SCOREBOARD INDICATORS '94

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
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FOREWORD

This report was prepared by the Economic Analysis and Statistics Division of the Directorate for Science, Technology and Industry of the OECD for the Technology Administration, US Department of Commerce. It is a document describing the data and methodology for the construction of *Scoreboard indicators* at the level of individual industries and industry groupings for OECD countries. These indicators were constructed on the basis of data in a number of OECD databases, namely STAN, ANBERD and COMTAP. The data do not represent official Member country submissions and are produced on the responsibility of the Secretariat.

The indicators described in this report cover four broad areas: (i) international trade; (ii) industrial structure and performance; (iii) business-enterprise R&D; (iv) employment and productivity; and (v) physical investment. In international trade, they address the question of trade specialisation and performance in international markets. Industrial structure and performance is explored through indicators of the importance of the manufacturing industry in the economy of OECD countries, the industrial composition of manufacturing, the weight of different countries in OECD production by industry, and the relative growth performance of industries. In industrial R&D, indicators examine the distribution of business enterprise research and development efforts within and across OECD countries, the intensity of R&D, and the relationship of investment in R&D to physical investment. Employment and productivity indicators cover employment and compensation structure by industry, labour costs and labour productivity. Finally, indicators of physical investment address the issue of the distribution of investment efforts by manufacturing industry and the intensity of investment in production and employment.

The OECD Secretariat has put in considerable effort to ensure the quality and international comparability of the underlying data and the derived indicators, which have all been put through a number of diagnostic tests. In certain indicators, individual points have been omitted because of problems in the underlying data. This is particulary the case in certain 3-digit and 4-digit industries, especially in smaller countries. Nevertheless, as with any such work, it is possible that undiscovered problems remain. As the STAN and ANBERD databases on which the indicators are based are experimental and under constant development, the OECD Secretariat would be grateful for any feedback from users on any problems that are discovered.

NOTE ON DISKETTES

The indicators are contained in a series of diskettes, where each file is in DIF format and relates to the time series of a particular indicator for a given country. Thus, for example, the file **XMSO14.DIF** represents the time series between 1970 and 1992 of export market shares across the OECD (indicator code **XMSO**) for Japan (country code **14**). For indicators that were calculate in both national currencies and in PPPs, the file name will include a **P** at the end in the PPP case. Thus, **ULC** represents unit labour costs calculated in national currencies and **ULCP** unit labour costs calculated from data converted into US dollars using PPPs.

For each indicator, the different country (and country groupings) files have been zipped together into a self-executable file which "explodes" into the constituent DIF files when its name is typed. Thus, for example, the export market shares indicator is **XMSO.EXE** which explodes into the XMSO01.DIF,XMSO02.DIF,...etc. country files whn yoy type **XMSO**.

I. LIST OF INDICATORS

Area I. International trade

1. Export market shares
2. Export specialisation
3. Export share of production
4. Industrial composition of manufacturing exports
5. Import specialisation
6. Import penetration
7. Export import ratio
8. Trade balance as a share of GDP
9. Intra-industry specialisation
10. Exposure to competition

Area II: Industrial structure and performance

11. Production shares across the OECD-19
12. Share of GDP contributed by manufacturing
13. Share of GDP contributed by manufacturing (constant prices)
14. Value added shares in manufacturing
15. Value added shares in manufacturing (constant prices)
16. Relative growth performance

Area III: Business enterprise R&D

17. Industry R&D shares across the OECD
18. Industry distribution of R&D within a country
19. R&D intensity (using value-added data)
20. R&D intensity (using production data)
21. Industrial R&D and physical investment

Area IV. Employment and productivity

22. Employment composition of manufacturing
23. Labour compensation per employee by industry
24. Labour compensation per employee by industry (in US PPPs)
25. Labour productivity
26. Labour productivity (in US PPPs)
27. Relative labour productivity performance
28. Unit labour cost
29. Unit labour cost (in US PPPs)
30. Relative unit labour cost
31. Labour share of value added

Area V. Physical investment

32. Investment composition of manufacturing
33. Investment intensity
34. Investment per employee

II. DATA SOURCES

The *Scoreboard Indicators 1994* are created from data contained in the following OECD databases: the STAN database, the Analytical Business Enterprise R&D Database (ANBERD), and the Compatible Trade and Production (COMTAP) Database. The STAN and ANBERD databases are produced by the Directorate for Science, Technology and Industry while the COMTAP database is maintained by the Statistics Directorate of the OECD.

The STAN database

The STAN Industrial Database was created to fill the gap that exist between detailed data collected through industrial surveys, which lacks international comparability, and national accounts data that are internationally comparable but only available at fairly aggregate levels. Through the use of an estimation technique, the OECD Secretariat has created a national accounts compatible database. Unlike many OECD databases which are based on submissions from Member countries, the STAN database is an estimated database. STAN is not composed of Member countries' official data because national accounts data at a detailed sectorial level do not usually exist or are not available because of confidentiality restrictions.

The STAN database has recently been updated and four new OECD countries have been added (Austria, New Zealand, Portugal, and Spain) bringing the total number of countries to twenty. There are nineteen OECD countries including Mexico and one non-OECD country, Korea. One new variable has been added (constant price value added in 1985 prices) and the time series have been extended through 1993 for most countries. The constant price value added series are available for 16 of the nineteen OECD countries at the three and four digit ISIC levels. The STAN estimates for production, value added, number engaged and labour compensation were extended to 1993 based on a *nowcasting* technique which extended the STAN estimates to the present time period using short term indicators such as indices of production and employment and producer price indices. Many of the current price national accounts compatible series have been revised due the availability of national accounts data submitted directly to STAN and improvements have been made for specific variables in several of the G-7 countries (France, Germany, Italy, and Japan).

The ANBERD database

The ANBERD database contains business enterprise expenditure on R&D performed (BERD) by industry. This OECD database contains OECD estimates and differs significantly from official data for a number of countries. ANBERD was constructed with the objective of creating a consistent data set that overcomes the problems of international comparability and time discontinuity associated with official BERD provided by OECD Member countries. The ANBERD data set for each country is constructed in close collaboration with national statistical authorities. The database has recently been updated and contains R&D expenditure data from 1973 to 1992 for twelve of the largest OECD R&D performing countries.

The COMTAP database

Trade data extracted from the COMTAP database are also used in the construction of the Scoreboard indicators. The trade portion of the COMTAP database contains flows by ISIC, Rev. 2 category. These data have been converted from the Standard International Trade Classification (SITC), Rev. 1,2 and 3 (depending upon the year concerned). The conversion from the SITC commodity classification to the ISIC industry classification is not exact because many SITC commodities can be produced by two or more ISIC industries.

The OECD Secretariat has developed a conversion table that distributes a fixed percentage of each multi-industry commodity to a corresponding ISIC industry. Due to the inexactness of the conversion process

the export and import data may have inconsistencies across sectoral aggregations. For instance, the aggregation of the lower level ISIC industries are not always equivalent to higher levels of ISIC and the trade data may not be strictly comparable with trade flows published in other sources. The COMTAP trade data were not subject to the same review process as were the ANBERD and STAN data.

***** A note of caution *****

Although each of these three data sets are based on the International Standard Industrial Classification, Revision 2 (ISIC, Rev. 2), some problems have been discovered in indicators that are composed of STAN and COMTAP trade data. This is due in part to the process by which the trade data are converted to the ISIC, Rev. 2 classification as discussed above, and in part due to the inclusion of re-exports in trade data which can make the exports of certain industries exceed their production. A note of caution is also warranted for indicators produced with the STAN industrial variables at the 4-digit ISIC detail, especially for smaller countries. These sectors tend to be the weakest in STAN and they often represent survey level data. Survey level data are used as a substitute in cases when national accounts compatible estimates cannot be produced. The survey level data are used to indicate the relative trend and magnitude of the series.

III. COUNTRY COVERAGE

The indicators were constructed so that comparisons may be made on an individual country and industry basis or at an aggregate level based on country groupings and industry groupings. In most instances, the indicators are available by individual country, individual industry, country group and industry group. It must be noted, however, that at times the underlying data does not permit the construction of either the country or industry groups. The following is an explanation of the country and industry coverage used in the construction of the SCOREBOARD indicators. The country codes used in the electronic files are indicated next to each country.

Country coverage

Countries for indicators composed of production, value added, gross fixed capital formation, number engaged, and labour compensation.

Country code	
01	Australia
02	Austria
03	Belgium
05	Canada
06	Denmark
07	Finland
08	France
09	Germany
13	Italy
14	Japan
26	Mexico
16	Netherlands
17	New Zealand
18	Norway
19	Portugal
20	Spain
21	Sweden
24	United Kingdom
25	United States

Countries for indicators constructed with value added in 1985 prices.

Code	
01	Australia
02	Belgium
05	Canada
06	Denmark
07	Finland
08	France
09	Germany
13	Italy
14	Japan
26	Mexico
16	Netherlands
18	Norway
19	Portugal
21	Sweden
24	United Kingdom
25	United States

Countries for indicators constructed solely of trade data.

Code	
01	Australia
02	Austria
03	Belgium
05	Canada
06	Denmark
07	Finland
08	France
09	Germany
10	Greece
11	Iceland
12	Ireland
13	Italy
14	Japan
	Luxembourg (included in Belgium; trade data are for Belgium/Lux.)
26	Mexico
16	Netherlands
17	New Zealand
18	Norway
19	Portugal
20	Spain
21	Sweden
22	Switzerland
23	Turkey
24	United Kingdom
25	United States

Country groups

Codes

31	Australasia:	Australia and New Zealand.
29	EC-12:	Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and the United Kingdom.
32	G-7:	Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.
33	Nordic-4:	Denmark, Finland, Norway, Sweden.
30	North America:	Canada, Mexico, and the United States.
		NOTE: This grouping consists only of the United States and Canada for all trade and business-enterprise R&D indicators.
34	OECD-12:	Australia, Canada, Denmark, Finland,France, Germany, Italy,Japan, the Netherlands, Sweden, the United Kingdom and the United States.
		NOTE: this grouping is used for indicators which are composed of ANBERD R&D data.
34	OECD-16:	Australia, Belgium, Canada, Denmark, France, Finland, Germany, Italy, Japan, Mexico, the Netherlands, Norway, Sweden, the United Kingdom and the United States.
		NOTE: this grouping is used for indicators which are composed of constant price value added data.
35	OECD-19:	Australia, Austria, Belgium, Canada, Denmark, France, Finland, Germany, Italy, Japan, Mexico, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States.
36	OECD-24:	Australia, Austria, Belgium, Canada, Denmark, France, Finland, Germany, Greece, Iceland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.
		NOTE: this grouping can only be obtained with the trade indicators.

