing similar problems with peacetime stocks and have significant shortages in wartime requirements.3

Direct and indirect military consumption of bearings account for approximately 19 percent of U.S. apparent consumption, with enormous quantities and varieties used in a number of military items. To cite a few examples: the KC-10 refueling aircraft uses an estimated 6000 bearings; the C-17 transport plane (with a complex flap lift system) uses a phenominal 10,000 bearings; and a typical helicopter uses about 2500 bearings in its transmissions, gear boxes and rotor linkages.

In summary, a viable domestic bearings industry is a key element of our defense preparedness. Bearings are pervasive in military and essential civilian applications, and have been cited as potential bottlenecks by several recent government studies.

---

2. Aircraft Engine Main Bearing Study, Industrial College of the Armed Forces, cited in Joint Logistics Commanders Bearing Study, June 1986, p.24.

3. Joint Logistics Commanders Bearing Study, June 1986.

II. NATURE OF THE INDUSTRY

A. INDUSTRY DESCRIPTION

1. World Bearing Production

Five countries dominate free world production of anti-friction bearings, which was valued at $11.4 billion in 1986. The United States, Japan, and West Germany alone account for about 71 percent of production. Table II-1 presents annual production figures for the top five major bearing-producing countries.

Table II-1
Production of Anti-friction Bearings
Selected Countries: 1982-1986

($ Millions)*

	1982	1983	1984	1985	1986
United States	2,973	2,778	3,698	3,556	3,440
Japan	2,368	2,332	2,807	2,961	2,736
West Germany	1,558	1,466	1,684	1,894	1,981
France	418	447	485	559	565**
United Kingdom	308	297	316	336	343**

* All Figures at 1986 exchange rates.
** Estimated.

Source: Official government statistics of the United States, Japan, West Germany, France, and the United Kingdom.

United States anti-friction bearing product shipments, at $3.4 billion in 1986, account for about 30 percent of total world production. Although the United States remains the world's largest and most important market for anti-friction bearings, the U.S. share of free world production has dropped from approximately 45 percent in 1979 to 30 percent in 1986.[1]

---

[1]Other important producers include Italy, Sweden, and a growing number of new producers in the Far East and Eastern Europe. Estimates indicate, however, that the top five nations continue to account for approximately 79 percent of total free world production.

Table II-2

Relative Shares of Free World Production
Held by Top Five Bearing Producers

(Based on 1986 Exchange Rates)

	1986
United States	30 %
Japan	24 %
West Germany	17 %
France	5 %
United Kingdom	3 %

Source: Official Statistics of the United States, Japan, West Germany, France, United Kingdom.

A number of economic factors have contributed to the decline in U.S. production during the last decade. These factors included: a) (until recently) an overvalued dollar; b) high domestic lending rates; and c) loss of domestic and international market share to foreign competitors for a variety of reasons. In relation to the latter point, the rise in U.S. imports of automobiles and other end products with 'embedded' bearings, and increased foreign sourcing of anti-friction bearings by major U.S. original equipment manufacturers, has delivered a particularly strong blow to domestic demand.

Japanese bearing production, which has grown substantially in this period, amounted to $2.7 billion in 1986, or an estimated 24 percent of free world production. West German production stood at $2 billion, approximately 17 percent of free world production in 1986.

There have been a number of entrants into the global bearing market over the last ten years from countries outside of the traditional production core of Western Europe, Japan, and the United States. These include, among others, Thailand, China, Singapore, Taiwan, South Korea, Romania, Hungary, and Yugoslavia. Bearing production in these countries, which is relatively recent, is now undergoing a period of rapid export-led expansion. These countries, primarily due to their lower wage rates, may become more important factors in the global arena in the near future.

2. Bearing Production by Multinational Corporations

It is important to note that the analysis of bearing production

and exports on a country-by-country basis does not provide a complete picture of the dynamics of the global bearing market. Worldwide, the bearing industry is dominated by several very large, multinational firms with production facilities in numerous countries (See Table II-3 below). None of the top five multinational bearing firms is U.S.-based, although all have production facilities in this country.

Table II-3

Multinational Bearing Firms
1986 Bearing Production

Firm		Sales ($ Millions)
SKF	(Sweden)	$2,270
FAG	(W. Germany)	$1,480
NSK	(Japan)	$1,246
NTN	(Japan)	$1,236
Koyo	(Japan)	$ 895
Timken	(USA)	$ 763
Torrington	(USA)	$ 700
INA	(W.Germany)	$ 500
Nachi	(Japan)	$ 298
NMB (Minebea)	(Japan)	$ 225
SNR	(France)	$ 200
RHP	(U.K.)	$ 150
	Total:	$9,963
	World:	$11,350

Source: Company Annual Reports.

By far the largest of these firms is the Swedish-based Aktiebolaget Svenska Kugellagerfabrikken (SKF), which had world-wide sales of nearly $2.3 billion in 1986 (20 percent of free world bearing production). Other major multinational producers are FAG Kugelfischer Georg Shaefer KG (FAG) of West Germany, Nippon Seiko K.K. (NSK) of Japan, NTN Toyo Bearing Co., Ltd. (NTN) of Japan, and Koyo Seiko Co., Ltd. (Koyo) of Japan. In 1986, these five bearing producers accounted for almost 63 percent of free world production of anti-friction bearings - 83 percent of free world production outside the United States. This figure reflects a substantial increase from about 50 percent ten years earlier.

Other smaller multinational bearing producers include two U.S.-based firms, Timken and Torrington; West Germany's INA

Waelzlager Schaeffler KG (INA); Nachi-Fujikoshi (Nachi) and Nippon Miniature Bearings Corporation (NMB, the bearing division of Minebea Corporation), both of Japan; Societe' Nouveau Roulements (SNR) of France; and Ransome, Hoffman, & Pollard (RHP) of the United Kingdom. Together these twelve multinational firms produced 88 percent of free world production in 1986.

The high level of firm concentration presently characterizing the global bearing market is reflective of historical developments in both home bearing markets and within the international market for traded bearings. The European market, for example, is heavily dominated by two indigenous multinationals. The most significant of these is SKF, which alone is estimated to control more than 35 percent of the $4 billion European market. The other major European multinational, FAG, supplies roughly half of the $1.5 billion West German market, and about $300 million to the rest of Europe.

The emergence of these firms as dominant forces in home and Europe-wide markets is the result of rationalization spurred in part by the development of the European Common Market and in part as a response to stiff foreign competition, particularly competition from Japan. The establishment of the European Common Market in the late 1950's, and the subsequent inclusion of the United Kingdom and other countries, presented SKF and FAG with the opportunity to rationalize formerly separate national markets into a common continental bearing market. Rationalization eliminated capacity redundancies, increased marketing efficiencies, and provided these firms with the degree of manufacturing flexibility required to meet an increasingly competitive international market which developed during the 1970's.

The development of competitive multinational bearing producers in Japan occurred with considerably less external pressure and relatively greater governmental guidance than in Europe. A government sponsored cartel organized in 1956 rationalized the Japanese bearing industry by allocating production of individual, lower volume, bearing part numbers to specific firms. Japanese planners hoped to reduce capacity redundancies, and to achieve economies of scale in production. To provide each firm with access to a full product line, the producer was obliged to sell these allocated bearing lines to a jointly owned intermediary which in turn offered the bearings to competitors. Industry experts agree that this arrangement contributed to the success of Japanese bearing producers in developing a world-class bearing industry. A rapid rise in Japanese automotive and machinery production in the last twenty years completed the development of Japan's major bearing multinationals. As a result, bearing production increased nearly ten-fold between 1965 and 1985.

Virtually all bearing multinationals have sales operations in

each of the major bearing markets, including the United States, and most of these firms also operate production facilities within them. World trade in the low unit cost commodity type bearings (and many specialty bearing lines as well) is essentially the private preserve of this oligopoly. By rationalizing production of similar bearing types in individual plants, by developing complex international sourcing and transfer pricing systems, by consolidating research and development and marketing staffs, and by employing other similar business practices, these firms will continue to set the pace for the international bearings market.

3. World Exports

As seen in Table II-4, although the U.S. is the largest bearing producer, West Germany and Japan rank as the leading exporters of ball and roller bearings. According to U.N. statistics, Germany in 1986 exported over $1 billion worth of bearings, while Japan exported about $800 million in 1986. Other major bearing exporters include, in order, France ($383 million in exports in 1986), Italy, ($326 million), and the United States ($283 million).

Table II-4

World Exports of Ball and Roller Bearings

($ Millions)

	1982	1983	1984	1985	1986
West Germany	776	781	916	1,062	1,056
Japan	735	722	927	921	806
France	234	241	307	368	383
Italy	171	171	231	301	326
United States	310	253	331	305	283
United Kingdom	156	149	184	221	242
Sweden	146	163	190	219	239
Thailand	0	7	33	66	154
Singapore	109	109	132	139	154

* All figures converted at 1986 exchange rates.
Source: U.N. Statistics.

A number of other countries, including Singapore and Thailand, have dramatically increased their presence in the bearing export arena in recent years and will likely continue to do so. Thailand, for example, increased bearing exports from almost zero in 1982 to about $154 million in 1986. Imports of bearings from these relatively low wage rate countries should continue to increase.

Table II-5 below presents exports as a percentage of production for the five major bearing manufacturing nations.

Table II-5

1986 Exports as a Percentage of Production

United States	8 %
Japan	29 %
West Germany	53 %
France	68 %
United Kingdom	71 %

Source: U.N. statistics and official statistics of the United States, Japan, West Germany, France, United Kingdom.

While European exports have posted strong gains in the period between 1984 and 1986, Japanese exports have declined 13 percent. (Inter-European trade has expanded quite dramatically, especially since 1977 when tariffs on bearings and other industrial goods were eliminated within the EEC.) The relatively weaker performance of Japanese bearing exports is explained, in part, by recent transfers of Japanese production to offshore locations. Minebea, for example, has established export facilities in Singapore and Thailand. Despite a marginal decline in Japanese production between 1985 and 1986, if Thai and Singaporean exports were added to Japanese export figures, it would be apparent that Japanese firms, far from fading from the international bearing market, have been expanding their participation in nearly every major world bearing market.

4. World Imports

As a measure of expanding world trade in anti-friction bearings, imports of these articles by seven of the world's top bearing consuming nations increased by nearly 62 percent between 1982 and 1986 (See Table II-6). In absolute terms, the United States is clearly the world's largest and most open market for bearing imports. According to U.N. statistics, U.S. imports of ball and roller bearings were approximately $684 million in 1986, reflecting a 54 percent increase over 1983.

Table II-6

World Imports of Ball and Roller Bearings

($ Millions)

	1982	1983	1984	1985	1986
United States	478	444	654	660	684
West Germany	388	392	477	565	587
Italy	169	194	260	319	354
France	232	232	266	294	305
United Kingdom	147	155	204	241	249
Canada	146	150	210	216	243
Japan	102	97	158	174	146

* All Figures translated at 1986 exchange rates.

Source: U.N. Statistics.

Table II-7 presents import penetration percentages for each of the major bearing consuming (and producing) countries. As can be seen from this table, the highest import penetration occurs in the European countries, as high as 72 percent in the case of France. A closer analysis reveals, however, that the sources of imports in each European country is mostly other European countries (close to 75 percent of imports are intra-Common Market).

Table II-7

Import Penetration Levels

United States	18 %
Japan	7 %
West Germany	39 %
France	72 %
United Kingdom	63 %

Source: United Nations Trade Statistics and official government statistics of the United States, Japan, West Germany, France, and the United Kingdom.

As revealed in Table II-8, given that the major indigenous European bearing multinationals have developed a rationalized

bearing production system which is based on production facilities located in a number of these same countries, the "external" level of import penetration in Europe is much lower than the figures would indicate. For example, West Germany's imports are primarily from other EEC countries where FAG of West Germany and SKF of Sweden own a number of production facilities. In contrast, U.S. bearing imports are primarily from non-U.S. owned bearing facilities.

Table II-8

1986 Imports of Ball and Roller Bearings and Parts
By Country and Region
($ millions)

Importing Country

Source:	Germany	France	U.K.	Italy	Sweden	Japan	U.S.A.
Europe	$423	$235	$175	$302	$120	$22	$249
Japan	95	27	30	1	14	--	301
USA	35	22	33	15	7	28	--
Pacific**	10	3	4	8	1	95	(X)
Other	25	19	8	28	4	1	134
Total:	$587	$305	$249	$354	$146	$146	$684

(Percentage Shares of Total Imports)

Importing Country

Source:	Germany	France	U.K.	Italy	Sweden	Japan	U.S.A.
Europe*	72%	77%	70%	85%	82%	15%	36%
Japan	16%	9%	12%	(X)	10%	--	44%
USA	6%	7%	13%	4%	5%	19%	--
Pacific**	2%	1%	2%	2%	1%	66%	(X)
Other	4%	6%	3%	8%	3%	(X)	20%

(X) = Less than 1 percent.
* EEC plus Switzerland, Sweden, and Austria.
** Peoples Republic of China, South Korea, Taiwan, Thailand.

Source: United Nations Statistics.

United States and Japanese bearing exports control only 5.9 (down from 9.0 percent in 1984) and 16 percent of the West German import market respectively. West Germany has nearly three times the import share in the United States that U.S. firms have in

West Germany. Overall, with respect to West Germany, the United States imports approximately five times the value it exports to West Germany.

Japan has the lowest level of import penetration of any of the major bearing producing and consuming countries - seven percent in 1986. Moreover, Japanese imports are overwhelmingly sourced (two-thirds) from Japanese-owned facilities in three Pacific-rim countries: Thailand, Singapore, and Taiwan. The U.S. share of total Japanese imports was about 19 percent in 1986 as compared to the Japanese share of U.S. imports which exceeds 40 percent. In terms of dollar value, the United States imports over thirty times the amount exported by the U.S. to Japan.

5. U.S. Industry Overview

The U.S. Bureau of the Census estimates that 87 firms presently operate within the U.S. Ball and Roller Bearing and Parts Industry (SIC 3562). Commerce industry experts estimate that approximately 50 firms, with 140 U.S. facilities, produce complete bearings. The remaining firms produce various parts and components, such as rolling elements, dust shields, or retainer rings, which are used in the manufacture of complete bearings.

Total shipments for SIC 3562 were estimated at $3.4 billion in 1987. Table II-9 provides a breakdown of 1986 shipments by major bearing types.

Table II-9

1986 Ball and Roller Bearing Shipments
By Bearing Type
($ millions)

	Percent of Total
Ball Bearings	39%
Tapered Roller Bearings	20%
Roller Bearings	21%
Mounted Bearings	9%
Total Complete Bearings	89%
Parts and Components	11%
Total SIC 3562	100%

Source: Bureau of the Census

In 1987, imports totaled approximately $693 million and exports approximately $310 million. Apparent domestic consumption in

1987 was an estimated $3.8 billion.
The Department of Commerce Section 232 surveys found that of the 50 or so firms producing complete bearings, the 28 with shipments in excess of $5 million account for more than 95 percent of total U.S. shipments. Three of these companies had domestic shipments valued at more than $300 million; six shipped between $50 and $300 million; and nineteen shipped less than $50 million worth of domestically produced bearings.

U.S. bearing industry concentration, already lower than in foreign markets, has been declining. For example, the top eight firms in 1984 held 64 percent of domestic shipments. By 1987, the share held by the top eight bearing manufacturers dropped to 58 percent of shipments.

Table II-10 lists major bearing manufacturers with facilities located in the United States.

Table II-10

Major U.S. Manufacturers
(1987 Shipments in $ Millions*)

Firm	Ownership	U.S. Facilities	Production Workers	Shipments
Deleted to Protect Company Proprietary Data				
Total:		55	27,707	$2,300

* 1987 Figures.