III. INDUSTRY COVERAGE

The industry groups are based on the ISIC, Rev. 2 classification. In addition to individual industries, industry groups were created in three categories: technology-based, wage-based and orientation-based industries.

Industrial coverage of the classification schemes

ISIC Revision 2 Classification - 26 Industries

ISIC Rev. 2	*Classification Description*
3000	Total manufacturing
3100	Food, beverages & tobacco
3200	Textiles, apparel & leather
3300	Wood products & furniture
3400	Paper, paper products & printing
3500	Chemical products
3510+3520-3522	Chemicals excl. drugs
3522	Drugs & medicines (pharmaceuticals)
3530+3540	Petroleum refineries & products
3550+3560	Rubber & plastic products
3600	Non-metallic mineral products
3700	Basic metal industries
3710	Iron & steel
3720	Non-ferrous metals
3800	Fabricated metal products
3810	Metal products
3820-3825	Non-electrical machinery
3825	Office & computing equipment
3830-3832	Electrical machines excl. comm. equip.
3832	Radio, TV & communication equip.
3841	Shipbuilding & repairing
3843	Motor vehicles
3845	Aircraft
3842+3844+3849	Other transport equipment
3850	Professional goods (scientific instruments)
3900	Other manufacturing, nec

Industrial coverage of the industry groupings

Technology based industry groups

This industry grouping is constructed on the basis of R&D intensities and follows the standard OECD definition of high, medium and low technology industries, established in 1986 using 1980 data. An analysis conducted in 1991 using different databases (STAN and ANBERD) and a different selection of countries than the work done in 1986, reconfirmed the technology groupings. The work indicated that the ranking of industries of the industries is relatively stable over time and would not change significantly if more recent data were used. [See OECD (1992), *Industrial Policy in OECD Countries - Annual Review*, Paris.]

High technology industries

3522	Drugs & medicines (pharmaceuticals)
3825	Office & computing equipment
383-3832	Electrical machines excluding communications equipment
3832	Radio, tv and communication equipment
3845	Aircraft
3850	Professional goods (scientific instruments)

Medium technology industries

351+352-3522	Chemicals excluding drugs
355+356	Rubber & plastic products
3720	Non-ferrous metals
382-3825	Non-electrical machinery
3842+3844+3849	Other transport equipment
3843	Motor vehicles
3900	Other manufacturing

Low technology industries

3100	Food, beverages & tobacco
3200	Textiles, apparel & leather
3300	Wood products & printing
3400	Paper, paper products & printing
3553+354	Petroleum refineries & products
3600	Non-metallic mineral products
3710	Iron & steel
3810	Fabricated metal products
3841	Shipbuilding and repairing

Wage based industry groups

This classification of industries was based on the average labour compensation across nine countries for 1985. The average was calculated using PPPs. The high wage group was defined as industries in which the wage was mor than 15 percent above the median and the low wage group contains industries in which the wage was at least 15 percent below the median wage. These groupings were tested for two other time periods and for additional country groupings where the data were available. These groupings appear to be quite stable. The only industries which move between groupings are iron & steel and other transportation equipment.

High wage industries

351+352-3522	Chemicals excluding drugs
3522	Drugs & medicines (pharmaceuticals)
3553+354	Petroleum refineries & products
3825	Office & computing equipment
3843	Motor vehicles
3845	Aircraft

Medium wage industries

3400	Paper, paper products & printing
355+356	Rubber & plastic products
3600	Non-metallic mineral products
3710	Iron & steel
3720	Non-ferrous metals
3810	Fabricated metal products
382-3825	Non-electrical machinery
3832	Radio, tv and communication equipment
3841	Shipbuilding and repairing
3850	Professional goods (scientific instruments)

Low wage industries

3100	Food, beverages & tobacco
3200	Textiles, apparel & leather
3300	Wood products & printing
383-3832	Electrical machines excluding communications equipment
3842+3844+3849	Other transport equipment
3900	Other manufacturing

Orientation based industry groups

This classification is based on one developed for the OECD (1987) *Structural Adjustment and Economic Performance*. The scheme was originally developed for dividing manufactured trade into groups on the primary factors that affect the competitive process: access to natural resources (resource-intensive group); labour costs (labour-intensive group), length of production runs (scale-intensive group); differentiated products (specialised-supplier group); rapid application of scientific advances (science-based group).

Resource intensive

3100	Food, beverages & tobacco
3300	Wood products & printing
353+354	Petroleum refineries & products
3600	Non-metallic mineral products
3720	Non-ferrous metals

Labour intensive

3200	Textiles, apparel & leather
3810	Fabricated metal products
3900	Other manufacturing

Scale intensive

3400	Paper, paper products & printing
351+352-3522	Chemicals excluding drugs
355+356	Rubber & plastic products
3710	Iron & steel
3842+3844+3849	Other transport equipment
3843	Motor vehicles

Specialised supplier

382-3825	Non-electrical machinery
383-3832	Electrical machines excluding communications equipment
3832	Radio, tv and communication equipment

Science based

3522	Drugs & medicines (pharmaceuticals)
3825	Office & computing equipment
3845	Aircraft
3850	Professional goods (scientific instruments)

IV. DEFINITIONS OF THE INDICATORS

This section gives the notation of the underlying variables and the algebraic formulation of the scoreboard indicators. It also gives some explanations of their interpretation, limits and potential problems. The electronic file name given to each indicator is shown next to the title in each case.

Notation

The following notation is used in the presentation of the formulae of the SCOREBOARD indicators.

i = industry
k = country
t = time;
totecon = total economy
BERD = Business enterprise R&D data in current prices
EMPN = number engaged
EXP = exports in current prices
GFCF = gross fixed capital formation in current prices
IMP = imports in current prices
KVALU = value added in 1985 prices
LAB = labour compensation in current prices
PROD = production in current prices
VALU = value added in current prices

Area I. International trade

Indicators in this area address the question of trade specialisation and performance in international markets. Country groupings include intra-group trade (thus for example the EC group does not exclude intra-EC trade). The country grouping North America comprises Canada and the United States as trade data for Mexico are not available. The data presented for Belgium actually represent trade for Belgium/Luxembourg.

Indicator 1. Export market shares **XMSO**

Exports refer to exports to the world. Export market shares are calculated as exports of a certain industry for a given country (or country group) as a proportion of exports of this industry for the OECD-24 as a whole. For each industry and industry grouping, summing across all OECD countries equals 100 per cent. The data were converted to US dollars using exchange rates prior to calculation.

$$EXP^k_i / \sum_k EXP^k_i$$

Indicator 2. Export specialisation **XSPEC**

Exports refer to exports to the world. This indicator shows the proportion of a country's (or country group) exports in an industry in total manufacturing exports for that country divided by the OECD-24 exports of the same industry as a fraction of the OECD-24 total manufacturing exports. For a given country, a value above 100 in a certain industry implies that, relative to the OECD average, the country is specialised in exports of that industry. The data were converted to US dollars using exchange rates for trade prior to calculation. The indicator is also commonly known as the *revealed comparative advantage index.*

$$[(EXP^k_i / \Sigma_i EXP^k_i) / (\Sigma_k EXP^k_i / \Sigma_i \Sigma_k EXP^k_i)] * 100$$

Indicator 3. Export share of production **XPROD**

Export share of production is the ratio of exports in a given industry to production in that industry. The export and production data were converted to US dollars using exchange rates for calculation of the country and industry groups.

$$EXP^k_i / PROD^k_i$$

Indicator 4. Industrial composition of manufacturing exports **XSH**

Industrial composition of manufacturing exports is calculated as exports in a given industry for a given country divided by total manufacturing exports for that country.

$$EXP^k_i / \Sigma_i EXP^k_i$$

Indicator 5. Import specialisation **MSPEC**

Imports refer to imports from the world. This indicator shows the proportion of a country's (or country group) imports in an industry in total manufacturing imports for that country divided by the OECD-24 imports of the same industry as a fraction of the OECD-24 total manufacturing imports. For a given country, a value above 100 in a certain industry implies that, relative to the OECD average, the country is specialised in imports of that industry. The data were converted to US dollars using exchange rates for trade prior to calculation.

$$[(IMP^k_i / \Sigma_i IMP^k_i) / (\Sigma_k IMP^k_i / \Sigma_i \Sigma_k IMP^k_i)] * 100$$

Indicator 6. Import penetration **MPEN**

This indicator is calculated as the ratio of imports to total domestic demand (production plus imports minus exports) for industries, industry groupings, and total manufacturing. The calculation is limited to eighteen countries due to the unavailability of trade data for Mexico. Some 3-digit and 4-digit industry detail has

been omitted because of problems with incompatibility between production and trade data, particularly in smaller countries.

$$[(IMP^k_i) / (PROD^k_i+IMP^k_i-EXP^k_i)] * 100$$

Indicator 7. Export import ratio **XM**

The export import ratio is calculated as the ratio of exports in a certain industry to imports in that industry. The trade data in country groupings and for the OECD-24 total include intra-group trade.

$$EXP^k_i/IMP^k_i$$

Indicator 8. Trade balance as a share of GDP **TBAL**

Trade balance as a share of GDP is calculated as exports of a given industry minus imports in that industry divided by GDP in current prices for the total economy. National currencies were used in the calculation of individual countries and data converted with exchange rates to US dollars were used for the calculation of the country groups.

$$(EXP-IMP)^k_i / GDP^k$$

Indicator 9. Intra-industry specialisation **IIT**

Intra-industry trade is the value of total trade remaining after subtraction of the absolute value of net exports or imports of an industry. For comparison between countries and industries, the measures are expressed as a percentage of each industry's combined exports and imports. For total manufacturing, the calculation is the summation of the value of total trade remaining after subtraction of the absolute value of net exports or imports for all manufacturing industries.