Source: Section 232 Producers Survey

Preliminary 1987 Bureau of Labor Statistics data show that total and production worker employment levels in the bearing industry were 43,400 and 33,300, respectively. These levels represent a 26 and 27 percent decline respectively from 1979 peak levels. Employment levels in the 1983-87 period are the lowest for the industry in the post-1960 period.

Historically, labor turnover has been lower for the bearing industry than for all manufacturing. From 1970-81 - the most recent figures available - separation rates within the industry ranged from 1.7 percent to 4.2 percent (3.6 percent to 4.9 percent for all manufacturing) and hire rates ranged from 1.7 percent to 3.0 percent (3.7 percent to 4.8 percent for all manufacturing).

Individual firms vary greatly in terms of employees and number of plants operated. Five firms have four or more plants and employed approximately 16,300 employees in 1987. Fourteen other firms operate two to three plants in the U.S. and employed 4,430, and another eleven firms were single plant companies employing a total of 1,850 employees.

About 37 percent of production worker employment is presently located in the Southeastern region of the country, with an additional 30 percent located in the North Central and Midwest states, and another 30 percent located in the Northeast. These figures reflect a substantial relocation of bearing production away from older facilities in the Northeast and North Central regions toward the Southeast, a shift which began in the early 1970's. Leading states by employment include South Carolina, with an estimated 16 percent of total industry employment of production workers; Ohio, with 13 percent; and Connecticut, with 13 percent. Other major states employing production workers include Indiana, Georgia, New Hampshire, Tennessee, Pennsylvania, and New York.

Most U.S.-based bearing firms are independent companies, engaged exclusively in the manufacture of products categorized within the ball and roller bearing and parts industry. There are exceptions, however. One notable case, The Torrington Company, is a wholly-owned subsidiary of Ingersoll Rand. Other subsidiary companies include New Departure Hyatt (General Motors Corporation), and Rexnord (Banner Industries).

Restructuring of the industry in the face of increased domestic and foreign competition has led to:

- several major mergers and acquisitions.
- direct foreign investment in the United States (e.g., INA);

- o the decline and/or closing of some formerly major U.S. bearing manufacturers (e.g., New Departure);

- o consolidation of existing capacity by individual companies (e.g., Torrington);

Recent examples of mergers and acquisitions include Minebea's (Japan) purchase of New Hampshire Ball Bearing Company in March of 1985, NTN's (Japan) purchase of the Bower bearing production facilities from Federal Mogul in 1987, SKF's purchase of MRC's ball bearing plants from TRW in 1988, and Torrington's acquisition of Fafnir in the fall of 1985.

Of the fifteen largest bearing manufacturers (in terms of domestic shipments), nine are fully-owned subsidiaries of foreign bearing multinationals (See Table II-11). Shipments from these foreign-owned bearing firms amounted to $630 million in 1987, or about 20 percent of U.S. production, up from 15 percent in 1984. This increase reflects both an expansion of production at preexisting foreign-owned plants in the United States as well as a more limited recent increase in new foreign investment.

Table II-11

U.S. Bearing Production
by Foreign-Owned Manufacturers

(in Thousands $)

Firm	1984	1987
Deleted to Protect Company Proprietary Data		
Total:	$430,209	$630,892

Source: Section 232 Producers Survey.

6. U.S. Industry Structure

Although there is significant overlap, the U.S. bearing market can be divided into several tiers, including: a) full line producers; b) type specialists and market niche firms, c) components manufacturers, and d) distributors and service

companies.

Most of multinational bearing companies, facilitated by import of completed bearings and bearing components from overseas establishments, offer a complete line of bearing part numbers and a host of specialized services. These firms include U.S.-owned Torrington company and several foreign-owned firms such as SKF, FAG, INA, Koyo, NTN, and NSK. Products produced in the United States by these and other major bearing manufacturers are listed below.

Table II-12

Bearing Products Produced in the United States

(Product Category By Company)

Company	Ball <30mm	Ball 30/100	Ball >100	Integral	Thrust	Other Ball	TRB	Spher	Cyln	Nedl	Othr Roll

Source: Section 232 Producers Survey.

An analysis of end-market sales clearly shows that these firms maintain a large share of high volume, low unit cost sales to the major automotive and machinery original equipment manufacturers (OEM's) in the United States. In addition, a number of firms are entering more specialized markets and the defense area. As a result of their dominance of the high volume markets, the multinational bearing manufacturers identified above held at least three-quarters of the market in 12 of the 15 product categories under investigation. Exceptions were the "all other" categories, shared by a number of smaller producers, and integral shaft bearings.

The next tier consists of mid- to large-sized manufacturers primarily specializing in a variety of high and low volume product niches such as aerospace and defense-related applications. Japan's Minebea company, for example, produces miniature and instrument bearings at its U.S. subsidiary - New Hampshire Ball Bearings. Similarly, Timken, the largest U.S.-based manufacturer, focuses entirely on tapered roller bearings.

Other firms focusing on specialty markets such as aerospace and defense include Kaydon - a significant producer of specialty thin section bearings; Industrial Tectonics - a major aerospace bearing manufacturer; and Rexnord - a major defense contractor; Incom International, Accurate Bushing, Emerson Electric, Reliance Electric, Invetech, L & S Bearing, and the Aetna Bearing Company. Many of these firms cater to small- to medium-sized machinery manufacturers and/or high volume consumer outlets specializing in automotive parts and supplies.

Although production of specialty bearings, which accounts for an important portion of defense consumption, is carried out primarily by niche producers, the 1986 Joint Logistics Commanders Bearing Study documents a rapid rise in the number of foreign-owned multinational bearing firms certified for Department of Defense procurement. Given that this evidence portends a growing trend, the long-term prospects for many domestic producers now sheltered in niche markets may not be bright.

In addition to the smaller- and medium-sized niche manufacturers listed above, other larger firms that have been forced into niche markets by foreign competition may face a similarly unstable future. These firms include such companies as (deleted to protect company proprietary data).

A number of manufacturers produce only parts and components such as balls. A notable example of this kind of firm is the Hoover Group which produces a large volume of anti-friction balls and rollers for use by bearing manufacturers.

Several major bearing distributors operate in the U.S. market. Two notable examples are Bearings Incorporated and King Bearing. Distributors tend to serve a wide range of markets but often will specialize in serving certain industries because of the types of customers in their geographic area. Some of the markets served by these distributors include: agriculture and farm equipment, food processing and packing, mining, forest products, motor vehicles, and machine tools.

7. The Civilian Bearing Market

In 1987, an estimated 31 percent of bearing consumption was automotive-related, 26 percent went to various machinery and equipment manufacturers, 7 percent to aerospace markets, and the remaining 35 percent to a variety of smaller industries. These figures suggest an increase in the share of consumption accounted for by the automotive market, from only 24 percent of consumption in 1977; a slight decrease in the share accruing to machinery industries, down from 29 percent of the total in 1977; and a marginal decline in aerospace consumption from 8 percent of the total in 1977.

Major U.S. bearing-consuming industries have weathered two major recessions since 1978. Automobile production plummeted between 1978 and 1982 to its lowest level in twenty years; the farm machinery market was depressed, and orders for commercial aircraft fell dramatically. This decline in U.S. manufacturing output has had a negative impact on the domestic bearing market and constituted the single most important cause of the precipitous drop in bearing shipments from 1978 to 1982.

Although U.S. sales of automobiles recovered after 1982, sales since 1986 have been flat. Moreover, there is a growing trend toward foreign sourcing of automotive parts by domestic car makers and an increasing presence of foreign manufacturers in the U.S. market who often depend on imported bearings and/or auto parts with embedded foreign bearings.

Lackluster performance in the automotive industry over the last two years has been mirrored in the farm machinery industry, and several other industrial machinery sectors. These declines have been strong enough to offset modest growth in bearing demand from other sizable markets including construction machinery, mining and oil field equipment, aerospace, and special industrial machinery. It should be noted that while these domestic OEM markets have declined, imported automobiles and machinery have been on a steady upward course. As a result, the volume of bearing imports 'hidden' in these finished product imports has continued to rise.

In addition to declines in overall industrial demand for bearings, the composition of demand has shifted due to technological changes. The most widely acknowledged of these has occurred due to a shift in preference from rear-wheel drive toward front-wheel drive car designs. Ball bearings, which are better suited to the lighter load front-wheel drive designs, have become a correspondingly larger factor in automotive bearing consumption. Other shifts in bearing consumption patterns relate to advances in bearing design, end uses, and pricing.

B. PRODUCT DESCRIPTIONS

1. Overview

Anti-friction bearings classified by the Bureau of the Census under SIC 3562 are precision components which consist of rolling elements, such as balls, rollers, and needles, sandwiched between ground inner and outer rings.[2] There are an estimated 80 thousand bearing types in use in the United States today, about two thousand of which are manufactured in high volumes. Bearings sizes range from as small as a tenth of an inch in diameter to as large as 30 feet across.

Bearings are used throughout the commercial sector to reduce friction in items as varied as automobiles, airplanes, machine tools, computers, and virtually any item with moving parts. Bearings are particularly important for defense applications, where precision and speed are critical to weapon system performance. Defense items which depend on high-quality bearings include military aircraft, missiles, tanks, and submarines. Due to their critical function, substitutes for bearings cannot normally be found without seriously compromising performance.

Anti-friction bearings are classified according to the type of rolling element they contain as well as by their size and precision. Ball bearings have the least friction because of the relatively small "point" contact between the rolling element and raceway surfaces.
This point-contact makes ball bearings especially suitable for high speed applications by minimizing the level of heat generated

---

[2]Excluded from the investigation are unground (or non-precision) bearings used in crude applications such as file drawers, sliding doors and toys. Further excluded are plain bearings (also known as sliding or journal bearings), in which a shaft rotates on a film of oil, as they are produced by a separate industry using different processes.

by friction during rotation. Roller bearings, on the other hand, have relatively larger linear contact at the rolling surfaces and are therefore more suitable than ball bearings for load-carrying applications.

2. Manufacturing Process

The manufacture of anti-friction bearings varies considerably among bearing types, lot sizes, level of precision, and even among specific firms. There are, however, certain common features used in the production of all bearings. A description of the operations used in the production of radial ball bearings is provided as an illustration.

Ball bearing production involves three parallel production processes which are joined in the matching and assembly stages. These processes are: 1) production of the inner and outer rings; 2) production of the balls; and 3) production of retainers and/or shields. Since the manufacture of precision bearings is a process involving precise dimensional tolerances, the grinding and honing processes tend to be the most critical in terms of time and influence over the quality of the product.

Ring production begins with either steel bar or tube stock. Tube stock is fed into a screw machine which cuts the tubing into rings of roughly correct dimensions. These rings are then machined to produce the inner and outer grooves which will serve as raceways for the rolling elements. The rings are then surface hardened through a process of heat treatment. This is followed by a series of grinding stages applied to all surfaces to bring the dimensions closer to specified tolerances. Finally, the rings are brought within required tolerance through carefully controlled honing of the races.

Ball production begins with steel wire which is cut into small slugs. The slugs are pounded into a roughly spherical shape, and then filed and ground to within moderate tolerances for dimension and roundness. The semi-finished balls are then heat treated for hardening. Finally, the hardened balls are carefully ground to bring them within required tolerances, and are polished.

Retainer production utilizes ribbons of strip steel which are blanked and pierced into shape.

In the final assembly stage, the rings, rolling elements and retainers are joined and in some cases lubricated or coated with a protective shield. The most critical operations in bearing production are those associated with achieving the specified dimensions.

In the case of superprecision bearings, the processes of grinding bearing parts to acceptable dimensions involves use of extremely accurate machine tools and gauging systems as well as highly skilled machinists. Although regular precision bearing production does not rely as heavily on skilled labor and precision machines, it is still important for a manufacturer to maintain a consistently high level of reliability in its bearing production.

3. Individual Product Descriptions

For the purpose of this investigation, we have divided industry products into fifteen distinct categories. In some cases, this analysis breaks bearings into "regular" and "superprecision" categories, a distinction necessary in a national security analysis. Descriptions and typical applications for each of the categories follows:

Ball Bearings Less than 30mm, O.D.

This product category includes radial ball bearings of single row conrad configurations, with outside diameter of 30mm or less. Those bearings with a diameter of less than 9mm are often referred to as "miniature bearings," while those with diameters between 9mm and 30mm are called "instrument bearings." In our analysis, and for the remaining two radial ball bearing size categories, the size range is also broken into 'regular precision' and 'superprecision' subcategories.

These bearings generally carry light radial (i.e., perpendicular to the axis of rotation) loads such as might be encountered in fractional horsepower electric motors. A certain amount of thrust (i.e., parallel to the axis of rotation) load can be accommodated as well. Due to their minimal contact and low friction, these bearings are ideal for light, high speed applications, and for noise reduction.

Defense Uses: Military consumption includes a wide variety of gyroscopes and other guidance, telemetric and control-related instruments for aircraft, missiles, oceangoing vessels and land vehicles. These include altimeters, artificial horizons, pressure and fuel instrumentation, compasses, fire control mechanisms, range finders, machine tools, computer drives, and in bomb sights for ordnance systems. They are also used in a variety of applications associated with radar, high speed cameras and other ground control equipment.

Bearings in these categories account for about 5 percent of the total value of all ball and roller bearing consumption and nearly

15 percent of the unit volume. Approximately 13 percent of unit consumption in 1987 was of superprecision types, with the remaining 87 percent falling within the regular precision category.

Ball Bearings 30-100mm, O.D.

Radial ball bearings in the 30-100mm category have the same basic design as miniature and instrument bearings, but are larger in size, and thus are suitable for larger load carrying applications. Ball bearings 30-100mm account for about 12 percent of total consumption of all bearings on a value basis, and 14 percent on a volume basis. Less than one percent of unit consumption is of superprecision types.

Defense Uses: An estimated 8-10 percent of peacetime consumption of ball bearings 30-100mm is directly related to military weapons systems with perhaps an additional 2 percent used in applications such as motor vehicles, fork lifts and other uses with commercial counterparts. Regular precision bearings are used extensively in military aircraft accessories such as wing flaps, lifts, motors and pulleys, and in ground vehicle transmissions steering columns and fuel pumps. There are also numerous applications aboard ships in pumps, motors, compressors and elevators.

These bearings, however, are essential to nearly all weapon systems, particularly aircraft and missiles. They are critical components in the gas turbine engines and gear boxes that power most military fighter and transport aircraft, cargo helicopter and reconnaissance aircraft as well as trainer planes. They are used in the Bradley fighting vehicle and the M-60 tank as well as many other ground vehicles and equipment and in numerous oceangoing applications, including noise quiet submarine bearings.

Ball Bearings Over 100mm O.D.

These bearings are similar to radial ball bearings in the smaller size categories in both design and basic mechanical function. However, due to their large diameters and ball sizes, they are better suited to larger and heavier load applications than their smaller counterparts.

Defense Uses: Military end uses for bearings in this category include atomic reactors, electrical generators, gun mounts, marine propeller shafts, rudder posts, cargo handling equipment in naval applications; tanks and heavy ordnance; bomber and cargo aircraft landing gear; and airfield equipment. Frequent uses also include gas turbine engine and gear box applications for aircraft, missiles, ships, and land vehicles.

Consumption of radial ball bearings in the over 100 mm O.D. category in 1987 amounted to about 5 percent of total bearing consumption on a value basis. About one-third of the value was accounted for by superprecision bearings, although the volume underlying this figure is small.

Ball Bearings with Integral Shafts

Ball Bearings with integral shafts are similar in design to radial ball bearings. However, a central shaft, which serves as the raceway, is built into the bearing. This configuration saves space and eases installation of the bearing.

The majority of integral shaft ball bearings produced in the United States is consumed by the automotive industry, where they are primarily used as wheel bearings or water pump bearings. An important, and growing, non-automotive use is in computer disk drives and spindles.

Defense Uses: Military consumption of these bearings are analogous to civilian uses. These include a variety of motorized vehicles, and other support equipment.

Consumption of integral shaft bearings represents about 3 percent of total bearing consumption on a unit basis and nearly 14 percent in value terms.

Thrust Ball Bearings

Thrust ball bearings are designed to withstand forces parallel with the axis of rotation. While employing anti-friction balls as rolling elements, these bearings have a ring design which allows thrust forces to be transmitted directly to the rolling elements. These bearings are best suited to moderate speed applications, and are frequently used in combination with other bearings which assume the radial load.

Thrust ball bearings are used in numerous applications in which a mechanical part is subject to thrust forces. Examples of these include: struts for wheels, steering columns, transmissions, starters, and propellers. Automobiles and trucks account for over half their use. Other uses are spread widely across consuming sectors such as aircraft, machinery and transportation equipment.

Consumption of thrust ball bearings is relatively small, representing only about 1 percent of total bearing consumption in both unit and value terms.

Other Ball Bearings

The other ball bearing 'catch-all' category includes all ball bearing types not described above. Among these are: mounted, angular contact, double row, and maximum capacity bearings.

Mounted ball bearings are custom-fitted to facilitate installation with bolts or other fasteners in the end product. These bearings are used primarily for fixed site applications such as conveyors, rolling mills, and elevators.

Angular Contact bearings are bearings in which the balls contact the raceways at an angle to the axis of rotation. This design provides for thrust loads in one direction and modest radial loads. Examples of end-uses include: machine tools, wheel bearings, vertical shafts, and propellers.

Unlike other ball bearing types which have a less than full complement of balls (and consequently allow the balls to have some "play"), "Maximum Capacity" type ball bearings have a full complement of balls. This configuration allows "maximum capacity" type bearings to carry larger loads than other types. These bearings are frequently found in automotive transmissions.

This diverse category of bearings accounts for about 7 percent of total ball and roller bearing consumption on a unit basis, and over 14 percent on a value basis.

Tapered Roller Bearings

Tapered roller bearings consist of a cup (outer race) and cone (inner race) assembly with conical or 'tapered' rollers. The tapering of the rolling elements allows the bearing to accommodate both heavy radial and thrust loads. For this reason, tapered roller bearings are found in an extremely broad range of medium to heavy load-bearing applications.

Automotive and truck end-uses of tapered roller bearings account for about one-third of shipments. Other applications include truck trailers, construction machinery, power transmission equipment, railroad equipment, aircraft landing gear, hydraulic motors, farm and industrial machinery, and conveyors.

Tapered roller bearings are a large and important segment of the anti-friction bearing market, representing 22 percent of total ball and roller bearing consumption last year, both in terms of value and units.

Spherical Roller Bearings

Spherical roller bearings utilize "spherical," or barrel shaped, rolling elements. The shape of the rolling elements allows the bearing to withstand substantial radial as well as thrust loads applied in either direction. This flexibility allows the bearing to adjust its alignment to match that of a shifting axis of rotation. This capability, combined with heavy load carrying capabilities, makes them of critical importance in construction machinery (cement mixers, bulldozers, excavating equipment) deep well pumps, dredges, extruders, printing presses, and textile machinery.

U.S. consumption of these bearings in 1987 was an estimated four percent of the total value of consumption, and only one-third of one percent on a unit basis.

Cylindrical Roller Bearings

Cylindrical roller bearings are characterized by their utilization of cylinder-shaped rolling elements. The geometric design of these rolling element provides a linear contact with the raceway which enables the bearing to withstand heavy radial loads.

Defense Uses: Defense uses include metal rolling mills, mining machinery, construction machinery, oil and gas field equipment, off-highway equipment, and large motor transmissions, and gas turbine engine and gear box applications, where high radial load bearing capacity and high speed performance are critical.

Consumption of cylindrical roller bearings in 1987 amounted to about 6 percent of total bearing consumption on a value basis, and less than 2 percent on a unit basis.

Needle Roller Bearings

Needle roller bearings have rolling elements with lengths at least four times greater than diameter. Most (80 percent) are less than one inch in diameter. Due to their thin section, needle bearings are useful where space is at a premium and in oscillating and slow speed applications.

It is estimated that at least half of U.S. consumption of needle bearings is automotive related, especially in transmissions. Other uses include trucks, off-highway equipment, farm equipment and construction machinery.

With a 1987 share of unit consumption of about 33 percent, the needle roller bearing product category is by far the largest

individual sector of the bearing market. In value terms, the share is only 10 percent.

Other Roller Bearings

The other roller bearing category includes mounted roller bearings and all other roller bearing types not described above. Also in this category are a wide variety of specially-designed bearings employing rolling elements, including combination ball and roller bearings.

As is the case with mounted ball bearings, the advantage of mounted roller bearings lies in the reduction of time and effort associated with choosing among different bearing configurations, and the ease of final installations. Examples of the uses of mounted roller bearings include mainly stationary applications usually of a heavier load than mounted ball bearings. Other bearings in this category are found in the large bearing consuming industries such as the automotive, aircraft, and construction machinery.

Consumption of bearings in this category represents approximately 2 percent of the unit volume, and 7 percent of the value of total ball and roller bearing consumption in 1987.

III. COMPETITIVE FACTORS

This chapter presents an overview of the competitive factors affecting the domestic bearing industry's ability to manufacture the products needed for defense and essential civilian applications. The purposes of this overview are:

1) to assess current trends in the industry that affect its ability to meet future national security requirements. This evaluation is necesssary to supplement the Department's production capacity analysis which only presents a 'snapshot' of the bearing industry's current capabilities; and

2) to enable the Department to design effective remedies that address the industry's unique circumstances should it be determined that Federal action is required to ensure a viable domestic production base for national security purposes.

This chapter begins with a discussion of how the structure of the international bearing industry has affected the U.S. industry's competitiveness, and how the industry's profitability has affected its ability to respond to changing industry conditions. This analysis is followed by a discussion of the industry's investments in capital and research and development needed to maintain its industrial competitiveness. Next is an assessment of steel and labor supplies: the industry's two most important inputs. This chapter concludes with a review of the principal factors affecting bearing purchase decisions including: price, leadtimes, quality and service.

A. Competitive Overview

The U.S. bearing industry's competitiveness has deteriorated markedly in recent years. Declining profit is decreasing the ability to make needed investments in research and facilities. At the same time, the industry is facing increasing pressure from foreign competition dominated by a few large multinational firms with substantial financial and technological resources.

Hopeful signs for the industry's recovery have included, most importantly, the change in relative exchange rates. The cheaper dollar has decreased U.S. bearing production costs, and could soon begin to increase the actual selling price of imported products.

B. Global Industry Structure

- In 1986, the world's five largest bearing firms accounted for 63 percent of total free world bearing production, up from only 50 percent ten years ago. These firms are all based outside the United States: two in Europe (SKF and FAG) and three in Japan (NSK, NTN Toyo, and Koyo Seiko). Their share of the U.S. market, comprised almost equally of U.S. production and imports, has risen from about -- percent in 1984 to about -- percent currently. Their dominance outside the United States is even greater, where they control nearly 83 percent of free world bearing production.

- Each of the five firms has a loyal customer base that provides a high degree of stability to cash flow as well as assurance of future income - ingredients facilitating investment planning. These sales bases are characterized by strong national loyalties and long-standing business relationships. These allegiances have been strengthened and reinforced by years of shared growth and success resulting from the rapid industrial expansion that took place in post-war Europe and Japan.

- In the past, U.S. bearing firms have also benefitted from a loyal customer base. However, this base has been weakened in the last decade by international competitive pressures on U.S. producers of automobiles, machinery, and other bearing-consuming industries.

Strong Sales Base - Japan

- In 1956, Japanese bearing producers were organized into a production cartel with antitrust immunity by the Ministry of International Trade and Industry. The cartel limited production of less popular bearing part numbers to a single producer, thereby increasing production runs and efficiency. Each producer would then sell the bearings through a jointly-owned intermediary to customers or other members as needed. The cartel remained officially in business for almost 30 years, and still functions informally. At its peak, this arrangement accounted for about ten percent of Japanese bearing production.

- By 1986, the three largest Japanese bearings firms supplied about -- percent of the Japanese market. These shipments contributed more than $- billion to the companies' revenues, and represented about -- percent of their worldwide sales. Included were some of the most lucrative, high volume long-term contracts from firms such as Toyota, Nissan, Mitsubishi and Komatsu. These sales provided the Japanese bearing companies with the wherewithal to maintain modern, highly productive facilities, and a springboard from which to venture into the international market.

- Japanese bearing production has increased ten-fold since the mid-1960s, in step with rapid growth in Japanese motor vehicle production and in other bearing-consuming sectors. The bonds between bearing end-users and bearing suppliers are reinforced by the shared ownership of some of the companies. Nissan Motor, for example, holds about 3 percent of the stock of both NSK and NTN, while Toyota Motor holds 22 percent of Koyo's stock.

- One result of such ties has been very limited penetration by imports into the Japanese market. In fact, the limited amount which is imported is primarily sourced from Japanese-owned facilities abroad. About two-thirds of Japanese bearing imports are purchased from Minebea's miniature and instrument bearing operations in Singapore and Thailand.

Strong Sales Base - Europe

- The European bearing market is similarly dominated by indigenous firms, although not to as a great a degree as Japan. FAG supplies ---------- of the $1.5 billion West German bearing market, and almost $--- million to the rest of Europe. SKF supplies -- percent of the $4 billion European market, and maintains a strong presence in all major European bearing markets. The company is dominant in Sweden and Italy, and has been a major factor in the FRG since 1928, in the U.K. since 1911, and in France since 1916.

- The establishment of the European Economic Community (EEC) has encouraged the emergence of a continental bearing market and the rationalization of bearing production facilities. European producers have been able to greatly improve their efficiency by servicing the entire continent from specialized facilities with increased production lots.

- The restructuring of the European bearing industry was made more urgent by the influx of imports from Japan during the early 1970's. In response, SKF embarked on its 'PC-80' rationalization program to develop three unmanned bearing plants in Sweden, the FRG and Italy to produce large volume part numbers. These actions reversed import penetration levels, consolidated SKF's position as leader of the European industry, and vastly improved the company's operating efficiency.

- FAG responded to these actions by acquiring several smaller companies, primarily in Germany. The company consolidated its production in Schweinfurt (FRG) where it operates the world's largest bearing facility. Schweinfurt now has over 160 production lines which each feature state-of-the-art equipment.

- In addition, the growth of imports from Japan has been limited since 1976 by the EEC's imposition of anti-dumping duties. These duties have effectively preserved most of the high volume bearing markets for SKF and FAG.

International Market Power

- Strong sales bases in their home countries have allowed the five largest bearing producers to become formidable and aggressive competitors internationally. Each has developed a global marketing network offering a full line of bearing products and after-market services at competitive cost. All five have built or purchased bearing production facilities worldwide to participate in, maintain, or develop new markets.

- The companies have concentrated their efforts on the largest, most lucrative accounts in other countries - especially in the United States. The importers survey conducted for this study reveals, for example, that about 43 percent of the five firms' 1987 imports were sold to only 14 major end-user firms. In fact, the results of the 1987 tapered roller bearing anti-dumping investigations indicate that, in some cases, the companies have 'bought' into markets by pricing below production costs.

C. The U.S. Industry

- The U.S. bearing industry is much less concentrated than its international rivals. In 1987, the top four U.S. firms accounted for 49 percent of domestic shipments. If New Departure were removed because of its status as a captive producer, the concentration level would fall to -- percent, compared with 75 percent in Europe and 80 percent in Japan.

- Further, the top eight firms in the U.S. produce only 58 percent of finished bearings, compared with over 90 percent in both Western Europe and Japan.

- By 1987, three of the largest U.S. niche producers; Kaydon (very large bearings), Federal Mogul (auto clutch bearings) and MPB (superprecision bearings); were among the eight largest U.S. firms. This indicates that the number of broad line producers (e.g. MRC and Fafnir) in the United States is declining.

- Since the late 1970s, there has been a substantial decline in concentration levels in the United States. This decline is a direct result of displacement of U.S. firms from high volume markets by imports. The loss of high volume bearing markets has had a particularly injurious impact on domestic firms' larger production facilities that previously supplied the high volume accounts. Many of the larger facilities were closed, and others partially dismantled. Further, despite mergers and consolidations among some of the larger firms, the level of concentration in the U.S. bearing industry at the eight firm level has also declined.

Table III-1

U.S. Industry Concentration Levels*
(in $millions)

1984			1987		
	Shipments	Percent		Shipments	Percent
(Deleted to Protect Company Proprietary Data)					
Top 4	$1,659.8	45.7%	Top 4	$1,738.7	48.5%
(Deleted to Protect Company Proprietary Data)					
Top 8	$2,307.2	63.5%	Top 8	$2,071.6	57.8%
Total Market	$3,635.4		Total Market	$3,584.3	

Source: Section 232 producers survey

* Total market includes producer shipments and imports. Parts are excluded to avoid double-counting. Export shipments of individual firms are not known; thus, exports were not deducted from the market total.

- The decline of large U.S. bearing production facilities is demonstrated by data from the Commerce Department's "County Business Patterns" publication. In 1979, 35 bearing facilities (of a total of 117) were reported to have over 500 employees. By 1985, the number had fallen to 25 (of 115 facilities). A significant drop in average plant employment was also noted. Data from the Section 232 producers survey indicate that only 16 such plants remained by 1987.

- Shrinking U.S. bearing shipments also can be attributed to increased imports of automobiles and other finished products with 'embedded' bearings. Each of the 3.4 million motor vehicles imported in 1987 contained about 40 bearings, which added an additional 130 million bearings to the 500 million bearings imported directly. As these embedded bearings are typically of high-volume manufacture, both direct and embedded bearing imports can be seen to injure the viability of larger domestic bearing manufacturing plants.

- As indicated in Table III-2, the displacement of domestic bearing firms from many of the higher volume bearing markets has lowered industry efficiency to levels below what it was in 1967. Underlying this trend has been a general reduction in the average size of production lots. More frequent changeovers and smaller production lots have reduced the operating time, and thus the efficiency, of production equipment.

Table III-2

U.S. Bearing Shipments, Employment and Output/Employee

Year	Shipments ($87 in 000s)	Employment (000s)	Output/Employee (1967=100)
1967	$4,614	62.8	100
1977	4,099	55.1	101
1978	4,304	56.5	104
1979	4,565	58.3	107
1980	3,976	57.9	94
1981	3,790	57.4	90
1982	2,797	48.2	79
1983	2,829	43.4	89
1984	3,268	48.0	93
1985	3,157	46.9	92
1986	2,973	45.6	89
1987	3,025	43.4	95

Source: DOC/Bureau of the Census and DOL/Bureau of Labor Statistics

- Timken, America's largest bearing company, makes only tapered roller bearings and bearing-quality steel. The firm suffered major losses in the last five years as a result of depressed markets. Despite these setbacks, the company has made significant investments to cut costs and streamline operations.

- As exchange rates now stand, Timken is the world's low cost producer of quality tapered roller bearings, and it is expected to continue recovering substantial portions of the U.S. and international tapered roller bearing market.

- The only American firm aspiring to full line producer status is the Torrington Company, a wholly-owned subsidiary of Ingersoll-Rand. Historically, Torrington was strictly a roller bearing company, focusing on needle bearings which the firm invented in 1935. However, in 1985, Torrington purchased the Fafnir Ball Bearing Company from Textron and established itself as America's only full line producer.

- The lower value of the dollar and the company's efficient process technologies have made Torrington the world's low cost producer of needle bearings. However, Torrington's situation is not as optimistic as Timken's, as its ball bearing lines continue to face strong import competition. In addition, the Fafnir acquisition straddled Torrington with a large debt and a host of older ball bearing plants, two of which have already been closed. Torrington's long-term success in establishing itself as a full line producer remains to be seen.