For individual industries:

$$[1 - |(EXP^k_i - IMP^k_i)|/(EXP^k_i + IMP^k_i)] * 100$$

For total manufacturing:

$$[1 - \sum_i|(EXP^k_i - IMP^k_i)|/ \sum_i(EXP^k_i + IMP^k_i)] * 100$$

Indicator 10. Exposure to competition **XMCOMP**

This indicator is based on the premise that the share of output that is exported suffers from 100 percent exposure while exposure of the share sold on the domestic market is proportional to the rate of import penetration into that market.

$$EXP^k_i/PROD^k_i + [1-EXP^k_i/PROD^k_i][IMP^k_i/(PROD^k_i+IMP^k_i-EXP^k_i)]$$

Area II: Industrial structure and performance

Indicators in this area address the issues of the importance of the manufacturing industry in the economy of OECD countries, the industrial composition of manufacturing, the weight of different countries in OECD production by industry, and the relative growth performance of industries.

Indicator 11. Production shares across the OECD-19 **PDSO**

This indicator has been calculated as production in a certain industry for a given country (or country grouping) as a proportion of production for the OECD-19 in this industry. For each industry, summing the shares across the 19 OECD countries included in the calculation yields 100. The data were converted to US dollars using PPPs prior to calculation. For some industries and industry groups, the OECD-19 group may not contain for data all 19 countries.

$$PROD^k_i / \sum_k PROD^k_i$$

Indicators 12 and 13. Share of GDP contributed by manufacturing **MGDP** and **MGDPK**

This indicator is calculated as the value added contributed by all manufacturing sectors divided by the value added of the economy. The calculations were made in both current and constant prices. More country groups were possible in the construction of this indicator in current as opposed to constant prices.

1. $\sum_i VALU^k_i / VALU^k_{totecon}$

2. $\sum_i KVALU^k_i / KVALU^k_{totecon}$

Indicators 14 and 15. Value added shares **VASH** and **VASHK**

The value added shares indicator is calculated by dividing each sector's value added by the total value added of the manufacturing sector and converting this ratio to a percentage. Summing the shares for all manufacturing industries yields 100. These calculations were made in both current and constant prices. More country groups were possible in the construction of this indicator in current as opposed to constant prices.

1. $(VALU^k_i / \sum_i VALU^k_i) * 100$

2. $(KVALU^k_i / \sum_i KVALU^k_i) * 100$

Indicator 16. Relative growth performance **RPROD**

For a given industry in a certain country, the relative growth performance indicator is calculated as actual growth in constant-price value-added less expected growth. Expected growth refers to the growth of that industry across countries, the growth in manufacturing as a whole in the country in question and the overall manufacturing growth in all countries. This indicator was calculated with constant price value added and labour productivity (see area IV).

actual growth - expected growth

$$gX^k_i - [g\Sigma_k X^k_i + g\Sigma_i X^k_i - g\Sigma_i\Sigma_k X^k_i]$$

Gx^k_i represents the actual growth of a sector in a country

$g\Sigma_k X^k_i$ represents the average growth of a sector across all countries

$g\Sigma_i X^k_i$ represents the average growth of a country across all sectors

$g\Sigma_i\Sigma_k X^k_i$ represents the average growth of all countries across all sectors

$$gKVALU^k_i - [g\Sigma_k KVALU^k_i + g\Sigma_i KVALU^k_i - g\Sigma_i\Sigma_k KVALU^k_i]$$

Area III: Business enterprise R&D

Indicators in this area address the question of the distribution of business enterprise research and development efforts within and across OECD countries, the intensity of R&D, and the relationship of investment in R&D to physical investment.

Indicator 17. Industry R&D shares across the OECD **RDSO**

Industry R&D shares for one OECD country are calculated as business enterprise R&D in a certain industry for a given country (or country group) as a proportion of the business enterprise R&D for the group of twelve OECD countries for this industry. Summing industry shares across the 12 OECD countries included in the calculation yields 100. These shares are calculated using data converted to US dollars using purchasing power parities (PPPs) for GDP.

$$ANBERD^k_i/\Sigma_k ANBERD^k_i$$

Indicator 18. Industry distribution of R&D within a country **RDS**

This indicator is calculated by dividing the R&D performed by an industry (or industry group) by the total manufacturing R&D expenditure for that year in the specific country (or country group). Summing shares across all manufacturing industries yields total manufacturing R&D.

$$ANBERD^k_i/ANBERD^k_{man}$$

Indicator 19 and 20. R&D intensity **RDIP** and **RDIV**

R&D intensities have been calculated in two ways. The first calculation divides the R&D performed by an industry (or industry grouping) by its value added while the second divides the R&D performed by production.

1. $ANBERD^k_i/PROD^k_i$
2. $ANBERD^k_i/VALU^k_i$

Indicator 21. Industrial R&D and physical investment **RDINV**

This indicator is calculated by dividing the R&D performed in an industry by investment (gross fixed capital formation) in that industry.

$$ANBERD^k_i / GFCF^k_i$$

Area IV. Employment and productivity

Indicators in this area address the issue of employment structure and compensation, labour costs and labour productivity. The employment data represent number of persons engaged except for Austria where data the rata represent number of persons employed.

Indicator 22. Employment composition of manufacturing **EMPSH**

The employment composition of manufacturing indicator is calculated by dividing each sector's employment by total manufacturing employment and converting this ratio to a percentage. Summing the shares across all manufacturing industries yields 100. This calculation was made for each sector within a given country, for each sector within the OECD-19 and for each sector in the various country groupings.

$$(EMPN^k_i/EMPN^k_{man}) * 100$$

Indicators 23 and 24. Labour Compensation per employee by industry **LABEMP** and **LABEMPP**

Labour compensation per employee is calculated as the ratio of labour compensation for a particular industry (or industry group) to the number engaged divided by the ratio of labour compensation of total manufacturing to number engaged for total manufacturing. Labour compensation data were converted to US dollars using PPPs for GDP prior to computation.

$$[(LAB^k_i/EMPN^k_i)/(\Sigma_i LAB^k_i/\Sigma_i EMPN^k_i)]$$

Indicators 25 and 26. Labour productivity **LPDTY** and **LPDTYP**

Labour productivity is calculated as constant-price value added divided by the number of employees engaged. Although hours worked could be better than the number engaged for the calculation of labour productivity, at the present time consistent hours data do not exist. This indicator was calculated in both national currencies and in US dollars (PPPs). For some industries and industry groups, the OECD-16 group may not contain for data all 16 countries.

$$KVALU^k_i/EMPN^k_i$$

Indicator 27. Relative productivity performance **RPDTY**

For a given industry in a certain country, the relative productivity performance indicator is calculated as actual productivity growth in constant-price value-added less expected productivity growth. Expected productivity growth refers to the productivity growth of that industry across countries, the productivity growth in manufacturing as a whole in the country in question and the overall manufacturing productivity growth in all countries.

actual growth - expected growth

$$Gx^k_i - [g\Sigma_k X^k_i + g\Sigma_i X^k_i - g\Sigma_i\Sigma_k X^k_i]$$

Gx^k_i represents the actual growth of a sector in a country

$g\Sigma_k X^k_i$ represents the average growth of a sector across all countries

$g\Sigma_i X^k_i$ represents the average growth of a country across all sectors

$g\Sigma_i\Sigma_k X^k_i$ represents the average growth of all countries across all sectors

$$GKVALU^k_i/EMPN^k_i - [g\Sigma_k KVALU^k_i/\Sigma_k EMPN^k_i + g\Sigma_i KVALU^k_i/\Sigma_i EMPN^k_i - \Sigma_i\Sigma_k KVALU^k_i/\Sigma_i\Sigma_k KVALU^k_i]$$

Indicators 28 and 29. Unit labour cost **ULC** and **ULCP**

Unit labour cost has been calculated as the ratio of labour compensation in current prices to constant price value added in a given industry. This indicator was calculated in both national currencies and in US dollars (PPPs) for individual countries.

$$LAB^k_i/KVALU^k_i$$

Indicator 30. Relative unit labour cost **RULC**

Relative unit labour costs are calculated as the unit labour cost for a country and industry divided by the average unit labour cost of the industry for the country's trading partners (proxied by the OECD-16). Labour compensation and constant price value added are converted to US dollars using PPPs prior to calculation.

$$[(LAB^k_i/KVALU^k_i) / (\Sigma_k LAB^k_i / \Sigma_k KVALU^k_i)]$$

Indicator 31. Labour share of value added **LABVAL**

This indicator is calculated by dividing labour compensation in a certain industry by value added in that industry. This indicator was calculated in both national currencies and in US dollars (PPPs) for individual countries.

$$LAB^k_i / VALU^k_i$$

Area V. Physical investment

Indicators in this area address the issue of the distribution of investment efforts by manufacturing industry and the intensity of investment in production and employment. Investment data are not available for Mexico.

Indicator 32. Investment composition of manufacturing **INVSH**

This indicator is calculated by dividing the annual gross fixed capital formation (GFCF) investment expenditures in each individual industry by GFCF for total manufacturing for each country (or group of countries). The GFCF data were converted to US dollars using PPPs for GFCF for the calculation of this indicator for country groups.

$$GFCF^k_i / \Sigma_i GFCF^k_i$$

Indicator 33. Investment intensity **INVI**

Investment intensity is calculated as the ratio of GFCF in a certain industry to production in that industry. This ratio is converted to a percentage. The GFCF data were converted to US dollars using PPPs for GFCF for the calculation of this indicator for country groups.

$$(GFCF^k_i/PROD^k_i) * 100$$

Indicator 34. Investment per employee **INVEMP**

This indicator is calculated as GFCF in a certain industry divided by the number engaged in that industry for a specific country (or country grouping). Although capital stock would be more appropriate than GFCF data, capital stock data at detailed levels are unavailable.

$$GFCF^k_i/EMPN^k_i$$

OECD DOCUMENTS

MANUFACTURING PERFORMANCE:
A SCOREBOARD OF INDICATORS

PUBLISHER'S NOTE

The following texts have been left in their original form to permit faster distribution at lower cost.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971) and New Zealand (29th May 1973). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

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TABLEAUX D'INDICATEURS

Country summaries

By viewing the indicators collectively and juxtaposed against each other, the following general trends emerge:

- The pre-eminence the United States enjoyed across a wide variety of sectors has declined over the past two decades, but the United States still enjoys a considerable lead in many sectors, particularly the high technology industries;

- Where the United States has lost ground, it has usually been Japan who has gained. In many cases these gains have been unusually broad based, emanating from high, medium and low technology sectors. Almost without regard to the indicator chosen, Japan has exhibited the largest change in the indicator over the period, representing a significant structural realignment.

- As Japan has gained, the six EC countries have seen the erosion of their "number two" spot behind the United States. Collectively, the European countries analyzed have had remarkably stable manufacturing performance given the economic shifts that have occurred over the last two decades.

- The remaining countries -- Australia, Canada, Finland, Sweden and Norway -- all tend to be natural resource based economies oriented towards sectors such as food processing, wood and paper, petroleum refining and basic metals. These countries have followed a dual strategy of deepening their specialisation in these natural resource sectors while carving out niches in new, more technologically sophisticated sectors.

The United States

In the early 1970s, the United States held a commanding position relative to 12 of its other competitors: it performed over half of all the group's manufacturing R&D, produced over a fifth of the manufacturing exports and generated nearly two-fifths of the value of manufacturing goods produced in the 13 OECD countries. Although much has been written about the demise of the United States manufacturing base and its loss of competitiveness, it would have been unrealistic to expect the United States to forever retain the preeminent position it held in the early 1970s. Accordingly, the United States's relative position declined across many of these indicators. Nevertheless, it is somewhat surprising that after two decades the losses were not larger. In comparison to the 12 other OECD countries, the US's share of the business enterprise R&D (BERD) fell eight points to 47 per cent (1973 to 1990), its share of manufacturing exports fell three points to 17 per cent (1970 to 1990) and the US share of manufacturing production fell three points to 37 per cent (1970 to 1990). Despite these falls, the United States maintained the largest shares of

business enterprise R&D expenditures and production in 1990, leading even the closest country by 22 and 21 share points respectively. Although its export market share in 1990 was no longer the largest of the 13 countries, it was second only to Germany.

These aggregate changes obscure the more radical shifts that were occurring in individual industries. At this level, the United States did have significant losses in several sectors, particularly those characterised as being medium technology such as the motor vehicle and the non-electrical machinery (i.e. machine tools) industries. In these two industries the United States' share of the export market formed by the 13 OECD countries fell by a third or more over the past two decades. It had a revealed comparative advantage index which was below the average, and falling, in the medium technology group. The United States also witnessed the fastest-rate of increase in import penetration of its manufacturing sector, nearly tripling in 20 years, of any of the 13 countries analyzed. In terms of the overall share of production of the 13 countries, the United States declined in every single medium technology industry. These large sectoral losses in motor vehicles and non-electrical machinery provide the basis for claims of deindustrialization and a loss of competitiveness.[2]

Nevertheless, the United States still holds a significant lead in many indicators and this is particularly true in those industries characterised as being "high-tech:" pharmaceuticals, computers, aircraft, communication equipment and instruments. In 1990, as in 1970, the United States still had the most R&D intensive manufacturing sector of the 13 OECD countries. This is largely because of the large role high technology industries play in the United States. As a group, these industries perform nearly twice as much R&D as the six EC countries combined and three times as much as Japan. Although its lead has been cut, the United States still has the largest share of the high-tech export market of the 13 countries. The United States had the highest, and nearly the same, index of revealed comparative advantage in both 1970 and 1990 for high technology industries. The high technology group of industries was the overwhelming source of manufacturing jobs, adding over a million jobs between 1972 and 1988 while the medium-tech group added nearly 200 thousand and low technology group lost over half-a-million.

By no means is the strength of the United States high-tech sector monolithic. Import penetration into the computer and communication equipment sectors have increased by a factor of five from 1970 to 1990 and the US's export market share in the computer industry fell by 10 points from 1984 to 1990. To some degree, the impressive results for the high technology sector in export market shares, production share and R&D shares across the 13 OECD countries can be attributed to one sector: aircraft.

Japan

Over the course of the last two decades, Japan has made significant strides in its manufacturing performance to the point where it can no longer be considered to be "catching up" but on the front ranks as an equal competitor with the United States and the large Western European countries. This is evident from a number of indicators: Japan was the only country of the 13 analyzed to experience a real increase of its manufacturing sector as a share of GDP, it was one of the few to add manufacturing employment and it had the highest manufacturing labour productivity growth rate. Since the early-1970s, Japan has systematically increased its business enterprise R&D spending, achieving the fastest increase in manufacturing R&D intensity, allowing it to overtake France and the United Kingdom and match the intensity of Germany. Within the

Group of Seven countries (G7), Japan, along with Germany, is now second to the United States, in terms of R&D intensity of the manufacturing sector as a whole, but this is only because of the US's strength in high-tech industries. In the low technology and medium technology groups, Japan has the highest R&D intensity of the 13 countries analyzed. In terms of international trade, Japan registered the largest increase in the share of the 13 countries' exports. Unlike other countries, its increase in import penetration was negligible, resulting in a 1990 manufacturing import penetration rate which is half the rate of the second lowest country, the United States.

These developments are associated with an unusually high degree of structural change. Japan in the last two decades has achieved a much more balanced and less specialized structure than most countries. Its declines have generally occurred in sectors in which it was relatively strong at the start of the two decades and it has seen gains in industries which were relatively weaker in the early 1970s. Japan realigned the sectoral composition of output, employment, investment and exports, away from low technology sectors such as textiles, wood and food and into medium and high technology sectors such as motor vehicles, computers and communication equipment. It's export market share in low technology industries fell by 50 percent from 1970 to 1990 while its share of exports from medium technology sectors doubled and its share in high technology industries grew by more than 50 percent, surpassing Germany as the second largest exporter of high technology products. By 1990, Japan had tripled its share of the 13 countries export market in both motor vehicles and computers while its share of textiles and apparel fell by a factor of three. These results were echoed in the index of revealed comparative advantage where Japan saw the most change of any country analyzed and was the only country of the thirteen to end the 1980s with a RCA index which exceeded the average in both the medium and high technology groups.

The Largest European Countries

As the United States has slipped and Japan has gained, the collective effort of the six European countries has been relatively stable. Relative to the OECD-13 total, the six European Countries' (EC-6: Denmark, France, Germany, Italy, the Netherlands and the United Kingdom) share of manufacturing R&D fell only one point, from 29 to 28 per cent from 1973 to 1990. Its share of export markets was unchanged at 42 per cent from 1970 to 1990 and their index of structural change from 1980 to 1989 was among the lowest measured.

This image of stability varied considerably between countries, with Germany and to a lessor extent France, frequently maintaining a rather stable position while Italy improved its position in many indicators and the United Kingdom fell. The degree of stability also varied between sectors with a general shift occurring out of the high technology sectors and into the low technology industries. For example, the stability in the EC-6's total manufacturing export market shares is attributable to a eight share point gain in low technology industries (i.e. Italian textiles) which offset a two point share drop in medium technology exports (i.e. UK motor vehicles) and a five point drop in the share of high technology exports (i.e. German and Italian computers). France was unique among the six European countries in increasing its export market share in each of the three technology groups. Instead of moving towards the average of 1.0 in the indicator of revealed comparative advantage (RCA) for high technology industry exports, the six EC countries fell from 0.9 in 1970 to 0.8 in 1990. Only the United Kingdom had a significant increase in RCA, but this was offset by declines in Germany, Italy and the Netherlands. On the other hand, Germany and Italy saw significant increases in their low technology RCAs, leading to an EC-6 increase from being at the average in 1970 (1.0) to exceeding the average in 1990 (1.13). These shifts in exports were

accompanied by increases in import penetration, particularly in the high technology sectors in Germany and the United Kingdom. These two countries had larger increase in the penetration of the high technology industries than any other G7 countries.

Compared to the performance of the manufacturing sector of the other countries over the past two decades, the six EC countries, especially the United Kingdom, could be more accurately characterised as deindustrializing than any of the other countries. Of the net loss of 5.6 million manufacturing jobs which occurred across the 13 countries from 1970 to 1988, 6.2 million originated in the six EC countries and almost half of these happened in the United Kingdom. The largest drops in the GDP share contributed by manufacturing occurred in France and the United Kingdom, falling about eight share points each. Only in Italy did manufacturing's real share of GDP stay relatively stable. In terms of labour productivity, when the 1980 to 1989 labour productivity rates of 10 countries are ranked, four of the six EC countries are in the bottom half. Italy and the United Kingdom are the exceptions, but in the case of the United Kingdom most of the productivity boost is due to a shedding of labour, not an above average increase in output.

Australia, Canada and the Nordic Countries

The group of countries whose common feature is a large endowment of natural resources, experienced significant changes over the past two decades. These countries either specialised further in sectors which exploit their natural resources or deepened their effort in sectors where they have a particular market niche. These countries all have above average RCA indices in the low technology group, except for Finland where the index dropped and Sweden where it stayed stable. In terms of export market shares, the sectors with the highest shares within the country in 1990 were the same sectors that had a highest shares in 1970: the food group in Australia, the wood products group in Canada and Denmark, paper products in Finland and Sweden, and basic metals in Norway. These trends are parallelled in the distribution of manufacturing R&D where the low technology group for these countries had a share which was typically twice as big as that held by the low technology sector of France, Germany, Italy, the United Kingdom or the United States. For this reason, a number of these countries had a much higher overall manufacturing R&D intensity when their economic structure was taken into account (the STIBERD indicator) than when it was not: Sweden had the highest manufacturing R&D intensity of any country, Denmark rose to nearly the same level as Germany or the United States and Canada had about the same level as the United Kingdom. (Data availability prevented applying this adjustment to Australia, Finland and Norway, but it is likely that their intensities would rise as well.) These indicators suggest that these countries continue to specialise in natural resource oriented industries which compose the low technology group relative to the other countries in the OECD-13 sample.

Simultaneously with this tendency to continue to rely on these natural resource sectors, there was a shift towards sectors in the medium and high technology groups where the individual countries have a particular strength. For example, although Canada had one of the lower overall manufacturing R&D intensities, it had one of the highest in the communication equipment industry, allocating almost a third of its 1990 manufacturing R&D into this sector. This led Canada to have the largest increase in the R&D intensity of the high technology group of any of the thirteen countries. Canada also enjoys a comparative advantage in the motor vehicles sector where its 1990 RCA is the highest of any country. Australia has had a net job gain in the motor vehicle sector. It has seen its RCA for non-ferrous metals jump from 3.4 in 1970 to 11.6 in 1986 and has sustained an annual average increase in its manufacturing R&D intensity of 14 per cent from 1983 to 1989.