- The third largest U.S. producer is New Departure - a wholly-owned subsidiary of General Motors. Being captive to General Motors - the largest bearing consumer in the world, New Departure had unique advantages. In fact, New Departure was the largest bearing manufacturer in the world until the early 1950's.

- However, the company's wages rose above the bearing industry average, and New Departure lost sales in the non-GM commercial market. By the late 1970s, although still among the top five world producers, the firm was also the world's high cost producer.

- In 1981, New Departure's Clark, NJ tapered roller bearing plant was purchased in a much publicized employee buy-out. GM guaranteed a market for five years, after which time the plant was closed. New Departure's remaining two plants have also greatly curtailed operations, with most of their non-GM business sold to Torrington last September. GM now accounts for over -- percent of New Departure's shipments, the bulk of which are integral shaft bearings used on GM's front-wheel drive cars.

- While the saving in assembly cost offsets some of the high price of these bearings; ---------- and others have begun to offer a substitute version for less than half New Departure's price. In addition, GM is now testing pre-production samples of bearings from ----------. The probability is high that New Departure will continue to be phased out.

Conclusions

While bearings production technology continues to advance, the most important development in recent years has been the global rationalization of production. This has enabled large foreign firms to substantially lower costs by specializing plants, increasing production lots, and achieving significant economies of scale. Large firm size and global organizations have enabled the multinationals to produce bearings more efficiently.

The shrinking domestic market and intense pricing pressure from the large international bearing producers has had an adverse impact on virtually every domestic bearing firm. Imports have been a significant cause of the decline or closure of many large U.S. bearing production facilities, and of the less than optimal use of remaining capacity. This has reduced U.S. concentration levels at a time when large firm size is critical to the effective rationalization of production.

D. Profitability

- Bearing industry profitability has declined since 1978 (see Table III-3). Import penetration has risen steadily during this period increasing the pressure on prices and profitability. Declining industry profitability will make it more difficult to invest in the research and modern production capacity needed to increase both the industry's competitiveness and its ability to meet national security needs.

- However, as further set out in Table III-3, during most of these years, bearings industry profitability has exceeded that of other elements of SIC 356 (general industrial machinery) and also exceeded the profitability of the related special industrial machinery industry (SIC 355).

- The petitioner asserts that viability in high-technology product lines is threatened by low prices and low profitability in commodity bearing lines. If the industry is unable to compete in commodity lines, its fixed costs will be spread across fewer units, and its competitiveness in high-technology lines may soon be threatened.

Table III-3

U.S. Industry Profitability
(Percentage of Net Sales *)

	1978	1979	1980	1981	1982	1983	1984	1985	1986
Operating Profit**									
Bearings***	11.7	10.2	10.8	5.9	7.7	6.6	3.0	6.6	5.7
Special Industrial Machinery***	6.9	6.7	7.1	6.3	4.3	3.0	5.6	4.1	3.9
General Industrial Machinery***	7.0	8.0	7.8	7.1	4.9	3.1	5.9	5.0	5.4
Net Profit Before Taxes****									
Bearings	8.9	7.3	9.3	4.8	5.6	4.3	2.6	4.0	3.8
Special Industrial Machinery	5.3	5.7	6.0	5.0	2.9	1.8	4.4	3.2	3.0
General Industrial Machinery	6.0	6.7	6.0	5.4	3.0	1.7	4.4	3.5	3.7

* Net sales is gross sales, net of returns and discounts allowed, if any.
** Operating profit is gross profit minus operating expenses.
*** Bearings is SIC 3562; Special Industrial Machinery is SIC 3351/2/3/4/5/9);and General Industrial Machinery is SIC 3561/4/6/7/9
**** Net profit before taxes is operating profit minus all other expenses.

Source: 1987 Annual Statement Studies, Robert Morris Associates.

- As the international bearings market becomes increasingly dominated by large multinational firms offering a complete line of products, bearings purchasers will be more likely to meet all of their bearings requirements from a single source. This will further increase the pressure on U.S. niche producers.

- Conversely, several survey respondents assert that companies' decisions on entering or remaining in specific product markets are made based on the potential for earning profit in that particular market. (deleted) has stated, for example, that it makes such decisions on a 'profit center' basis, and that it would not produce a particular product line if it were not able to earn a profit on that line.

Conclusions

Bearing industry profitability has declined, thus decreasing the industry's ability to make the investments needed to maintain its competitiveness. It is unlikely that companies will invest in particular product lines without the possibility of earning a profit. At the same time, domestic firms must maintain a presence in a broad range of bearings markets to spread their fixed costs and to remain competitive with large international bearings firms.

Despite the inconclusive nature of the evidence concerning this question, its importance is lessened by the pervasiveness of both commodity and high-technology bearings in defense-critical applications. As we shall see in the national security requirements section of this paper, the United States will continue to require reliable sources of both commodity and high-technology bearings during a national security emergency.

E. Capital Investment

- Capital investment by the bearing industry has been inadequate in recent years to sustain capacity. During most of the 1980's, the industry has experienced high costs of capital, depressed prices and profitability, declining market shares, and low rates of capacity utilization. As shown in Table III-4, average investment in the 1982-1986 period was 29.7 percent below the level of the previous five year period. Investment as a percent of shipments averaged just over five percent for each period.

Table III-4

Investment in
New Plant and Machinery
(in millions of constant 1987$)

Year	Plant	Machinery	Total
1977	$35.4	$173.3	$208.7
1978	19.0	157.3	176.3
1979	24.2	162.3	186.5
1980	39.5	254.2	293.7
1981	21.3	184.4	205.7
Average	$27.9	$186.3	$214.2
1982	$15.7	$164.3	$180.0
1983	8.0	116.1	124.1
1984	8.5	126.1	134.6
1985	12.6	131.7	144.3
1986	35.8	135.0	176.5
Average	$16.1	$135.8	$151.9
% Change	(42.2%)	(27.1%)	(29.7%)

Source: DOC/Bureau of the Census, Annual Surveys of Manufactures, (AS-5)

- The drop in bearing shipments since the late 1970's has been accompanied by a considerable disinvestment or liquidation of capacity. At least 29 plants were known to have shut-down, which amounted to over $1 billion in capacity. Over three-fourths of these plants made complete bearings, while the rest made only components. All but two of the closings were in the Northeast and Midwest.

- Eight new U.S. plants have been constructed since 1977, and another is currently under construction. Seven of the new plants were built in the Southeast, one in Indiana, and one is under construction in Pennsylvania. Two of the plants were capacity expansions, while the other seven were transplants of existing capacity. Two of the transplants only partially replaced prior levels of capacity.

- As demonstrated in Table III-5, interest rates prevailing in the United States have exceeded those of our major trading partners for much of the 1980's. In addition, the U.S. industry's competitive decline has in many instances increased firms' cost of capital by lowering their creditworthiness.

Table III-5

Bank Lending Rates
(Period averages in percent annum)

	1981	1982	1983	1984	1985	1986
U.S.	18.87	14.95	10.79	12.04	9.93	8.35
Japan	7.79	7.23	7.05	6.66	6.52	5.91
FRG	14.69	13.50	10.05	9.82	9.53	8.75
Sweden	17.50	16.09	15.07	15.53	16.72	14.13
U.K.	13.25	11.79	9.79	9.65	12.29	10.83

Source: IMF/IFS Yearbook 1987

- One particular piece of equipment that is seldom purchased by American firms anymore is the screw machine, used for cutting 'green' inner and outer rings from bar and tube stock. The screw machine is primarily a high volume, dedicated machine that played its biggest roll in the "under 30 mm" and "30 to 100 mm" ball bearing sectors. Since U.S. firms have largely been eliminated from the higher volume portions of these sectors, the need for screw machines has greatly diminished.

- U.S. companies have frequently been criticized for their tendency to make investment decisions based on the anticipated return on investment in the short-term. This tendency is unfortunate as it compels many companies to purchase machines one at a time, as opposed to replacing an entire line, or constructing an entirely new factory. Replacing machines one at a time can present problems both in terms of coordination with existing equipment, and difficulties in training employees to learn several ways to accomplish the same task.

Conclusions

Greatly expanded investment is essential to the long-term viability of the bearing industry. Much more capacity was retired in the last decade than created. This trend is likely to continue because of low price and profit levels that cloud the investment climate.

F. Research and Development

- Investment in research and development is key to the future technological and price competitiveness of the U.S. bearings industry.

- Of the 32 bearings producers responding to our survey, foreign-owned companies reported a higher percentage of sales invested in research and development. In fact, of the seven companies investing two percent or more in R & D from 1983 to 1987, (deleted) were foreign-owned and only (deleted) were U.S.-owned.

1 The remaining (deleted) foreign-owned and (deleted) U.S. owned firms invested less than two percent of sales. This is consistent with the International Trade Commission's (ITC) finding in its 1986 "Competitive Assessment of the U.S. Ball and Roller Bearing Industry," that domestic bearings companies' investment in R & D averages 1.8 percent. Clearly, ---------- and the foreign-owned multinational firms (as well as some larger U.S. firms) were also able to benefit from R & D conducted abroad by related companies.

- Survey respondents believe that R & D in product, manufacturing and metallurgical technology are all important to firms' competitive viability. Smaller niche producers were less likely to be conducting R & D in all three areas than were large producers. This could restrict niche producers' flexibility as they face increased competition from larger foreign and domestic firms seeking to expand into their markets.

- The survey further asked firms to characterize their involvement in seven categories of manufacturing technology. Results are summarized in Table III-6. Not all of the technologies are suited, however, to each firm's operations. High-speed press forming had the narrowest application as it is generally used only in the production of needle bearings. Single-point turning technology used in high volume production and CAD/CAM were the most widely used technologies. Few firms reported that any of the technologies were too expensive at this time.

Table III-6

Type of Involvement in Research and Development

Technology	A*	B*	C*	D*	E*	F*
CAD/CAM	3	1	0	6	23	1
High speed press forming	22	0	1	0	10	0
Single point turning	4	0	0	0	28	1
Hard turning	13	0	4	1	11	4
Induction heat treating	11	1	1	1	13	3
NC grinding	6	1	0	7	19	0
Non-contact gauging	4	2	3	5	14	3

*A. Technology not suited for my operations.
*B. Technology too expensive at this time.
*C. Technology requires additional innovation.
*D. Plan to introduce in the next three years.
*E. Currently using, and plan to increase use.
*F. Currently conducting R&D in this area.

Source: Section 232 producers survey

- Joint ventures, acquisitions and licensing arrangements have sometimes been a means for firms to acquire advanced technology at a lower price. Minebea of Japan's recent acquisition of New Hampshire Ball Bearing represents such an effort to increase a company's competitiveness through the purchase of advanced technology.

Conclusion

The industry's relatively low level of investment in R & D threatens its future technological and price competitiveness.

IV. EXISTING GOVERNMENT PROGRAMS

The United States government has several programs and regulations in place that affect the bearings industry. The following section presents a brief description of these programs' impact on the industry's ability to meet national security requirements.

A. DOD Programs

The Department of Defense (DOD) has several programs with actual or potential impact on the bearings industry. For example, when Defense determined that it was depending on a sole foreign source for its 'noise-quiet' submarine bearings, it allocated Defense Production Act Title III funds in support of Barden's entry into this market. In addition, in several instances, Defense has used its Manufacturing Technology and other grant authorities in support of the industry's technological modernization.

The Air Force, for example, just completed a $2.13 million contract with Torrington's Fafnir subsidiary under the Industrial Modernization Incentives Program (IMIP). The contract had a number of projects associated with it to improve the company's overall manufacturing capability. The specific projects were: cellular rearrangement, set-up cost reduction, CAD/CAM/CIM, M50 technology development and retainer cost reduction. The Air Force will now be entering the last phase of the program with Fafnir in which the Air Force will get payback for its investment.

Furthermore, in 1971, Defense instituted a Federal Acquisition Regulation (FAR) requiring that direct and induced DOD purchases be restricted to U.S. and Canadian miniature and instrument bearings. The draft of an expanded FAR to place similar restrictions on all bearings for three years was published in the March 28, 1988, Federal Register. The Department of Commerce has submitted suggested modifications to the draft FAR that will strengthen its effectiveness. DOD is also continuing to implement a 'Bearings Action Plan' designed to complement the FAR in supporting the industry's revitalization.

Impact: It is premature to assess the impact of an expanded FAR on the industry's ability to meet national security requirements because it has not yet been implemented or even published in final form. In addition, DOD believes that while the IMIP will enhance Fafnir's competitivness, the program will have limited impact on the overall bearing industry. It is anticipated that the various initiatives set forth in the Bearings Action Plan will improve the industry's overall ability to meet national security requirements. However, it is too early to evaluate the full effect of these initiatives since the Plan has not been fully implemented.

B. Antidumping Duty and Countervailing Duty Laws

The antidumping duty law and the countervailing duty law are administered by the Department of Commerce (DOC) and the International Trade Commission (ITC).

In 1987, as the result of an antidumping duty petition filed by the Timken Company involving tapered roller bearings (TRB), the DOC determined that TRBs were being sold at less than fair value in the United States. As a consequence of this determination, and a finding of injury by the ITC, antidumping duties were imposed on TRBs imported from Japan, Hungary, Romania, Italy, and the Peoples Republic of China.

On March 31, 1988, the Torrington Company filed an antidumping duty petition involving all classes of ball and roller bearings, except TRBs, and parts thereof from West Germany, France, Italy, Japan, Romania, Singapore, Sweden, Thailand, and the United Kingdom. At the same time, the Torrington Company filed countervailing duty petitions on the same products imported from Singapore and Thailand. While investigations are being conducted by the Department in both cases, no determinations have been made to date. (The ITC has, however, made a preliminary finding of injury.)

Impact: The Department does not have any discretion under either of these unfair trade laws to consider the effects on the national security of the importation of the products under investigation. Therefore, the Section 232 investigation will not have any effect upon the Department's determinations under the antidumping and countervailing duty laws. These laws strictly prescribe the factors that may be taken into consideration by the Department in determining whether products imported into the United States are being sold at less than fair value or whether imports are receiving the benefit of a countervailable subsidy.

In addition, even if an antidumping or countervailing duty order is issued, the continued existence, if any, of government subsidization or sales below fair market value is reassessed periodically by the Department (also without reference to the effect of the imports on the national security or other factors not germane to administration of the antidumping and countervailing duty laws). Thus, any estimate of the effect of antidumping and countervailing duty cases would be highly speculative.

C. Antitrust Laws

The Department of Justice has indicated that it has brought no antitrust enforcement actions against bearings firms in recent years. It has, however, sought and obtained the termination of two long-standing antitrust judgments that it determined had become an unnecessary impediment to the efficiency of the firms concerned.

In one of these cases, in 1983, a U.S. District Court agreed to terminate a 1951 order requiring Timken to deal with its British and French subsidiaries as if they were unrelated companies. In the other case, another U.S. District Court terminated a consent decree which had enjoined SKF of Sweden from coordinating marketing with its U.S. and Italian affiliates.

In addition, Justice has investigated three bearings industry mergers and acquisitions in recent years, and in each case decided not to challenge the transactions under the antitrust laws. Finally, Justice notes that a Federal Trade Commission investigation during the 1970's uncovered allegations that SKF had ceded automobile aftermarket sales to Federal Mogul in return for Federal Mogul ceasing its production of tapered roller bearings under four inches. This investigation led to a 1980 consent order imposing certain requirements and limitations on purchasing and other business relationships between the two companies through 1991.

Justice notes that the antitrust laws apply to the bearing industry in the same way in which they apply to business conduct and transactions in the U.S. economy generally by preserving competition and by preventing firms from attempting to insulate themselves from the rigors of the marketplace.

Impact: U.S. antitrust laws have not hampered the bearing industry's ability to make management decisions to preserve or expand capacity.