The four Nordic countries, particularly Finland, have increased their share of OECD-13 manufacturing R&D in all three technology categories. The only other country to do so was Japan. As a result, Finland had the lowest variance in the distribution of R&D across sectors of any of the 13 countries, reflecting a broad based R&D effort. This effort is associated with the largest increase in export market shares in the high technology group of any country, as well as the highest manufacturing productivity rate of the 13 countries. Denmark's manufacturing R&D intensity doubled from 1973 to 1989 and by 1990, Denmark had the highest revealed comparative advantage in pharmaceuticals of any of the 13 countries.[3]

It is apparent that the relative relationships between the 13 OECD countries have shifted:

• Japan has joined the front ranks of technological know-how in many sectors. The practices it was able to employ and the fast growth which occurred during this "catch-up" period will not be as easily attainable in the 1990s. The agile capability Japan demonstrated restructuring its economy out of the low and into the high technology industries during the 1970s and 1980s was accompanied by a manufacturing growth rate which was nearly twice as high as its competitors. As Japan now must operate at the frontier, it will be much more difficult for it to sustain such a high growth rate.

• As Japan has grown in its manufacturing R&D capacity, the six EC countries have seen the erosion of their "number two" spot behind the United States. In many industries, Japan has matched or exceeded the EC effort. If present trends continue, the EC will be trailing the United States and Japan in terms of performance in high technology industries and could become even more specialised in sectors which typically have less rapid productivity and lower than average labour compensation.

• The major EC countries have witnessed a relative strengthening of their position in the low technology sectors. The OECD countries typically thought of as specialising in the natural resource industries of paper, wood and food such as Australia, Canada and the Nordic countries are remaining relatively strong in these industries but are also developing sectors of strength (i.e. communication equipment and pharmaceuticals) which fall beyond the scope of these traditional sectors. Many of these countries have a rate of manufacturing R&D increase which is among the highest of the 13 countries, albeit still at a low overall level. This suggests that the tendency to concentrate only on the five or seven largest economies or rapidly developing areas (i.e. the Dynamic Asian Economies) could lead to misjudgments of competitive strength. As the focus shifts to individual sectors, countries must strive to compete with a larger number of competitors.

• The concern in the United States over a broad based loss of high technology industries appears to be exaggerated -- the US high technology industries continue to fare reasonably well given that retention of its preeminent position in so many sectors is untenable. Although much strategic importance is attached to high technology sectors, technological opportunities in other, less sophisticated sectors frequently represent a larger share of employment and output. It is in these sectors that the US' competitors are investing and where further competitive challenges could emerge in the future.

Indicator summaries

Manufacturing R&D shares across the OECD-13

The United States has been, and continues to be, the largest contributor to OECD-13 R&D performed by business enterprises in the manufacturing sector, responsible for over 46 per cent of the OECD-13 manufacturing business R&D in 1990. Nevertheless, this is a decline of almost 10 percentage points from 1973, as other countries, most notably Japan which doubled its share from nine to 18 per cent, have increased their R&D shares. The shares of the six European Community countries (the EC-6) remained relatively stable throughout the two decades at 26 percent, with Italy's increase compensating for a decline in the United Kingdom's share.

Focusing solely on the high technology sector, the United States has maintained a dominant position, contributing over half of the 1990 OECD-13 high technology R&D. It sustained a lead of over 20 percentage points on the next largest contributor, the EC-6. The US's strength in the high technology group is dependent largely on one industry, aircraft, where it accounted for three quarters of all OECD-13 R&D that was performed in that industry.

The distribution of manufacturing R&D by sector within a country

R&D tends to be concentrated into five industries: aircraft, motor vehicles, communications equipment, computers and pharmaceuticals. These five sectors accounted for 64 per cent of the 1990 OECD-13 manufacturing R&D. The United States had the largest share of its 1990 manufacturing R&D, 73 per cent, clustered in these sectors, while the Nordic-4 and Japan had the least with less than 48 per cent. The EC-6 group had roughly the same profile as the United States, with R&D share levels for 1990 of over 60 per cent for these five industries. The United Kingdom led the EC-6 group at 70 per cent while Germany had the lowest share of the group at just over 50 per cent. The structure of sectoral R&D in Japan is distinctive by its rather even distribution of R&D across all manufacturing sectors, resulting in nearly the lowest cross-industry variance of any of the 13 countries.

R&D intensity

When the R&D performed is divided by the amount of production, it is apparent that the United States has the most R&D intensive manufacturing sector with much of this coming from the high technology manufacturing industries. Germany and Japan, on the other hand, displayed relatively lower levels of intensities in the high technology industries, even though they were practically tied, behind Sweden, for the third most R&D intensive manufacturing sector. Germany and Japan put relatively more R&D per unit of production into medium technology industries such as industrial chemicals and non-electrical machinery than the United States.

Japan and Germany were the only two countries where the R&D intensity increased in nearly every manufacturing industry from 1976-78 to 1986-88. With nine out of 22 sectors having a falling R&D intensity, the United Kingdom is the country which exhibited the highest number of sectors with declining intensities.

STIBERD (Structurally adjusted business enterprise R&D intensity)

The traditional R&D intensity indicator favours countries whose economies are oriented towards high technology industries, failing to take account of the fact that the economic structure of an economy may be affected by natural endowments or comparative advantages in low technology industries. An alternative indicator, STIBERD, measures the R&D intensity for a country's manufacturing after adjusting for differences in industrial composition. When this is done, a much different ranking of technological intensity is apparent where differences between countries decline and the position of the United States falls from being the highest to being third, just ahead of Germany, but behind Sweden (ranked first) and Japan (ranked second).

Investment shares within a country

A convergence in the structure of investment has occurred as investment has swung away from low technology industries such as: textiles, basic metals and non-metallic mineral products. The share of these low technology industries in total investment declined from around 55 per cent of the total in the early 1970s to 45 per cent in the late 1980s. Investment has increased in the fabricated metal products and machinery industry, particularly the motor vehicle industry, and the paper industry.

Japan underwent the most significant restructuring of investment, moving from having a higher than average share of investment in low technology industries in the mid-1970s (55-60 per cent) to a lower than average share at the end of the period (below 40 per cent). Investment was reduced in basic metals and textiles and increased in electronics and related industries. By the end of the 1980s, Japan and Germany had the highest shares of total investment in fabricated metal products and machinery, 48 and 46 per cent respectively, with Japan increasing its share by over 50 per cent from 1970.

Investment per employee

High wage, medium technology and scale intensive industries are characterised by high levels of investment per employee while low wage, labour intensive industries are characterized by a relatively low investment per employee. Petroleum refining is the industry which has the highest investment per employee levels, exceeding the manufacturing average by at least a factor of three in every country. Industrial chemicals and non-ferrous metals are the next two industries which typically had investment per employee ratios in the late 1980s that were about twice as high as the manufacturing average.

These sharp inter-industry differences propel countries, such as the Netherlands, Canada and Norway where one or more of these industries have a strong presence, to the top of the cross-country rank comparisons of investment per employee in the manufacturing sector. The somewhat surprising

presence of Japan and Germany in the bottom half of the list may be due to the fact that their economies rely more on comparatively less investment intensive industries such as non-electrical and electrical machinery, communication equipment and instruments.

Export market shares across the OECD-13

Germany and the United States dominated the OECD-13 export market in manufactured goods, with Germany slightly increasing its share from 19 per cent to 20 per cent between 1970 and 1990 while the share of the United States fell from 20 per cent to 17 per cent. The biggest gain in total manufacturing export market share was made by Japan whose share rose from 11 to 15 percent.

Much of the Japanese gain in share was in high technology or high wage industries. In the low technology and low wage industries, on the other hand, Japan's shares declined dramatically whereas the EC-6 saw strong growth in these low technology and low wage industries, largely due to Italy's gains in the textile sector.

In the high technology industries, Japan gained 7 percentage points between 1970 and 1990 to reach a share of 21 per cent by 1990. This growth enabled Japan to overtake Germany, whose share declined slightly from 18 to 16 per cent. The United States, despite a fall from 31 per cent in 1970 to 26 per cent in 1990, managed to remain the largest exporter in high technology industries, mainly due to its dominance in the aircraft sector. Nonetheless, the United States' lead of 14 percentage points in 1970 was cut to five percentage points by the end of the 1980s.

The share fluctuations in the medium technology group, for most countries, were being driven by two industries: motor vehicles and non-electrical machinery. In both of these industries, Germany was the leading exporter between 1970 and 1990, with approximately one-fourth of these export markets. In motor vehicles, Japan more than tripled its export share, moving from 8 per cent to 25 per cent in 21 years, while the shares of the United States, Canada and the United Kingdom fell.

Revealed comparative advantage

For most countries, the indices of revealed comparative advantage (RCA), an indicator of trade specialisation, were relatively stable from 1970 to 1990. This reflecting the fact that the distribution of each countries' exports moved in the same direction as the shifts that occurred on average across the OECD-13 countries. Japan is the only country which saw large shifts in its RCA indices, gaining a significant advantage in the high and medium technology industries and falling substantially in the low technology industries. The United States, while showing a slight drop in its index for the high technology industries, maintained its leading position with an RCA 1.5 in 1990 (1.0 being the OECD average). The EC-6 countries traditionally had an RCA hovering around the average in the medium and low technology industries. At the same time, their performance in the high technology industries was below average, with only the United Kingdom showing a specialisation in this industrial grouping. The nordic countries as well as Australia and Canada, had a dominant position in the low technology sectors, but were generally substantially below average in the high technology industries, with RCAs ranging from 0.3 to 0.7 in 1990.

Import penetration

Imports of manufactured goods increased as a proportion of domestic demand in the manufacturing sector in every one of the OECD-13 countries between 1970 and the end of the 1980s. The strongest increase by far was in the United States, where manufacturing imports more than tripled as a proportion of domestic demand in this period. Import intensities doubled in France, Germany and the United Kingdom.