D. Trade Adjustment Assistance

The U.S. government is authorized by the 1974 Trade Act to provide trade adjustment assistance to firms and workers that are adversely affected by imports. Trade adjustment assistance to firms is administered by the Department of Commerce, and assistance to workers is administered by the Department of Labor.

Under the Commerce program, six bearing firms have been certified as eligible for assistance. Two of these firms have received a total of $60,200 of technical assistance to help the firms diagnose their problems and opportunities, and implement recovery strategies. In addition, two of the firms received $1.5 million in direct loans and $4 million in guaranteed loans for working capital and other purposes.

Labor has received 80 petitions requesting trade adjustment assistance for workers in the bearing industry. Of these, 19 have been certified, 57 have been denied, one was partially certified, one was terminated, and two are pending. The Department paid $6.4 million in assistance to bearing industry workers.

Impact: These programs have had a positive effect on the firms involved. However, they have had a minimal impact in preserving overall U.S. bearing industry production capacity or in assisting the industry in meeting national security requirements.

E. Export Controls

The Department of Commerce maintains the Commodity Control List which includes all commodities subject to Commerce-enforced export controls. Export Commodity Control Number (ECCN) 1371A controls high-accuracy general purpose anti-friction bearings. Other ECCN's control bearings that are specially designed for controlled commodities such as aircraft. Bearings that are specially designed or modified for use with military systems are subject to the licensing requirements of the Office of Munitions Control at the State Department.

Since November, 1984, 300 license applications with a total value of $8.7 million were approved under ECCN 1371A, and one license application with a value of $1900 was denied.

Impact: U.S. export controls are not a significant detriment to the bearing industry's ability to preserve or expand capacity.

F. Export Promotion

The Department of Commerce has not scheduled any export promotion events directly targeted on the bearing industry. However, bearings are key components of automotive products, aircraft and industrial machinery, and some bearing companies particpate in events scheduled for their consumer markets.

In addition, there are a number of Commerce activities available to individual bearing firms including the identification of major markets, market trends, foreign manufacturers and dealers and trade barriers. Specific foreign trade opportunities are sent to appropriate bearing manufacturers by Commerce industrial specialists.

Impact: U.S. government export promotion initiatives have had a negligible impact on the industry's ability to preserve or expand capacity to meet mobilization requirements.

G. Generalized System of Preferences

The GSP program allows for the duty-free import of products from certain lesser developed countries. However, the Office of the U.S. Trade Representative removed bearings from GSP eligibility in 1975. Since that time, Singapore and Thailand, both GSP-eligible countries, have become two of the most important suppliers of miniature and instrument ball bearings to the U.S. market. President Reagan recently announced that he was graduating Singapore from GSP eligibility effective January 1, 1989.

Impact: Recent growth of exports from GSP-eligible countries occurred after bearings were removed from GSP eligibility. However, any move to reinstate GSP eligibility for bearings could have a negative effect on certain segments of the U.S. industry.

V. TRADE DATA ANALYSIS

The following section provides an overview of recent trends in shipments, consumption, exports, and imports. A detailed product category-level analysis of these trends is attached as Tab E.

A. SHIPMENTS AND CONSUMPTION

According to Department of Commerce estimates, U.S. manufacturers shipped bearings and bearing components worth a total of $3.4 billion in 1987.[1] This figure reflects a decline, measured in constant dollars, of almost 34 percent since 1979. A particularly severe slump in shipments brought about by the world recession beginning in 1980 bottomed out in 1982 when shipments reached a 20 year low of $2.8 billion. Shipments then recovered to about $3.3 billion by 1984, and have been flat since that time.

As seen in Table V-1, the greatest decline in shipments in recent years has occurred in ball, rather than roller, bearing categories, and in radial ball rather than in non-radial ball categories. Of the fifteen product categories under investigation, shipments declined in real terms during this period in more than half, three posted moderate gains, and one was flat.

Despite generally positive trends in all superprecision categories investigated, regular precision radial ball bearings under 30mm and 30-100mm and thrust bearings suffered declines in shipment values, ranging from 17 percent to 21 percent. Although a number of product categories posted moderate gains in shipments in 1987 over 1986 levels (particularly superprecision types), shipments of the two smaller regular precision radial ball bearing categories continued to decline.

Shipments of tapered roller bearings, which declined between 1984 and 1986, posted a moderate recovery in 1987, as did regular radial ball bearings over 100mm, "other" ball bearings, "other" roller bearings, spherical roller bearings and all superprecision categories. All other bearing categories either had flat domestic shipments or continued to decline.

---

[1]The figure quoted is for all products categorized under Standard Industrial Classification 3562. Unless otherwise indicated, however, all figures in this section refer to the 15 product categories under investigation and do not include unground bearings or bearing parts and components shipped separately. (See "Product Description").

Table V-1
U.S. Bearing Shipments
(in $ millions)

	1984	1985	1986	1987
Ball Bearings:				
Under 30mm				
Regular	$ 65	$ 62	$ 53	$ 51
Superprecision	37	37	39	38
30-100mm				
Regular	246	211	190	182
Superprecision	51	51	65	62
Over 100mm				
Regular	113	98	94	111
Superprecision	40	40	53	63
Thrust	43	46	37	35
Integral Shaft & Other Ball	871	$ 915	$ 863	$ 834
Total Ball	$1,466	$1,460	$1,394	$1,376
Roller Bearings:				
Tapered	$777	$734	$662	$719
Spherical	118	125	114	126
Cylindrical				
Regular	154	141	138	135
Superprecision	71	78	80	79
Needle	287	304	316	314
Other Roller	181	192	184	202
Total Roller	$1,588	$1,574	$ 1,494	$1,575
ALL BALL & ROLLER:	$3,054	$3,034	$2,888	$2,951

Source: Bureau of the Census

B. U.S. BEARING EXPORTS

Bearing exports, at little more than 8 percent of production in 1986, have never been a large revenue source for U.S. manufacturers, as domestic companies have concentrated their efforts in the United States - the world's largest and most

diversified bearing market.[2] In fact, the export share of domestic production has actually declined since 1982, at which time exports represented about 10 percent of production. An

Table V-2
U.S. Bearings Exports
(in $ millions)

	1984	1985	1986	1987
Ball Bearings:				
Under 30mm				
Regular	$ 4	$ 4	$ 3	$ 3
Superprecision	2	2	3	2
30-100mm				
Regular	16	14	12	10
Superprecision	3	4	4	3
Over 100mm				
Regular	16	13	10	10
Superprecision	6	5	6	5
Thrust	2	2	3	2
Integral Shaft & Other Ball	46	41	36	47
Total Ball	95	85	77	83
Roller Bearings:				
Tapered	$132	$112	$ 90	$137
Spherical	9	10	12	17
Cylindrical				
Regular	17	17	27	15
Superprecision	8	10	16	11
Needle	9	9	9	9
Other Roller	27	31	16	27
Total Roller	$201	$189	$170	$216
ALL BALL & ROLLER:	$297	$274	$247	$299

Source: Based on Bureau of the Census Data and Section 232 Producers Survey.

[2]Japan exports approximately 30 percent of production, while West Germany, France, and the United Kingdom, export between 55 and 65 percent of their production. However, if intra-European transfers were factored out of European export figures, country export figures as a percentage of production would only be slightly greater than the U.S. figure.

estimated $299 million of bearings were exported by U.S. manufacturers in 1987. (Table V-2) This figure reflects a decline of about 16 percent between 1980 and 1987. Roller bearings represented nearly three-fourths of the value of industry exports in 1987. Tapered roller bearing exports, at $137 million, accounted for 44 percent of the value of all exports, followed distantly by "other" ball bearings ($44 million), and "other" roller bearings ($27 million).

Exports of eight out of fifteen categories dropped between 1984 and 1987, with the greatest declines in exports occurring in the regular precision medium and large radial ball bearing categories and in the category of bearings with integral shafts. However, the small nominal values of U.S. exports in these categories may tend to exaggerate fluctuations.

Roller bearing exports have fared somewhat better since 1984, and healthy export gains were posted in spherical roller bearings in particular. With the exception of tapered roller bearing exports, which remained fairly stable, almost all of these categories are small compared with either domestic shipments or consumption.

The International Trade Commission in its 1986 "Competitive Assessment of the U.S. Ball and Roller Bearing Industry" identified the following factors as contributing to the decline in exports: a) the strong dollar; b) worldwide overcapacity which drove bearing prices below levels that are economical to U.S. manufacturers; c) increased offshore manufacturing by U.S. bearing-consuming industries in countries that have indigenous bearing industries; and d) depressed market demand for U.S. ball and roller bearings in the United States' traditional bearing export markets. To what extent the recent decline in the value of the dollar will lead to a reversal of this trend remains to be seen.

Of major U.S. bearing export markets, Canada traditionally ranks first, and exports to that country accounted for about 27 percent of the 1986 total.[3] Other ranking export destinations include Mexico (10 percent of the total in 1986), West Germany (8 percent of the total in 1986), Brazil (6 percent of the total in 1986), and the United Kingdom (6 percent of the total in 1986). Despite their dominance of the U.S. import market, U.S. exports to Japan placed eighth in this ranking.

---

[3]These figures are based on United Nations statistical compilations and consequently deviate slightly from figures quoted elsewhere in this report, which rely on U.S. Government statistical sources.

Table V-3 below shows U.S. bearing export values by destination between 1982 and 1986.

Table V-3
U.S. Bearing Export Destinations
($ Millions)

	1982	1983	1984	1985	1986
Canada	$ 78	$ 84	$ 110	$ 89	$ 76
Mexico	32	19	39	41	28
West Germany	19	18	22	29	24
Brazil	10	6	9	13	18
United Kingdom	18	14	17	19	17
Venezuela	13	6	11	9	10
France	15	11	10	10	9
Japan	9	6	8	9	9
Belgium/Luxembourg	13	9	12	10	9
Australia	13	11	14	12	8
South Africa	13	6	9	6	7
Other	136	63	70	58	68
Total	$369	$253	$331	$305	$283

Source: United Nations Statistics

C. U.S. BEARING IMPORTS

Imports of bearings which, despite the dollars weakness, remain the major competitive force in the U.S. anti-friction bearing market, increased by more than 5 percent in the last year to a record $640 million. According to Department of Commerce figures for the industry, imports have increased without interruption since the early 1960's and by more than 60 percent since 1978.

As shown in Table V-4, imports have increased in most categories since 1984, with particularly strong growth in needle bearings, cylindrical roller bearings, and radial ball bearings. Modest declines in imports were registered during this period in tapered roller bearings, while imports increased moderately in other bearing categories.

In 1987, the largest absolute amount of imports were in the radial ball bearing 30-100mm and tapered roller bearing categories. At $147 million each, these two categories together accounted for slightly less than half of 1987 bearing imports. Other categories with large amounts of imports include ball bearings under 30mm ($87 million imported), "other" roller bearings ($56 million), and "other" ball bearings ($45 million).

Table V-4
U.S. Bearing Imports
(in $ millions)

	1984	1985	1986	1987
Ball Bearings:				
Under 30mm				
Regular	$ 65	$ 62	$ 71	$ 69
Superprecision	19	18	16	18
30-100mm				
Regular	138	138	132	132
Superprecision	5	5	7	7
Over 100mm				
Regular	26	28	32	31
Superprecision	1	1	2	6
Integral Shaft	15	24	21	23
Thrust	2	1	1	2
Other Ball	33	39	46	45
Total Ball	$304	$316	$328	$333
Roller Bearings:				
Tapered	$163	$150	$145	$147
Spherical	23	27	25	25
Cylindrical				
Regular	22	25	24	32
Superprecision	8	7	9	8
Needle	12	17	21	39
Other Roller	47	49	51	56
Total Roller	$275	$275	$275	$307
ALL BALL & ROLLER:	$579	$591	$603	$640

Source: Bureau of the Census

As shown in Table V-5 below, Japan dominates U.S. imports of anti-friction bearings with approximately 46 percent of the total import market in 1987. West Germany places second with about 20 percent of the total market. Other leading import sources include: Canada at 9 percent, and Singapore, the United Kingdom, and France each at 5 percent.

Table V-5
U.S. Bearing Imports
By Country of Origin

($ Millions)

	1984	1985	1986	1987
Japan	288	298	291	296
West Germany	96	93	107	125
Canada	62	58	56	58
United Kingdom	24	24	27	31
Singapore	31	33	30	30
France	16	19	23	30
Italy	29	24	35	24
Sweden	15	14	16	21
Romania	13	17	13	18
Thailand	3	7	13	15
Other	31	28	27	20
Total:	579	591	603	640

Source: Bureau of the Census

From Table V-6 below, it is clear that the United States has had a chronically large trade deficit in bearings with Japan, and has

Table V-6
U.S. Bearing Trade Balance

(in $ millions)

	1978	1982	1986
Brazil	9	7	15
Canada	22	34	20
France	5	3	(17)
West Germany	(60)	(69)	(94)
Italy	(4)	(11)	(30)
Japan	(187)	(182)	(291)
Mexico	25	32	27
Singapore	(4)	(22)	(27)
Sweden	(8)	(12)	(12)
Thailand	0	1	(12)
United Kingdom	(4)	(16)	(11)
Venezuela	10	13	10
Other	47	55	(21)
WORLD:	(149)	(167)	(401)

Source: United Nations Statistics

significant deficits with West Germany, Italy, Singapore, France, Sweden, and Thailand. At the same time, U.S. surpluses with Canada and major Latin American bearing markets in Brazil, Mexico, and Venezuela have been flat or declining.

Most of the high volume import trade in bearings is attributable to the marketing activities of a handful of major bearing multinationals. According to the Section 232 survey responses, seven of the largest eight multinational bearing firms import bearings from wholly-owned subsidiaries overseas. In addition, six out of the eight top firms reported that they import superprecision bearings, and performed various value-added operations in this country. Such value-added activity includes: assembly, heat treating, finished grinding, and other manufacturing processes. Together, imports by these eight firms totaled more than $591 million in 1987, 84 percent of total bearing imports.

Specialized domestic producer/importers responding to our survey indicated that they import in part from the multinationals and to an even greater extent from a variety of lesser known foreign sources. Medium-sized firms import primarily from major West German and European manufacturers. Others import from less traditional, low-cost firms in Eastern Europe or the Pacific Rim. Many of these bearings are then sold to smaller manufacturers of machinery and other equipment and in the aftermarket.

Of the major domestic industrial consumers of bearings, the big three domestic automotive manufacturers estimated that their combined direct imports of bearings totaled $60 million in 1987 - 9 percent of total imports.[4] (The companies consumed as much as an additional $240 million of bearings imported through other channels.) Virtually all of these bearings were purchased from the major European and Japanese bearing multinationals. In addition, (Deleted) reported importing smaller quantities of bearings from their parent companies in Japan.

Seven major aerospace firms with large amounts of defense business reported importing bearings worth an estimated $91 million, or 14 percent of the total, in 1987. Three major domestic construction machinery manufacturers reported directly importing bearings worth an estimated $27 million - 4 percent of the total. The remaining six end-user/importers responding to the survey include electronic machinery and other machinery

---

[4]This figure refers only to direct imports. The automotive industry actually consumes a far greater quantity of foreign-made bearings than this figure would imply. These other imported bearings are purchased through distributors and/or marketing operations located in the United States.

manufacturers who directly imported $29 million - 4 percent of total imports.

4. IMPORT PENETRATION

Bearing import penetration is highest in the regular precision radial ball bearing categories. Overall bearing import penetration in all ball and roller bearings stood at about 19 percent by value in 1987 - up 2 percentage points since 1984.