In most countries, high technology industries are characterized by higher import penetration rates, followed by medium technology sectors, while the total domestic demand in low technology industries tends to be mostly satisfied by domestic production.

The profile of import penetration in Japan is strikingly different from that of other 12 OECD countries. Imports accounted for less than 6 per cent of the total of domestic demand for manufactured goods in 1989, a 2 percentage point increase in 20 years. Little variation is observable across the three technology groups. The high technology group of industries had roughly the same degree of import penetration as the medium technology group, and only marginally lower than the low technology group.

Employment shares in manufacturing

Over the past two decades, employment in the manufacturing sector of the OECD-13 declined by 8 per cent, reducing the overall level by 5.6 million jobs. This decline was largely attributable to the fall in employment in the textiles, apparel and leather industry, which started with 15 per cent of total manufacturing employment in 1970 but ended in 1988 with eleven per cent of the total: a loss of over three million jobs. The basic metals industry, in particular its ferrous metals component, also experienced significant job reductions causing its share of the OECD-13 manufacturing employment to drop from 6.4 per cent to 3.9 per cent.

Employment in the fabricated metal products and machinery group of industries, by far the largest employer in the manufacturing sector, remained steady, thus increasing the share of this industry group from 40 per cent in 1970 to 43 per cent of the manufacturing total in 1988. The only two industry groups that saw a net increase in jobs were the chemicals sector, which increased 5.7 per cent from 1970 to 1988 and the paper products and printing group of industries, where employment during this period increased by almost 8 per cent overall.

Although on aggregate the 13 OECD countries lost jobs in the manufacturing sector over the last two decades, most of the loss was concentrated in the six European countries whose employment in this sector fell by nearly twenty per cent over the period. The United Kingdom had the largest decline of any country. The Netherlands also had a relatively high rate of decline, but over three-quarters of the drop occurred in the 1970s. Manufacturing employment in North America gained nearly half-a-million jobs with both the United States, and particularly Canada, registering gains. Canada generated more manufacturing jobs over these two decades than any other country. Japan also had a net increase, but unlike most of the other countries, its increase in manufacturing jobs occurred in the 1980s. Japan added over three-quarters of a million manufacturing jobs during the 1980s, while ten other countries lost manufacturing jobs and two others made only small gains.

Labour compensation per employee by industry

Labour compensation differentials by industry tend to be narrower in Scandinavian countries such as Norway, Sweden and Denmark and in the Netherlands. They are most dispersed in countries with a strong specialisation in certain industries, such as Australia or Italy, as well as in the United States and in Japan. Over time, such intra-country differences in the dispersion of labour compensation differentials in manufacturing seem to be diminishing. Industry pay differentials in countries with higher than average dispersion have tended to decline, and vice versa in countries with lower than average coefficients of variation.

High technology industries tend to be better paid in most countries, with higher compensation per employee than medium technology or low technology industries. The exceptions are Germany and Japan where compensation in medium technology industries exceeds that of high technology ones.

Labour productivity

The 1970 to 1989 rate of labour productivity growth varied widely by country, ranging from a low annual rate of 1.9 per cent in Canada and Norway to a high of 5.2 for Japan. A majority of the countries had faster manufacturing productivity gains in the 1980s than in the 1970s. The highest growth rates were achieved in the basic metals (achieved largely though employment reductions) and fabricated metal products and machinery industries (primarily attributable to output increases) while low rates prevailed for the food, paper and wood groups.

Japan and Finland stand out as having the highest increase in manufacturing labour productivity with both countries more than doubling their productivity from the 1970s. The United States and the United Kingdom have also seen large increases of 75 per cent or more while the performance of Norway, Germany, Denmark and Canada have not been as strong.

Production shares across the OECD-13

Across the OECD-13 during the period from 1970 to 1989 five countries, Japan, Italy, Canada, Finland and Norway, increased their share of total manufacturing production. These gains in share came at the expense of the shares held by United States, the United Kingdom and Germany. In particular, the United States lost the most share points (-2.6) while Japan gained nearly an equal amount (+3.0), with significant changes in production share between the United States and Japan occurring in the computer and motor vehicle industries. Nonetheless, the United States was still responsible for almost two-fifths of all production in manufacturing industry of the OECD-13 in 1989, the largest producer by 16 share points.

The EC-6 maintained a relatively stable position, losing one share point over the period; but significant internal changes occurred with the wide differences that existed in the 1970s between Italy, the United Kingdom and France being reduced significantly, resulting in 1989 manufacturing production shares which are very similar.

The share of GDP contributed by manufacturing

Over the last two decades the share of Gross Domestic Product (GDP) originating in the manufacturing sector declined in every country in our group of 13 OECD countries when measured in current prices. In constant prices a different picture emerged. For those nine countries where constant price data was available, five witnessed a decline, while three (Denmark, Italy and the United States) kept a constant share and one country, Japan, actually experienced an increase in the share. The most precipitous declines in the manufacturing sector's share of GDP, regardless of valuation, occurred in France and the United Kingdom, where the share in each country fell about 8 percentage points over the last two decades.

A pattern of convergence towards a similar share of GDP being contributed by the manufacturing sector is evident when viewed over the past two decades. Countries which had the largest initial share in 1970 were frequently the same countries that experienced the largest decline in share. This is supported by the fact that the variance in manufacturing's share of GDP existing between the countries dropped by a third between 1970 and 1989.

The sectoral distribution of manufacturing's value added

Within the manufacturing sector, the distribution of value added between industries has changed significantly from the early 1970s to the late 1980s, with most countries moving out of the low technology, labour and natural resource intensive industries such as: food, textiles and wood products industries and into the high and medium technology, scale intensive and science based industries such as: fabricated metal products and chemicals.

Japan exhibited the largest amount of structural change from 1970 to 1989 with an index which is nearly twice as large as the next closest country, Denmark. The United States ranked third in the overall rate of structural change from 1970 to 1989 with the bulk of this change occurred in the 1980s where the rate of change was nearly double what occurred in the 1970s.

II. Indicators of Research and Development (R&D), Investment, International Trade, Employment and Structural Change

Manufacturing R&D Shares across the OECD-13

The United States has been, and continues to be, the largest contributor to OECD-13 R&D performed by businesses in the manufacturing sector (Figure RDSO 1). In 1990, it was responsible for over 46 per cent of the OECD-13 manufacturing business R&D. Nevertheless, this is a decline of almost 10 percentage points from 1973, as other countries, most notably Japan, have increased their R&D shares. In 1973, the United States was responsible for 55 per cent of all the manufacturing R&D that was performed, whereas the EC-6 and Japan together only accounted for 42 per cent. This dominant position remained relatively unchallenged until the second half of the 1980s when Japan increased its investment in R&D at twice the rate of the United States causing its share to rise from 13 per cent of the OECD-13 total in 1973 to 22 per cent in 1990 (Table RDSO 1).

Description of the Indicator

R&D shares across the OECD-13 are calculated as business enterprise R&D in a certain industry for a given country or country grouping as a proportion of the business enterprise R&D for the OECD-13 for this industry. This indicator is skewed towards the larger countries which because of their size will dominate R&D shares. On the other hand, in many cases the smaller countries appear to show extremely high growth in their R&D shares, but this is much easier to accomplish starting from their small bases. These shares were calculated using United States purchasing power parities (PPP) for GDP. It should be noted that the results could be significantly different if exchange rates or a PPP specifically for R&D was used.

Despite Japan's large increases, it remained behind not only the United States, but also the EC-6. The EC-6's share of the OECD-13 manufacturing R&D moved slightly during these eighteen years, declining only from 29 per cent to 28 per cent. Although within the EC-6, some notable shifting did occur (Figure RDSO 1). The United Kingdom's share fell from 8.3 per cent to 5.7 per cent and Italy's share, while still small, grew at a much faster rate than any other OECD-13 country. The Nordic countries all hold very small R&D shares, but Finland, Denmark and Sweden saw significantly increases.

At a detailed sectoral level, the convergence between the United States and Japan is even more pronounced than it is in total manufacturing. In 1973, out of 22 industrial sectors, there were only four in which the United States did not have the largest R&D share: textiles, apparel and leather, chemicals excluding drugs, drugs and medicines, and ferrous metals. In these four industries, the EC-6 held the largest share in three of them and Japan performed the most R&D only in ferrous metals. During the course of the 1970s and 1980s, the United States lost R&D shares in 18 of 22 industries, whereas Japan gained R&D shares in all but two industries: shipbuilding and other transportation equipment. The United States remained the R&D leader in most industries, but Japan succeeded in substantially narrowing the gap between itself and the United States, and in five industries: rubber and plastic products, non-metallic mineral products, non-ferrous metals, non-electrical machinery and electrical machinery, it surpassed the United States. The EC-6's R&D shares remained relatively stable throughout the two decades,

even at the sectoral level. The only EC-6 country to experience dramatic changes was the United Kingdom. Its R&D shares fell in all but three industries: drugs and medicines, computers and office machinery and other manufacturing.

Grouping the 22 industries by their level of technological sophistication, the greatest convergence between the United States and Japan has occurred in the low technology sector (Figure RDSO 4). In 1973 the difference between the United States' R&D share and Japan's R&D share in the low technology industries was 23 percentage points, whereas by 1990 the difference in their shares was only 3 percentage points. In the medium technology industries the Japanese share is converging towards that of the United States almost as sharply as it does in the low technology industries. The United States, however, had a larger lead on Japan in the early 1970s in this grouping, and the differences between their shares are thus still large (Figure RDSO 3). The sectors in which there has been the least convergence between these two countries are the high technology industries (Figure RDSO 2). The United States still maintains a dominant position in R&D shares in the OECD-13 for the high technology industries. R&D shares in this grouping have been relatively stable and the gap in the R&D shares between the United States and Japan was still 36 percentage points in 1990. In the EC-6, because the shifts in R&D were so well balanced, all three technology groupings were extremely stable. From 1973 to 1990, the EC-6 held a share of about 26 per cent in the high technology industries and a share of about 33 per cent in the medium technology industries. Only the low technology grouping experienced any movement, and that was only from a share of 28 per cent to 24 per cent.

High technology industries

As with total manufacturing, the United States began the 1970s with an extremely high R&D share in high technology industries, 63 per cent in 1973. By 1990, its share had fallen to 54 per cent, but still remained more than twice as high as the share of the second largest high technology R&D performer, the EC-6. The EC-6's share stayed at 26 per cent, as Italy's growth compensated for a decline in the United Kingdom's share. Japan, on the other hand, doubled its share, rising steadily from 9 per cent to 18 per cent during these years. Despite this doubling, its share was still only one-third that of the United States' in 1990. The Nordic-4 countries, while still accounting for only 1.5 per cent of the R&D that is done in these industries, all made large gains in this area.

The United States' considerable lead in the high technology industries is largely a result of its sizeable R&D in the aircraft industry. In 1990, the United States accounted for three quarters of all OECD-13 R&D that was performed in the aircraft industry. This was probably due in a large part to the magnitude of the defense and space projects initiated by the United States government. Nearly three-quarters of the R&D performed in this sector was funded by the United States government.[4] France, Germany and the United Kingdom were the only other countries with significant R&D activity in this industry and their sum totalled only 22 per cent of the OECD-13 R&D in 1990. Of the EC-6 countries, Italy showed the most significant increase in aircraft R&D, increasing its share from 0.2 per cent in 1973 to 2.6 per cent in 1990. United Kingdom, on the other hand, saw a decrease from a share of 12 per cent in 1973 to a share of 6 per cent in 1990.

Japan, while only accounting for about 1 per cent of aircraft R&D, held significant R&D shares in two other industries in the high technology grouping: electrical machinery and computers and office machinery. In 1990, Japan was responsible for 49 per cent of the OECD-13 R&D that

was done in electrical machinery, nearly three times the share it held in 1973. This large gain was achieved at the expense of the United States whose share in this sector dropped from 54 per cent to 13 per cent over the same time period. The EC-6 also benefited from the United States' drop, rising from 27 per cent to 36 per cent. All of the EC-6 countries, except the United Kingdom, saw increases in their shares of electrical machinery, Germany and Italy most significantly. Germany's share rose rapidly, surpassing the United States' share by 1986 and attaining 18 per cent of the OECD-13 R&D by 1990. Italy exhibited extremely strong growth, moving from a share of 0.6 per cent to 4.7 per cent.

The other high technology area in which Japan experienced impressive growth is the computer industry. It jumped from a share of 7 per cent in 1970 to 23 per cent in 1990. Nevertheless, in 1990 the United States' R&D share was still almost three times higher than Japan's in this industry. The United States share has declined since 1973, but in 1990, the United States still accounted for a full 60 per cent of the R&D done in this industry. Most of the EC-6 countries saw small increases in this industry, but the overall EC-6 share still fell, driven by France's drop from 7 per cent to 2 per cent.

The R&D shares in the pharmaceutical industry have proved to be much more stable throughout the 1970s and 1980s than those in aircraft and the fabricated metal products sectors. The United States and the EC-6 both had shares that hovered about 40 per cent in 1973 and declined only slightly to about 38 per cent in 1990. Within the EC-6, the United Kingdom's increase from 11 per cent to 13 per cent, almost offset the decline in Germany's R&D share. Japan gained slightly in this industry and in 1990 had a share of 19 per cent, up 5 percentage points from 1973.

Medium technology industries

In the medium technology industries there is a much more significant convergence between Japan and the United States than their was in the high technology industries. The United States share declined between 1973 and 1990 from 46 per cent to 36 per cent, while Japan's share rose from 17 per cent to 27 per cent. The EC-6's share remained constant, at about 33 per cent, due largely to Germany's consistent share of about 16 per cent (Figure RDSO 3). Japan made gains in six of the seven industries which comprise this grouping. The only medium technology industry in which it did not increase its R&D share was other transport equipment. In this industry, its share fell from 26 per cent to 7 per cent.

In motor vehicles, the United States, despite a decline in its share, still held the largest R&D share in 1990. It moved from 56 per cent to 44 per cent, remaining significantly above Japan, who in spite of an increase of 11 percentage points, only obtained a share of only 25 per cent in 1990. The Nordic countries showed a substantial increase, although their share remained small.

In rubber and plastics, an extremely large change was evident. Japan's R&D share doubled between 1973 and 1990 whereas the United States's share fell to one-half its 1973 level. The R&D shares of both Japan and the EC-6, were larger than the United States' by 1987. The EC-6's move from 25 per cent to 33 per cent was largely attributable to Germany, which increased its share from 6 to 11 per cent, but was also helped by France, whose share rose from 11 per cent to 14 per cent.

Japan also made considerable gains in the non-ferrous metal and the non-electrical machinery industries. In the non-ferrous metal industries, Japan almost doubled its share, increasing from 23 per cent to 42 per cent, and surpassing the R&D share of the United States. At the same time, the United States' share declined sharply, from 43 per cent to 30 per cent. Although the trends were not quite as sharp in the non-electrical machinery industries, Japan moved up sharply to attain the largest R&D share, while the United States share declined sharply. The EC-6 fell slightly, from 22 per cent to 18 per cent, in the non-ferrous metal industries, despite Italy's strong increases. Canada has a relatively large share of the R&D performed in non-ferrous metals. In 1990 it held a share of 6 per cent, a share which is larger than every other country except Japan and the United States.

In the chemical industry, the R&D shares were more stable than in most of the other medium technology industries. The EC-6 and the United States fell slightly, but still held shares of 41 per cent and 35 per cent in 1990. Japan's R&D increased, but only to a share of 24 per cent of the OECD-13. Nevertheless, this was enough to surpass Germany, whose share stayed stable at 19 per cent.

Low technology industries

The low technology industries showed the most dramatic convergence between the United States and Japan (Figure RDSO 4). Japan's share increased from 20 per cent in 1973 to 32 per cent in 1990, to close within 4 percentage points of the United States, after being more than 24 per cent points behind. The EC-6, although much less dynamic than both Japan and the United States, showed more movement in the low technology industries than it did in the high and medium ones, falling from 28 per cent to 24 per cent. This drop in the EC-6's share is attributable to the United Kingdom whose share fell sharply from 11 per cent to 4 per cent.

Japan's biggest increase occurred in textiles, apparel and leather. Its share rose from 28 per cent to 50 per cent. This occurred mainly at the expense of the EC-6 whose share fell from 47 per cent to 21 per cent. Again, as with the entire low technology group, this change was being driven by the United Kingdom, whose share dove from 22 per cent in 1973 to only 3 per cent in 1990. The United States' share increased slightly rising from 22 per cent to 24 per cent.

Table RDSO 1
R&D Shares across the OECD-13

ISIC	Industry	Canada		France		Germany		Italy	
		1973	1990	1973	1990	1973	1990	1973	1990
3000	Total Manufacturing	1.0	1.3	6.5	6.5	9.8	10.9	2.2	3.1
3100	Food, beverages and tobacco	2.4	1.8	4.5	7.1	3.1	4.4	0.9	1.4
3200	Textiles, apparel & leather	1.5	3.7	11.5	6.6	6.5	8.5	5.7	1.0
3300	Wood products & furniture	0.9	8.5	3.3	2.1	1.4	15.9	0.0	1.1
3400	Paper products & printing	4.3	5.9	3.2	2.8	1.7	3.5	0.8	0.1
3500	Chemical products	1.0	1.2	7.9	7.8	14.8	13.5	3.4	4.0
3600	Non-metallic mineral products	1.0	0.6	9.5	5.6	5.7	8.1	0.7	1.4
3700	Basic metal industries	3.4	2.8	3.9	6.5	10.1	6.4	1.3	3.4
3800	Fabricated metal products	0.8	1.2	6.2	6.2	9.0	10.7	1.9	2.9
3900	Other Manufacturing	1.3	2.9	3.9	3.4	0.2	2.6	4.7	0.3
	High technology	0.9	1.4	6.4	6.6	8.4	8.5	1.5	2.9
	Medium technology	0.9	0.8	6.6	6.5	14.1	16.6	3.6	3.5
	Low technology	2.0	2.4	6.6	5.9	5.1	7.7	1.6	2.6

		Japan		Nordic-4		United Kingdom		United States	
		1973	1990	1973	1990	1973	1990	1973	1990
3000	Total Manufacturing	12.9	22.2	1.7	1.9	8.3	5.7	55.3	46.6
3100	Food, beverages & tobacco	20.1	32.4	4.0	3.9	16.8	7.8	16.8	35.5
3200	Textiles, apparel & leather	27.8	49.8	1.7	1.8	21.8	2.9	21.7	23.8
3300	Wood products & furniture	12.0	27.0	4.2	5.4	4.0	1.6	72.6	37.0
3400	Paper products & printing	24.9	28.1	8.8	8.8	5.4	4.3	49.1	44.4
3500	Chemical products	16.0	22.4	1.5	1.9	8.5	8.6	43.2	37.6
3600	Non-metallic mineral products	23.6	42.6	2.7	2.1	10.3	3.1	43.9	34.7
3700	Basic metal industries	31.8	52.3	4.0	2.9	9.2	3.1	31.8	18.2
3800	Fabricated metal products	10.6	20.3	1.5	1.7	7.9	5.0	60.3	50.5
3900	Other Manufacturing	20.2	35.1	3.5	5.4	7.1	7.5	58.4	40.9
	High technology	8.9	17.7	1.1	1.5	8.6	6.5	62.5	53.5
	Medium technology	17.4	27.9	1.8	2.3	6.9	4.4	46.2	36.1
	Low technology	20.8	32.5	4.2	3.3	10.6	4.4	44.1	36.5