Table V-7
Bearing Import Penetration Levels
(Value Basis)

	1984	1985	1986	1987
Ball Bearings:				
Under 30mm				
Regular	52 %	52 %	59 %	58 %
Superprecision	35	34	30	33
30-100mm				
Regular	37	41	43	43
Superprecision	10	9	10	11
Over 100mm				
Regular	21	25	28	25
Superprecision	4	4	5	10
Integral Shaft	4	5	5	6
Thrust	4	3	3	4
Other Ball	7	9	10	10
Total Ball	18 %	19 %	20 %	21 %
Roller Bearings:				
Tapered	20	19	20	20
Spherical	18	19	20	18
Cylindrical				
Regular	14	17	18	21
Superprecision	11	9	12	11
Needle	4	5	6	9
Other Roller	23	23	23	24
Total Roller	17 %	17 %	17 %	18 %
ALL BALL & ROLLER:	17 %	18 %	19 %	19 %

Source: Bureau of the Census

Import penetration in ball bearing categories stood at a slightly higher 21 percent in 1987 - up 3 percentage points since 1984,

and import penetration in all roller bearing categories stood at 18 percent - up 1 percent since 1984.

Tables V-7 and V-8 show that import penetration was highest in the regular radial ball bearings under 30mm category where it stood at about 58 percent on a value basis and nearly 80 percent on a unit volume basis in 1987.

Table V-8
Bearing Import Penetration Levels
(Unit Basis)

	1984	1985	1986	1987
Ball Bearings:				
Under 30mm				
Regular	68 %	72 %	78 %	78 %
Superprecision	64	72	68	71
30-100mm				
Regular	56	59	60	61
Superprecision	8	5	8	13
Over 100mm				
Regular	46	50	52	49
Superprecision	3	5	2	6
Integral Shaft	21	24	31	33
Thrust	6	9	7	8
Other Ball	19	23	24	26
Total Ball*	50 %	52 %	57 %	58 %
Roller Bearings:				
Tapered	39	37	36	38
Spherical	54	58	79	75
Cylindrical				
Regular	17	23	25	27
Superprecision	27	31	32	36
Needle	3	4	4	7
Other Roller	40	38	47	49
Total Roller*	20 %	17 %	19 %	21 %
ALL BALL & ROLLER*:	32 %	32 %	34 %	35 %

* Value Based.

Source: Bureau of the Census

The large and important category of regular precision radial ball bearings 30-100mm recorded the next highest import penetration

level of 43 percent on a value basis and 61 percent on a unit volume basis; and the smaller, but militarily-significant regular precision radial ball bearing over 100mm product category recorded import penetration levels of 25 percent on a value basis, and 49 percent on a unit volume basis.

Import Penetration in each of the superprecision radial ball bearing categories were lower, and ranged from 33 percent on a value basis (71 percent by volume) in the radial under 30mm category to much lower 11 percent and 10 percent on a value basis (13 percent and 6 percent by volume) for radial ball bearings 30-100mm and radial ball bearings over 100mm, respectively.

Other significantly high import penetration levels were identified in the "other" roller bearings (24 percent by value and 49 percent by volume), tapered roller bearings (20 percent by value and 38 percent by volume), and regular precision cylindrical roller bearings (21 percent by value and 36 percent by volume). Import penetration of spherical roller bearings in 1987 was quite high on a volume basis (75 percent) but only 18 percent on a value basis - evidence of the comparatively low value of imports in this category.

The greatest increases since 1984 in import penetration on a value basis have occurred in the radial ball bearing (30-100mm), needle bearing, and radial ball bearing under 30mm product categories. No category recorded a decline in import penetration on a value basis, though import penetration in three categories - thrust bearings, tapered roller bearings, and spherical roller bearings - did not change.

Overall import penetration levels are substantially higher, calculated on a volume basis than by value. Although conclusions drawn from aggregate data should be used with caution, the existence of such a large disparity strongly suggests that imports are concentrated in commodity part numbers with low average prices. These large disparities are particularly apparent in the spherical roller bearing category, as well as in each of the three radial ball bearing categories. The conclusions drawn from this evidence substantiate the claim that imported bearings, particularly radial ball bearing types, tend to be high-volume, low unit-cost types.

VI. NATIONAL SECURITY ASSESSMENT

A. MOBILIZATION REQUIREMENTS

Estimates of mobilization and wartime requirements for the ball and roller bearing industry were made consistent with the estimates of industrial outputs derived from the 1984 National Security Council (NSC) Stockpile Study. This is in accordance with page 2, paragraph 5 of National Security Decision Directive (NSDD) Number 174 entitled, "U.S. National Defense Stockpile Goals, Mobilization Planning Factors and Implementation Measures" which states:

> The NSC study base case reports on war scenario, wartime DOD expenditures, world-wide petroleum supply/demand and prices, GNP and investment levels, industrial output sector levels adjusted for austerity, wartime reliability of exporting nations, and sealane attrition factors shall be adopted where appropriate, on a case-by-case basis for related mobilization planning activities.

The War Scenario

The NSC Stockpile Study used Scenario 3A consisting of a 3-year war, preceded by a 1-year mobilization effort. The primary constraints on the level of GNP were the availability of energy, labor, and capital. Energy, particularly petroleum, was the binding constraint on the economy whereas capital and labor were much less constraining.

The scenario for the Section 232 investigation of the ball and roller bearings industry diverges from the scenario used for the NSC Stockpile Study in the time period used for the war. The Department of Commerce (DOC), with concurrence from the NSC, Department of Defense (DOD) and the Federal Emergency Management Agency (FEMA), chose to use a one year mobilization followed by the first year of a war of indefinite length. This scenario was considered to be more realistic in today's environment than the gradual increases in the three-year war depicted in Scenario 3A. Additional guidance from the Graduated Mobilization Response System was not available in time to incorporate in our study (A copy of the draft methodology is attached as Tab F).

The level of defense spending and the composition of the economy, however, during the first-year of a war of indefinite length, is consistent with the third year of the war of Scenario 3A used to estimate stockpile requirements. The third year of Scenario 3A was chosen because Federal defense expenditures had risen to their highest levels during the Scenario 3A war - 158 percent greater than the mobilization year; although, in fact, bearings requirements are lower during this year than in either of the other war years or the mobilization year.

Wartime Final Demands

The next step in the methodology was to translate the Stockpile Study's macroeconomic assumptions about the wartime economy into industrial final demands - a 'bill-of-goods.' This was done in two steps. First, the Federal defense industrial final demands were estimated by the DOD using the Defense Economic Impact Modelling System (DEIMS). Non-defense final demands were estimated by FEMA using the Demand Impact Transformation Tables (DITT). An industrial classification concordance was prepared to merge the industrial final demands of the two models.

The DOC's Office of Business Analysis (OBA) provided special analysis of Gross Private Fixed Investment. Other factors that influenced the levels of final demand were the austerity measures imposed on the economy, particularly the drastic reductions in residential home construction and automobile production, the sealane attrition rates provided by the Navy, and the political reliability of trading partners provided by the Department of State. Required bearings outputs in the NSC-approved scenario are to be met from domestic sources only with the net impact of imports and exports being factored into final demand estimates in the NSC analysis.

The final demands for the mobilization year and the third year of the Scenario 3A war were used to estimate bearing requirements. The next step in the methodology used in the stockpile analysis was to estimate the total output of all industries to support these final demands. The same step was employed for the bearing analysis.

Total Output Requirements

The Stockpile Study employed a 1972 based Bureau of Economic Analysis Input/Output table to determine the total industrial outputs. The Input/Output table reflected the 1972 technological relationships between the output of various industries. These industry outputs consist of both direct requirements (e.g., the steel that goes into tanks) and indirect requirements (e.g., the coal that is used to make the steel).

For the bearings study, a 1982 based Input/Output table was employed to estimate the direct and indirect output requirements of the economy. The 1982 based table is an updated 1977 Input/Output table produced by the Bureau of Economic Analysis. This table was used to obtain the 1982 technological relationships between industries, rather than relying upon outdated 1972 industrial relationships. It provides an identical mix of end products as contained in the NSC scenario, but identifies a different mix of intermediate products such as bearings needed to produce them.

Estimating Categories of Bearings

The estimates of total output were performed by FEMA using the 1982 based Input/Output table, described above, included in its Resolution of Capacity Shortfalls (ROCS) Model. Data to develop the uses of the 15 bearing categories were obtained from the domestic bearings industry. For example, for each $100 of output for autos, 24 cents of tapered roller bearings are required. Requirements of each bearing product for both the mobilization year and the first year of the war are determined from the ROCS-generated industrial output requirements (i.e., spherical roller bearings will represent 4 cents of each dollar of ROCS-generated overall bearings industry requirements) as set forth in Table VI-1 below.

Table VI-1

Bearings Mobilization Requirements
(1982$ millions)

	Mob. Yr.	War Yr.1	Peacetime Shipments(1985)
Regular Precision			
Ball under 30mm	$161	$ 42	$ 60
Ball 30-100mm	405	156	180
Ball over 100mm	128	144	100
Integral Shaft	602	417	423
Thrust	48	50	44
Other Ball	500	650	461
Tapered Roller	943	741	573
Spherical	155	147	116
Cylindrical	137	202	135
Needle	388	433	322
Other Roller	321	436	315
Superprecision			
Ball under 30mm	62	72	40
Ball 30-100mm	73	180	66
Ball over 100mm	48	136	51
Cylindrical	79	203	70
TOTAL	$4050	$4029	$2956

Source: FEMA ROCS model computation

B. MOBILIZATION CAPACITY

1. Overview

A reliable assessment of the ability of the U.S. defense industrial base to meet the demand for anti-friction bearings during a national emergency requires: a) a direct measurement of existing production capacity, and b) an analysis of significant factors which determine the industry's ability to expand that capacity under emergency conditions and to alter its product mix in order to meet emergency requirements.

As part of this investigation, questionnaires were sent to producers and importers of anti-friction bearings.[1] Producers with bearing sales of less than $5 million who employed less than 100 workers, and importers with direct imports of less than $1 million, were exempted from the questionnaires to ease the burden on small businesses.

In all, 34 bearing producers representing approximately 93 percent of domestic bearing shipments, and 56 bearing importers, representing approximately 97 percent of imports, submitted the completed questionnaires which form the basis of this analysis.

2. Derivation of Capacity Estimates

To develop projections of bearing capacity during a national emergency, calculations were made of the industry's projected capacity during an initial year of mobilization and during the first year of hostilities for each of the 15 product categories under investigation. This plant-by-plant information was provided on a unit volume basis under the following assumptions:

---

[1]Responses to the survey questionnaires were as follows:

	Producers	Importers
Total Received	66	118
Exempted	32	62
Completed Questionnaires	34	56

The share of total domestic industry shipments held by these firms was estimated by comparing 1986 shipments reported by these firms in their questionnaire responses with corresponding 1986 shipments figures published by the Bureau of the Census.

1. Existing production facilities are to be raised to full productive capacity;

2. New equipment may be purchased to replace existing machinery and/or existing machinery may be refurbished or otherwise brought into productive service;

3. Labor availability reflects normal local market conditions;

4. Material requirements can be fully met;

5. Facilities operate at the maximum rate possible given technological constraints;

6. Where identifiable, 75 percent of unit production should be of defense end-items and 25 percent of civilian end-items.

These assumptions were developed on the basis of current defense mobilization planning guidelines and are similar in content to those employed in related emergency preparedness studies.

Since less than 100 percent of bearing capacity is represented in the survey, the Department of Commerce estimated the industry-wide totals in each of the 15 product categories. This was achieved by comparing shipments quantities reported in the surveys with industry-wide figures provided by the Bureau of the Census.[2]

Inventories held by domestic bearing producers on December 31, 1986 were assumed to be representative of those likely to be available prior to a general mobilization. These figures were adjusted to reflect industry-wide inventories in the same manner as producers' capacity.

---

[2]The proportion of industry-wide shipments reported by firms surveyed by the Department of Commerce was assumed to reflect the proportion of total bearing productive capacity held by the surveyed firms in each of the product categories. The wartime production capacity figures provided in these surveys was adjusted accordingly to bring them to industry-wide levels. These unit figures were then translated into dollar values by multiplying each capacity figure by the average 1986 price of a unit of that bearing type based on the shipment quantities and values provided in the Bureau of the Census product shipment data. These dollar values were deflated into constant 1982 dollars to facilitate a comparison with defense requirements that are stated in these terms.

Estimates of importers inventories were derived in a similar manner. These figures were adjusted to reflect industry-wide imports of bearings by comparing the level of imports reported by firms responding to the survey with total imports of each bearing category as reported by the Bureau of the Census.

The final estimate of total bearings supply in the United States during an initial year of mobilization was calculated as the sum of mobilization year production capacity, producers inventories, and importers inventories. These results are reproduced in Table VI-2 on the following page.

All inventories are assumed to be consumed in the mobilization year, and therefore although capacity increases in the first war year, total supply decreases.

Table VI-2

ESTIMATED WARTIME PRODUCTION SUPPLY

($1982 MILLIONS)

Regular Precision Product	1986 Producers Shipments	Importers Inventories	Producers Inventories	Mob Year Capacity	Total Mob Year Supply	Year 1 Capacity
Ball Under 30mm	$49	$23	$4	$63	$89	$73
Ball 30-100mm	$177	$27	$16	$188	$230	$201
Ball Over 100mm	$87	$8	$18	$97	$122	$107
Integral Shaft						
Thrust	$34	$2	$3	$59	$64	$75
Other Ball Bearings						
Tapered Roller Bearings	$615	$33	$110	$1,173	$1,315	$1,274
Spherical Roller Bearings	$106	$14	$26	$192	$232	$217
Cylindrical Roller Bearings	$128	$13	$16	$130	$159	$157
Needle Bearings	$294	$8	$39	$319	$367	$304
Other Roller Bearings	$171	$14	$33	$241	$288	$269
Total Regular:	$2,464	$164	$372	$3,473	$4,009	$3,801

Superprecision Product	1986 Producers Shipments	Importers Inventories	Producers Inventories	Mob Year Capacity	Total Mob Year Supply	Year 1 Capacity
Ball Under 30mm	$36	$6	$4	$59	$69	$83
Ball 30-100mm	$60	$2	$15	$120	$137	$154
Ball Over 100mm	$50	$1	$24	$110	$135	$132
Cylindrical Roller Bearings	$75	$3	$23	$184	$211	$261
Total Superprecision:	$221	$12	$66	$474	$552	$629
GRAND TOTAL:	$2,685	$176	$438	$3,947	$4,560	$4,430

Source: Section 232 Producers Survey

3. Factors Effecting Expansion Capabilities

a. Overview

The assumptions under which firms estimated their production capabilities do not take into consideration the construction of new plants. The justification for this assumption, given the two year war scenario, is provided from an analysis of data pertaining to the time and cost involved in duplicating individual plants (with a new generation of equipment). The scenario also assumes the full availability of labor, materials, and new equipment. The reasonableness of these assumptions and the potential effects of shortages are treated in the following section, as are potential production bottlenecks.

b. Factors of Production

1. Labor Requirements:

The producers questionnaires-requested estimates of additional labor that would be required to support the expansion figures that were provided. The results of these estimates, extrapolated to reflect total industry requirements, are given in Table VI-3 below.

Estimated additions to the bearing industry's labor stock that would be required to support emergency mobilization are significant, and raise serious doubts as to whether projected capacity expansion estimates are sustainable in practice. Employment of production and technical workers would be required to increase by 23.8 percent in the initial mobilization year and another 15.1 percent in the first war year, for a total increase over the two year period of nearly 43 percent above peacetime levels.

Table VI-3

Additional Labor Required
to Support Emergency Expansion

	1987	Mob Year	Year 1	Total of Year and Mob Year
Production Workers	29,500	+ 7,068	+ 5,526	+ 12,594
Technical Staff	1,859	+ 403	+ 351	+ 754
Total:	31,359	+ 7,471	+ 5,877	+ 13,348
Annual Increase:		+ 23.8%	+ 15.1%	+ 42.6%

Source: Section 232 Producers Survey

Given that much of this labor will require extensive training to produce bearings to military specifications, it is likely that even if such numbers of able bodied workers could be found, training would result in incalculable delays. Evidence provided in analyses of anticipated expansion bottlenecks clearly underscore the concern over the availability of such large numbers of workers and the ability to train them in a timely manner, if at all.

The experience during World War II underscores this concern. During mobilization, the ratio of men to women (9 to 1) and the total supply of labor to the bearing industry remained stable. This was due in part to a) a 25 percent increase in productivity, and b) a large decline in the commercial automotive industry. As early as March 1942, however, the situation had changed drastically. The ratio of men to women decreased to 3 to 2 as the Selective Service cut deeply into the useful labor pool. The resulting shortages of labor became so acute and the perception of the importance of adequate bearing supplies so strong that by the Fall of 1943, "the bearing industry was accorded the importance from a manpower standpoint equal to military end products."[3] The elevation of the priority placed on the supply of labor to the bearing industry eventually eased the manpower shortage, but only after considerable delay.

The problems that were encountered in sourcing labor for bearing production during World War II would likely be exceeded today. For example, the Labor Department notes that the increased use of numerically controlled machine tools, industrial automation and improved inspection equipment in modern bearing plants have changed the mix and level of skills required of bearing production workers. For many machine operators, this new technology has decreased the handling of materials, increased the number of machines that each worker oversees concurrently, and has required a knowledge of statistical process control (SPC).

Several firms surveyed by the Labor Department indicated that they already face shortages of trained labor for certain highly skilled jobs, and many of these same firms indicated their reluctance, as a result, to lay-off trained workers even during business downturns. The rigidity of this hiring practice clearly attests to a present peacetime shortage of skilled production and technical workers and the corresponding value that producers place on retaining them.

For purposes of this study, a critical job was defined as one that is essential to maintaining production that requires a

---

[3]George W. Auxier, Historical Reports on War Administration: War Production Board, Bearings Production and Distribution: 1940-45. p.6.

minimum of one year's training to reach proficiency. Based on this definition, there appear to be 37 critical jobs in the bearing industry: 26 production jobs, 6 engineering jobs, and 5 technician-drafter-designer jobs. Critical production jobs require a high school education or technical training and from one to five years of on-the-job training or experience. These jobs include tool and die maker, furnace operator, millwright, and maintenance machinist.

Critical technical jobs include electrical technician, engineering lab technician, drafter and tool designer. These jobs require a technical associate degree or a four year apprenticeship and one to four years of on-the-job experience. The engineering jobs require a bachelor of science degree in engineering and two to four years of on-the-job experience to be fully proficient. DOC survey estimates indicate that the bearing industry would additionally require as many as 400 such scientists and engineers to support the kind of expansion of emergency capacity estimated in the survey responses.

Most managerial and supervisory jobs, as well as some support positions could also be considered "critical" to the extent that they require several years of experience and specific product knowledge for effective functioning. The Department of Labor estimates that critical occupations account for roughly 40 percent of those employed in the bearings industry.

Labor further states that the types of positions in the bearing industry are not, strictly speaking, unique to the industry. Several metalworking industries such as the machine tool industry (SIC 354) and other industries in SIC 356 (general industrial machinery) employ workers with similar skills.

In theory, the retraining of workers in these industries to perform tasks in the bearing industry would require substantially less time than hiring and training of unskilled employees. In a national emergency, however, it is highly probable that these industries, themselves experiencing the effects of a surge in demand, would compete directly with the bearing industry for limited supplies of skilled labor. Lacking, as the United States presently does, a coordinated plan to identify and allocate scarce industrial labor resources during a national emergency this competition could lead to crippling shortages. Clearly, the availability of labor during a wartime expansion of bearing production should be considered a grave concern.

2. Material Requirements

Instructions in the DOC industry survey specifically asked firms to assume the full availability of raw materials. This assumption was made to afford an estimate of the technological

limits to expansion and was not intended to provide a realistic assessment of actual availability during a national emergency. In reality, bearing producers would probably face an extremely tightened market for bearing quality steels. This tightening would arise as a result of a combination of factors including: a) rising demand for bearing steels due to the industry's own expansion; b) a logistically related decline in steel imports; and c) a domestic bearing steel manufacturing capacity that according to survey comments is inadequate to support the entire industry. Experience during World War II found that the location and distribution of limited supplies of bearing quality steels was "one of the most exacting problems" encountered in the war production effort.[4]

An initial analysis of the domestic bearing steel capabilities suggests that some idled capacity is still available in the U.S. in the event of an increase in demand. However, bringing this capacity on line will require time and cost.[5]

3. Equipment Requirements

Firms were asked to identify equipment that would be most critical to their ability to expand production during a national emergency. They were also asked for the domestic availability and lead times associated with this equipment.

Grinding Machinery for grinding ring surfaces was the most frequently cited equipment required for expansion. Lead times varied from as low as 8 months to as high as 50 months for delivery of new equipment. With few exceptions, this machinery is all available from domestic sources.

Turning equipment was the second most frequently cited equipment and lead times for these items varied from 6 to 12 months. Some of this machinery is highly specialized depending on the bearing manufacturing technology being used, the size, and the type of bearing being produced.

Heat Treating equipment was also frequently cited as a requirement for expanded production. Like grinding and turning

---

[4]Ibid. p.1.

[5]Ibid. Once again, the experience during World War II is instructive. During that period, planners discovered that it was extremely difficult to quantify steel requirements ahead of time. This led many bearing firms to secure adequate material supplies by overstating requirements.

equipment, the through-put time in heat treating equipment is limited by the physical capacity of the equipment. Beyond a certain point, heat treating equipment becomes a bottleneck that can be removed only by adding new heat treating capacity.

Automatic assembly equipment was also identified as an important element in expanding production for higher volume part numbers. Although, no estimated lead times were given, this kind of equipment is customized to assemble specific bearing types and sizes. It is, therefore, likely that extensive lead times will be encountered in sourcing automatic assembly equipment. In addition, where a manufacturing process is proprietary and/or a foreign manufacturer is involved, the assembly equipment may also require foreign sourcing.

Testing equipment is another important factor in expanding production. Equipment used in statistical process control and other monitoring and gauging devices are critical to the production of high quality bearings for defense use.

Other equipment cited in the survey as needed included: blank/chop/head equipment, gear cutting machines, ball grinders, cold headers, power presses, forging equipment, transfer presses, washing equipment, and CAD/CAM equipment.

The lead times provided in the survey involve estimates based on peacetime procurement experience. This experience clearly shows that it is difficult even under peacetime demand conditions to find domestic sources with adequately short lead times for some equipment, particularly numerically controlled machine tools. Despite the obvious importance of the bearing industry to the defense industrial base, it is certain that bearing firms will face fierce competition for limited supplies of machine tools from machinery and equipment manufacturers which would also be expanding production. This fact implies that production expansion capabilities based on peacetime availability of machinery inputs will lead to optimistic predictions.

c. Production Bottlenecks

Firms were asked to identify and rank the severity of bottlenecks that would be encountered during an emergency expansion of production in seven basic manufacturing operations. They were also asked to provide an estimate of the time and cost required to remove these bottlenecks. Results, ranked by importance, are summarized in Table VI-4 on the following page.

Information relating to bottlenecks should be used with caution since processes vary among product types and between bearing manufacturers. Nevertheless, survey results strongly suggest that the grinding and turning stages are the most

critical production bottlenecks. According to these results, manufacturers will be limited in their expansion capabilities by the capacity of existing grinding and turning equipment. Furthermore it will take each firm on average about a year and half and $4.5 million per plant to remove these bottlenecks.

Skilled labor was also cited as a bottleneck in nearly every manufacturing operation. Higher tolerances demanded of defense bearings will lead to even greater demands for skilled labor and worker training to remove labor-related production slowdowns and bottlenecks.

Table VI-4

Frequently Cited Bottlenecks

Operation	Bottlenecks
1. Machine Tools:	Grinding machines Turning machines Skilled labor
2. Heat Treating:	Equipment/Capacity Skilled labor
3. Other:	Skilled production workers Availability of steel Tooling Press forming Heading Drilling Engineering/Design staff
4. Assembly:	Automated assembly machines Skilled labor Fixturing
5. Polishing/Lapping:	Microfinishing capacity Skilled labor
6. Parts/Components:	Bearing steel Balls and Rollers Retainers and Seals
7. Calibration/Testing /Inspection:	Skilled Labor Testing Equipment and Gauges

Source: Section 232 Producers Survey

Other bottlenecks are found in parts supply and manufacture. A number of firms out-source components such as rolling elements, retainers, and seals. Restricted supplies of these components during a national emergency would be likely to create a bottleneck during production expansion. Raw materials such as steel wire and rod may be subject to similar short supplies.

Testing equipment and laboratories, engineers, and product and process designers will also be required. Inability to find adequate staff, or to train in new techniques may create another bottleneck.

d. Ability to Alter Product Mix

1. Converting from Regular to Superprecision

Conversion to production of superprecision bearings can take anywhere from 6 months to 3 years. The controlling factor in conversion is the availability of sufficient numbers of trained production workers and adequate quantities of machine tools and peripheral equipment capable of producing to the higher tolerances required in superprecision bearings. In some cases, much of this equipment can be obtained by converting existing machine tools to superprecision production. However, the retooling, regauging, and other modifications involved in this conversion could take several years to complete. In other cases, entirely new equipment must be purchased and installed.

In either case, labor will pose a considerable limit on the speed and volume of the conversion. Production workers will require extensive training that could take as long as 6 months, and this training could not commence until after new equipment is installed and operational or old equipment has been completely converted.

Processing of superprecision bearings is slower than for regular precision bearings. Plants converting to superprecision bearing production could expect to see capacity declines on the order of 20 to 40 percent.

2. Converting Between Sizes of Bearings

Bearing manufacturing equipment can produce bearings only in a restricted range of sizes due to the physical limitations of the equipment. As a general rule the breadth of this range rises as the bearing size increases and lot size decreases. Equipment used to produce high volume instrument bearings, for example, cannot be converted to production of bearings with outside diameters larger than 100mm.

Converting to larger- or smaller-sized bearings within the equipment's defined range requires retooling and set up of equipment and appropriate retraining of production workers. This could take from 3 to 6 months or more.

Converting to production of bearings in sizes falling outside of existing equipment size ranges is virtually impossible. To accomplish such a conversion on a plant level would require the purchase of new equipment and its set up, and the retraining of production workers to operate the new equipment.

3. Fungibility of Equipment Between Bearing Types

Radically altering the size of bearings to be produced in a given plant would necessitate the purchase of entirely new equipment, the introduction of new processing technologies, possibly new raw material inputs, and the retraining of labor. The costs associated with these factors suggest that the construction and set up of an entirely new production facility may be a better alternative.

In converting within a given size range, the primary stages of "green" machining and turning of rings is a process that is essentially universal to all ball bearing types below 100mm.[6] Variations, such as stamping of rings, do exist however. Larger ball bearing types generally require rings that are forged rather than cut from steel tubing. Medium and smaller sized roller bearing rings are also often cut from steel tubing, however needle bearing rings may be pressed from metal sheets or, depending on the size of the bearing, forged to size.

Secondary stages of grinding, honing, and lapping, which impart precision to the bearing are generally specific to the type and precision of the bearing to be produced. Conversion to new bearing types in these later stages, though possible, would certainly require extensive retooling, gauging, labor retraining, and set up with corresponding cost to the firm both in terms of lead times and financial expenditures. In some cases, conversion of these later stages may require entirely new equipment. The balance of costs and benefits of converting existing equipment in the secondary manufacturing stages as compared to the alternative of setting up an entirely new production facility, depends on the extensiveness of the modifications and retooling.

Production of radically different rolling elements is problematic. The material inputs, machinery, process technologies, and labor skills associated with the production of

---

[6]The vast majority of ball bearings produced and consumed in the United States are of this type.

balls is very different from those associated with the production of various roller types. Firms producing these items in-house would require entirely new equipment, retrained labor, and new sources of raw materials. Those firms presently contracting the production of rolling elements would be required to identify new sources of rolling elements. Both options involve long lead times and expense.

4. Converting from Commercial to Defense Bearings

Defense production is essentially similar to commercial production in terms of the final product produced, and a number of firms surveyed indicated that they already produce or could easily produce these bearings. Defense bearings are generally of higher precision than commercial products however, and a variety of complex specifications may necessitate modifications of machinery, training of labor, and possibly the sourcing of specialty materials. These specifications and the lower volume of typical defense orders leads to a "job shop" production environment with associated costs and lengthened lead times.

e. Constructing New Plants

Firms were asked to estimate the cost of replacing each production facility, the time required to construct and equip the plant, and the time required for the plant to become fully operational.

The total cost of doubling present capacity by duplicating existing plants comes to $3.997 billion. This figure compares with 1987 capacity valued at an estimated $4.113 billion indicating that, given present economic conditions, for every $1 invested in new plant and equipment, we could expect to increase capacity by a roughly equal amount.

The average time required to construct and equip these plants was estimated to be approximately two years (23.6 months) with responses ranging from a low of 8 months for highly automated plants with limited production lines, to four years for firms producing broad product lines and/or superprecision type bearings. The average time required to bring a duplicate plant to full operations was a little less than three years (32 months). The range of responses was from a low of a little over one year (13 months) to a high of five years (60 months).

The question assumed that financing is fully available and that the availability of materials and labor reflects present conditions. Under these assumptions, a little less than three-quarters of the responses indicated that the availability of capital equipment would pose the greatest constraint vis-a-vis

lead times in the duplication of facilities. Within this category, about half the responses indicated that CNC grinding machinery would be particularly prone to long lead times. CNC turning machinery and other machine tools were cited almost as often. Other less often mentioned equipment constraints included heat treating equipment, inspection equipment, and automatic assembly equipment.

After equipment, availability of skilled labor was the most frequently cited constraint on plant duplication. Forty percent of responses in this area cited skilled production workers as the main concern, about one-third cited technical personnel such as engineers, inspectors, and toolmakers as areas of special concern. The Department of Labor notes in this regard, that stockpiling equipment or placing entire moth-balled factories on reserve would be futile due to the severity of labor shortages that are likely to occur. Industry experts interviewed by Labor estimate that in non-crisis times, it would take up to two years to fully staff and train the work force of a newly operational bearings plant.

If equipment is in fact available and adequately trained production workers and support staff are on hand, the bearing industry could duplicate existing capacity and have this capacity on line in about three years. Only two plants reported that they could be fully operational in less than one year - both of these are Japanese-owned, highly automated, and dedicated to a limited number of high volume regular precision product lines. Fully 85 percent of plants would take longer than the two years envisioned in the emergency scenario to become fully operational.

This implies that, even in the unlikely event of full equipment and labor availability, only a fraction of new plant and equipment could be on line by the end of the first war year. Given that equipment availability, particularly CNC machine tools from domestic manufacturers, is likely to be strained to the limits during a national emergency, and that the availability of skilled labor is problematic, the 15 percent figure is optimistic in the extreme.

This information suggests that it would not be a wise course of action to fund or encourage widespread construction of new bearing capacity during a national emergency. Although the U.S. Government did subsidize nearly $100 million in plant expansion and construction during World War II, this capacity took several years to reach production and was dedicated to a less sophisticated product mix.

In today's world, new capacity could not be fully on line in less than two years, and probably would take as much as three years to become fully operational. Experience during World War II suggests that any new plants that may be targeted for

construction during a general mobilization would probably be extremely large integrated facilities. Surveys indicate that the cost of such facilities is in the range of $100 million apiece and that lead times to full operation stretch out to nearly four years. Furthermore, expansion of production to meet emergency requirements at existing facilities will greatly strain available sources of equipment, particularly CNC machine tools, materials, and skilled manpower. This would leave little material for new capacity to draw on.

f. Recent Plant Closings

At least 29 bearing plants have shut down operations over the last ten years. More than half of these plant closings have occurred within the last four years and nine plants have closed in the last two years alone. Seven plants specializing in the production of bearing components have shut their doors since 1980.

Most firms attribute these plant closings to low profitability and loss of market shares due to imports. Although relatively few firms have gone out of the bearing business altogether, the competitive pressures of increased import volumes have apparently forced many firms to restructure their domestic manufacturing operations by dropping entire lines of bearings. Survey data indicates that the commercial ball bearing sector has suffered greater capacity decline in this manner than have roller bearings. Specific examples of tapered, spherical, and cylindrical roller bearing lines being dropped are also evident.

Foreign owned bearing multinationals account for at least a third of the plant closings over the last ten years and these firms account for more than half of the plant closings projected over the next two years in the industry survey. Nearly all of these firms attribute these decisions to shut down individual plants to corporate "restructuring" strategies.

Of seven major plant openings projected over the next two years, all but one is being undertaken by a foreign owned multinational. In some cases, these openings are designed to relocate and/or consolidate production formerly carried out in other domestic plants. In other cases, for example American Koyo's planned expansion in South Carolina, the new investment appears to offer an addition to existing bearing production capacity.

VII. FINDINGS AND RECOMMENDATIONS

1. OVERVIEW

The following section reaches findings for the fifteen product categories under investigation regarding the effect of imports on the national security. The determination of individual product findings involves a two-step analysis.

Step 1: Determine whether available supply from mobilization capacity, producers and importers inventories, and reliable imports are sufficient to meet anticipated national security requirements. These determinations are made for a mobilization year and for the first year of a war of indeterminate length, with all inventories available for use during the mobilization year.

Step 2: In product categories where it is found that available supply is insufficient to meet anticipated requirements, determine whether imports represent a significant factor contributing to the supply shortfall.

Establishing a link between imports and capacity shortfalls involves both a) the calculation of the magnitude of imports relative to the total market for that product (import penetration), and b) an analysis of trends in imports and domestic capacity.

Available supply was found to be adequate in the following categories; therefore the Department determined that imports do not threaten to impair the national security:

Regular Precision:

- Thrust Bearings
- Other Ball Bearings
- Tapered Roller Bearings
- Spherical Roller Bearings

Superprecision:

- Ball Bearings Under 30mm
- Ball Bearings 30-100mm
- Ball Bearings Over 100mm
- Cylindrical Roller Bearings

Table VII-1 sets forth a summary of our analysis of the adequacy of emergency supplies and the level of import penetration in each of the fifteen product categories.

Table VII-1

1987 Import Penetration
Shortfalls and Surpluses
(In $1982 Millions)

	Mobilization Year	Year 1	1987 Import Penetration (Unit/Value)
Regular Precision:			
Ball Bearings Under 30mm	- 72	- 41	78% / 58%
Ball Bearings 30-100mm	- 175	- 130	61% / 43%
Ball Bearings Over 100mm	- 6	- 43	49% / 25%
Integral Shaft Bearings		(DELETED)	
Thrust Bearings	16	41	8% / 4%
Other Ball Bearings	110	60	26% / 10%
Tapered Roller Bearings	372	905	38% / 20%
Spherical Roller Bearings	77	147	75% / 18%
Cylindrical Roller Bearings	22	- 23	27% / 21%
Needle Roller Bearings	- 21	- 150	7% / 9%
Other Roller Bearings	- 33	- 221	49% / 24%
Superprecision:			
Ball Bearings Under 30mm	7	18	71% / 33%
Ball Bearings 30-100mm	64	38	13% / 11%
Ball Bearings Over 100mm	87	83	6% / 10%
Cylindrical Roller Bearings	132	190	36% / 11%

Source: DOC calculations based on Section 232 Producers and Importers Surveys, FEMA ROCS Model, and Trade Data

Supply shortfalls were identified for either or both years in the following categories:

Regular Precision:

Ball Bearings under 30mm
Ball Bearings 30-100mm
Ball Bearings Over 100mm
Bearings with Integral Shafts
Cylindrical Roller Bearings
Needle Roller Bearings
Other Roller Bearings

2. INDIVIDUAL SHORTFALL ANALYSES

The following pages present supplemental analysis needed to reach findings for each of these categories.

REGULAR PRECISION BALL BEARINGS UNDER 30mm[1]
($1982 Millions)

	Mob Year	War Year 1
Domestic Capacity	63	73
Producer Inventories	4	--
Importers Inventories	23	--
Total Supply	89	73
Carryover	--	- 72
		1
Domestic Requirements[2]	161	42
Surplus/Shortfall	- 72	- 41

Discussion: Regular precision ball bearings under 30mm accounted for 12 percent of the volume and 3 percent of the value of domestic consumption in 1987.

Total supplies during the mobilization year will cover only approximately 65 percent ($89 million) of that year's requirements ($161 million) -leaving a shortfall of $72 million. Total supplies in the first war year ($73 million) will be sufficient to meet significantly lower requirements ($42 million) in that year. However, backlogged orders from the previous year totalling $72 million are carried over into the first war year's requirements, leaving another shortfall of $41 million in the first war year. Surplus supply of superprecision ball bearings of this type applied to these requirements would reduce the shortfalls but would not eliminate them.

Nearly all bearings are critical pacing items in the manufacture of machinery and equipment -smaller ball bearing types are no exception. Viewed in this context, and considering the wide scope of their application in machinery and equipment, the availability of adequate supplies of ball bearings in the regular precision under 30mm category serves to regulate the overall pace and level of a significant share of industrial output. Large shortfalls in the supply of these bearings during a mobilization could lead to production bottlenecks and a corresponding

---

[1]Note: Totals may not add due to rounding.

[2]Requirements must be met from domestic sources only. The NSC Stockpile Study projections already account for the net effect of imports and exports.

curtailment of defense critical production.

Imports are a factor affecting the industry's inability to meet national security requirements in light of the following facts:

- Domestic shipments declined 17 percent in volume and 22 percent in value between 1978 and 1987 at the same time that domestic consumption increased by more than 40 percent in volume.
- U.S. exports also declined in this period - 11 percent in value terms and 43 percent in volume terms.
- Imports during this period increased by more than 40 percent in value terms and by an even larger 79 percent in unit terms.
- Import penetration has grown steadily, both in unit and value terms, since 1978. As of 1987 import penetration stood at 58 percent in value terms and 78 percent in unit terms.

The Department of Defense is concerned with what has clearly emerged as a long term decline in both domestic manufacturing capacity and shipments of ball bearings under 30mm. In 1971 DOD instituted a Federal Acquisition Regulation requiring that funds be used to purchase only U.S. and Canadian-made ball bearings under 30mm. Despite these procurement provisions, however, the number of domestic manufacturers producing these bearings continued to decline.[3] Only five firms, three of them wholly-owned subsidiaries of foreign multinationals, presently produce these bearings in the United States.

---

[3] Sale of New Hampshire Ball Bearings, Inc to the Japanese-Based Minebea Company, Hearing Before the Subcommittee on Preparedness of the Committee on Armed Services, United States Senate, 98th Congress, Second Session, September 26, 1984.

REGULAR PRECISION BALL BEARINGS 30-100mm[4]
($1982 Millions)

	Mob Year	War Year 1
Domestic Capacity	188	201
Producer Inventories	16	--
Importers Inventories	27	--
Total Supply	230	201
Carryover	--	- 175
		26
Domestic Requirements	405	156
Surplus/Shortfall	- 175	- 130

Discussion: Regular precision radial ball bearings 30-100mm accounted for 13 percent of the units and 8 percent of the value of domestic bearing consumption in 1987.

The total supply of regular precision ball bearings 30-100mm that would be available during a year of mobilization ($230 million) could cover only approximately 57 percent of requirements during that year, leaving a shortfall of $175 million. Carried over into the first war year's requirements, the $175 million in backlogged orders alone would consume roughly 87 percent of the next year's total supply of $201 million. New requirements totalling $156 million added to that figure lead to another shortfall during the first war year totalling $130 million. Surplus supply of superprecision ball bearings of this type applied to these requirements would reduce the shortfalls but would not eliminate them.

The higher volume "commodity" type ball bearing products, which are included in this category, are considered to be the "bread and butter" market of the ball bearing industry[5]. These bearings are used across the economy and in an almost comprehensive range of industrial and commercial machinery and equipment. Defense applications are equally pervasive and these products can be found in critical items from ground transportation to ordnance equipment.

---

[4]Note: Totals may not add due to rounding.

[5]Perhaps the most common generic ball bearing part number, the 6203, is included in this category.

Imports are a factor affecting the industry's ability to meet national security requirements in light of the following facts:

- Since 1982, domestic consumption has risen 28 percent in unit terms and 7 percent in value terms.
- Domestic shipments have increased by only 1 percent in volume terms and actually declined overall by 8 percent in terms of value.
- Imports during this period have captured the entire growth in consumption, increasing 50 percent in volume terms and 38 percent in value terms.
- Import penetration on a value basis has increased from approximately 27 percent of apparent consumption in 1978 to 39 percent in 1987. In unit volume terms import penetration rose from approximately 18 percent in 1978 to more than 37 percent in 1987.

Foreign manufacturers first gained entry into the U.S. ball bearing market in the late 1960's and early 1970's by targeting sales of higher volume regular precision ball bearings in the 30-100mm category - most of these being sold to U.S.-based original equipment manufacturers. As a result, imports of these bearing types have grown almost 50 percent in both value and volume terms since 1978.

The rapid rise of imports in the regular precision ball bearings 30-100mm category during the 1970's prompted Congress, in May of 1975, to substantially increase the import duty on the large volume, low unit-cost bearings in this category. The temporarily salutary effect of this measure ended, however, in 1978 when tariffs were lowered again, and imports rapidly regained their earlier position.

REGULAR PRECISION BALL BEARINGS OVER 100mm[6]
($1982 Millions)

	Mob Year	War Year 1
Domestic Capacity	97	107
Producer Inventories	18	--
Importers Inventories	8	--
Total Supply	122	107
Carryover	--	- 6
		101
Domestic Requirements	128	144
Surplus/Shortfall	- 6	- 43

Discussion: A small ($6 million) shortfall in the mobilization year, totalling less than 1 percent of national security requirements in that year, will be followed by a shortfall of $43 million (about 30 percent of requirements) in the first war year. However, additional supplies of ball bearings in this category drawn from surplus production of superprecision bearings will help in substantially offsetting these shortfalls.

Large regular precision ball bearing types included in this product category cover a wide variety of medium volume and specialty products used in commercial and industrial machinery and equipment. Defense critical uses include heavy ordnance, bomber and cargo aircraft landing gear, and airfield equipment.

In 1987, imports captured about half of the volume and one quarter of the value of domestic consumption in this category. However, the following points must also be noted:

- Domestic shipments increased in 1982-87 and, in terms of units, shipments have grown at an even faster rate than domestic consumption;[7]
- Although exports were off approximately 19 percent in volume terms, the underlying value increased 7 percent - a fact which suggests that U.S. producers are

---

[6]Note: Totals may not add due to rounding.

[7]In volume terms domestic consumption increased 9 percent between 1982 and 1987 while shipments increased by a much larger 21 percent. In value terms the growth rates are comparable.

maintaining capacity in the militarily significant high value end of the market;

- The volume of imported ball bearings over 100mm actually declined (by 6 points) between 1982 and 1987;

BEARINGS WITH INTEGRAL SHAFTS[8]
($1982 Millions)

	Mob Year	War Year 1
Domestic Capacity		
Producer Inventories		
Importers Inventories		
Total Supply		
Carryover		
Domestic Requirements	602	417
Surplus/Shortfall		

Discussion: A shortfall (about percent of requirements) in the mobilization year would be eliminated in the following first war year leaving a surplus supply.

Integral shaft bearings are essential to a variety of defense end uses such as pumping equipment and motorized vehicles.

Imports cannot be considered a factor effecting the industry's ability to meet national security requirements as import penetration in 1987 stood at a very low percent in value terms and percent in volume terms.

[8]Note: Totals may not add due to rounding.

REGULAR PRECISION CYLINDRICAL ROLLER BEARINGS[9]
($1982 Millions)

	Mob Year	War Year 1
Domestic Capacity	130	157
Producer Inventories	16	--
Importers Inventories	13	--
Total Supply	159	157
Carryover	--	22
		179
Domestic Requirements	137	202
Surplus/Shortfall	22	- 23

Discussion: Under present conditions the U.S. will have a 16 percent surplus supply of regular precision cylindrical roller bearings during the mobilization year amounting to $22 million dollars. A modest 11 percent shortfall would occur in the first war year totalling about $23 million. However, significant surplus capacity for superprecision cylindrical roller bearings, if applied to regular precision requirements, would more than offset these shortfalls. Due to the adequacy of domestic supplies there is no need for an assessment of the effect of imports.

[9]Note: Totals may not add due to rounding.

NEEDLE BEARINGS[10]
($1982 Millions)

	Mob Year	War Year 1
Domestic Capacity	319	304
Producer Inventories	39	--
Importers Inventories	8	--
Total Supply	367	304
Carryover	--	- 21
		283
Domestic Requirements	388	433
Surplus/Shortfall	- 21	- 150

Discussion: Shortfalls have been identified in both the mobilization and first war year. A relatively modest ($21 million) shortfall, equal to about 5 percent of requirements, will occur during the mobilization year. A 17 percent decline in available supplies in the first war year due to the depletion of inventories, however, will result in a $150 million shortfall in the first war year (equal to nearly 35 percent of requirements).

Needle bearings used in motor vehicles and other power transmissions would be consumed in large amounts during a national emergency. Consequently, the timing and magnitude of these anticipated shortfalls are a serious concern.

Imports are not a factor effecting the industry's ability to meet national security requirements in light of the following facts:

- In 1982-87, U.S. shipments of needle bearings increased 69 percent in value and 73 percent in volume.
- U.S. exports grew by an equal percentage in the same period.
- U.S. consumption grew by more than 70 percent in both value and volume terms between 1982 and 1987.
- Although imports have risen over the last five years, overall import penetration levels remain very low - 9 percent in value terms and 7 percent in unit volume terms.

[10]Note: Totals may not add due to rounding.

OTHER ROLLER BEARINGS[11]
($1982 Millions)

	Mob Year	War Year 1
Domestic Capacity	241	269
Producer Inventories	33	--
Importers Inventories	14	--
Total Supply	288	269
Carryover	--	- 33
		235
Domestic Requirements	321	456
Surplus/Shortfall	- 33	- 221

Discussion: Supply shortfalls are anticipated in both the mobilization year ($33 million or about 10 percent of requirements) and in the first war year ($221 million or about 48 percent of requirements). This category is the "catch all" basket for roller bearings that are not classified under one of the other categories. They include a variety of bearing types with direct and indirect military applications. Mounted roller bearings, however, account for nearly 70 percent of this category and many of these are tapered and spherical roller bearings with cast or forged mountings attached. The projected shortfalls in this category can therefore be overcome through use of ample surplus tapered roller and spherical roller bearing capacity.[12]

---

[11]Note: Totals may not add due to rounding.

[12]Surplus tapered roller bearing capacity would total $372 million in the mobilization year and $905 million in the first war year.

3. FINDINGS AND RECOMMENDATIONS:

Findings

The Department finds that, at the present time, the domestic bearing industry would be able to meet most but not all national security requirements in the event of a major conventional war. Further, imports continue to pose significant challenges to domestic manufacturers in a number of product lines which can lead to the further erosion of domestic production capabilities. The Administration is currently taking a number of steps to improve the bearing industry's production capabilities including the DOD draft Federal Acquisition Regulation (FAR) that will require domestic procurement of all defense-related bearings.

Recommendations

The Secretary of Commerce recommends that the President defer making a finding in this investigation or take any action under Section 232 until the effect of these initiatives on the bearing industry's ability to meet national security requirements has been evaluated by the Departments of Commerce and Defense.