Figure RDSO 1

R&D Shares across the OECD-13

Total Manufacturing

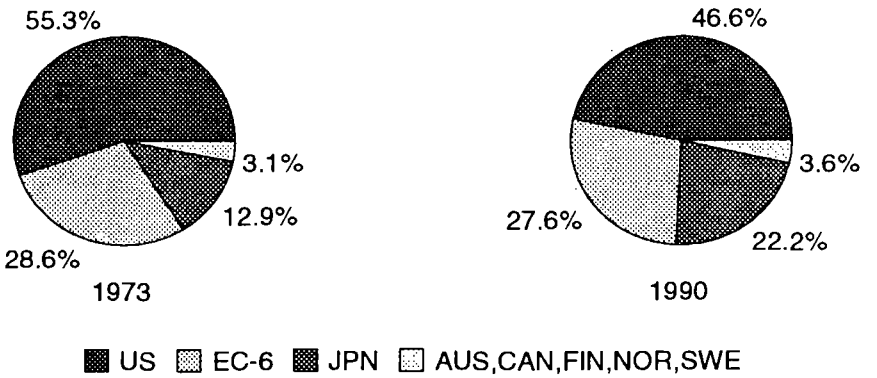


Figure RDSO 2

R&D Shares across the OECD-13

High Technology Industries

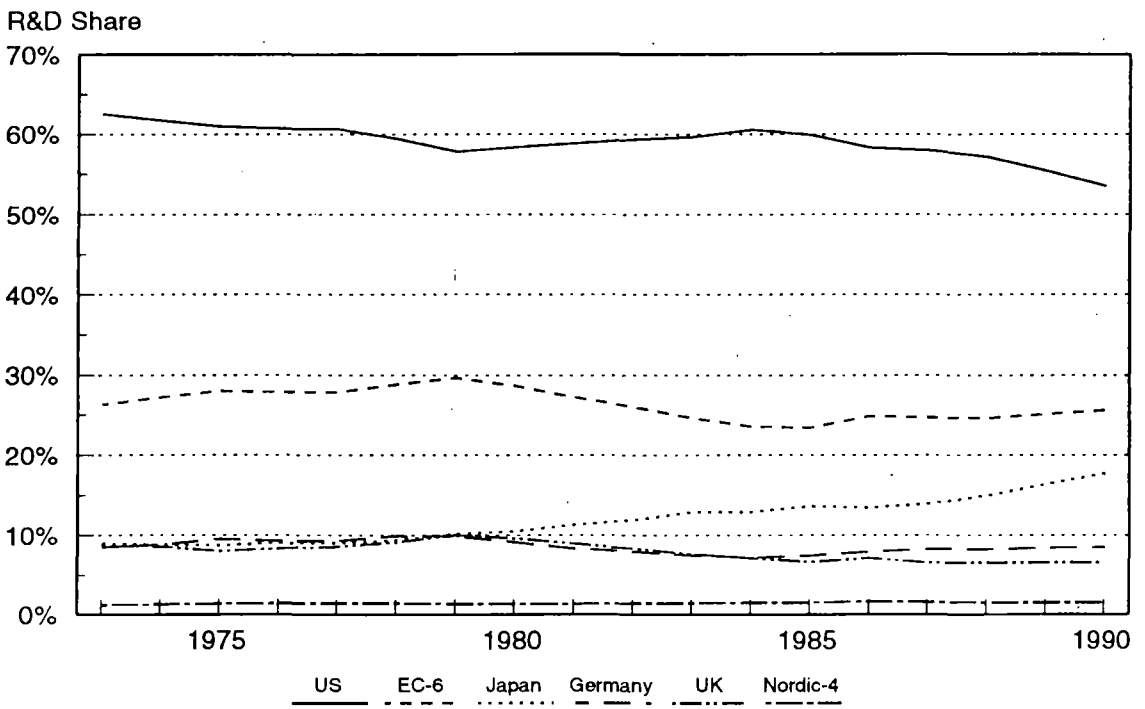


Figure RDSO 3

R&D Shares across the OECD-13

Medium Technology Industries

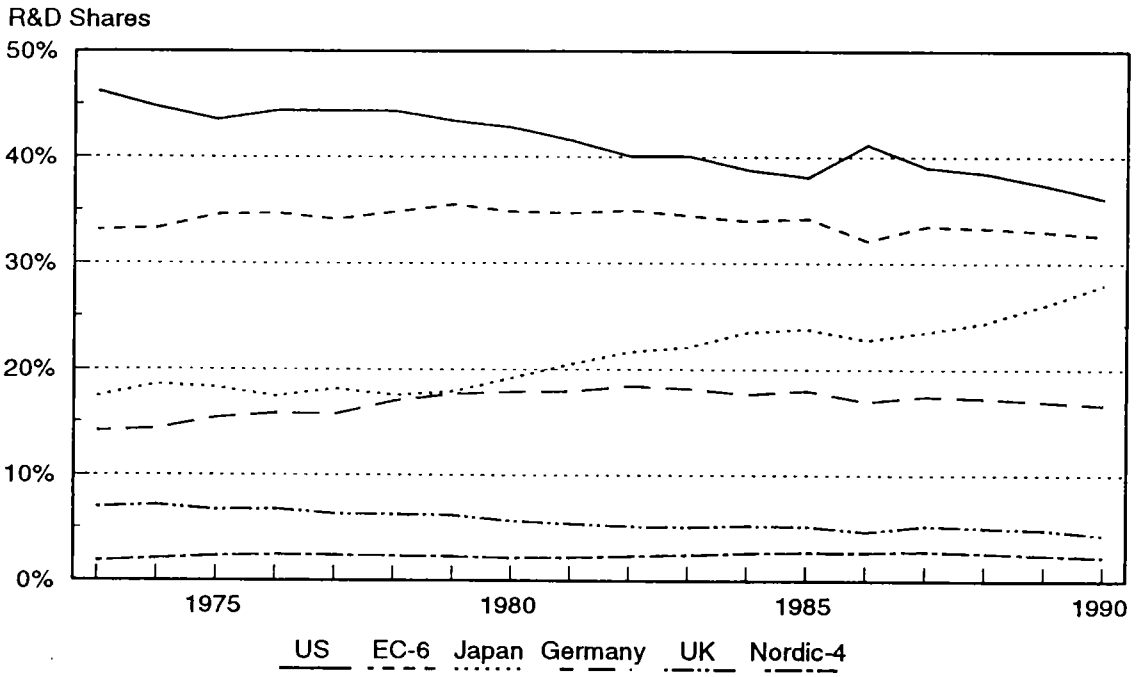
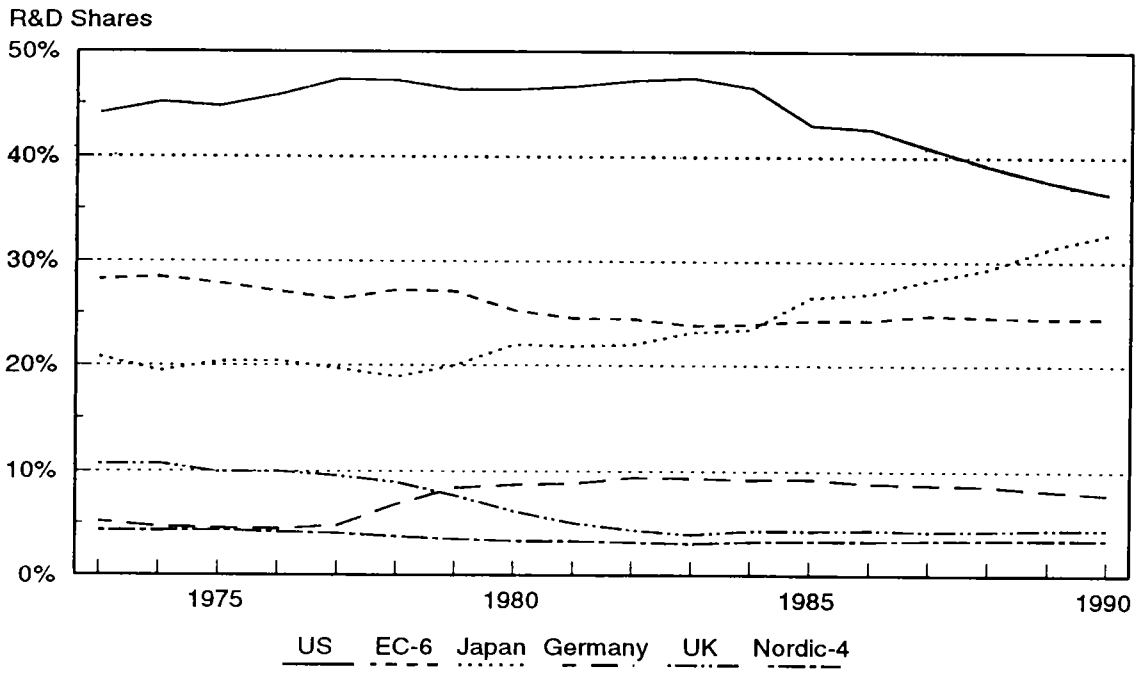


Figure RDSO 4

R&D Shares across the OECD-13

Low Technology Industries



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4/12/95

Mr. Lionel S. Johns
Associate Director for Technology
Office of Science and Technology Policy
Old Executive Office Building
17th and Pennsylvania Ave. NW
Washington DC 20500

Dear Skip,

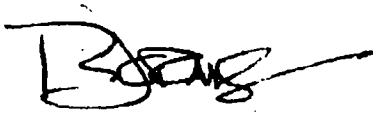
In response to your request to Andy Wyckoff, I have compiled a set of OECD data on R&D expenditures by country.

The data comes from OECD's STAN/ANBERD database (1994), and covers twelve OECD countries: Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom, and the United States. ANBERD data are provided in unscaled national currencies, in current prices. I have used exchange rate tables provided in the STAN database to convert these values to U.S. dollars as well as U.S. purchasing power parities.

This fax includes tables for the United States and Japan, showing national R&D expenditures by sector, in U.S. dollars. I would be happy to provide this data for the rest of the OECD-12, and/or R&D expenditures expressed in U.S. PPP's. Please let me know what would be most useful to you. I can provide the data in either hard copy or in electronic form (Excel 5.0 or comparable format).

Of course, if there is any other data or information you need please do not hesitate to call.

Sincerely,



Paul N. Doremus

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	A	B	C	D
1	US: Business R&D Expenditures, 1973-1992, in current US dollars			
2				
3	INDUSTRY BY MODIFIED ISIC CATEGORISATION	1973	1974	1975
4	3000 TOTAL MANUFACTURING INDUSTRY	$20,535,000,000	$22,119,000,000	$23,471,000,000
5	3100 FOOD, DRINK & TOBACCO	$269,000,000	$298,000,000	$335,000,000
6	3200 TEXTILES, FOOTWEAR & LEATHER	$64,000,000	$69,000,000	$70,000,000
7	3300 WOOD, CORK & FURNITURE	$71,000,000	$81,000,000	$89,000,000
8	3400 PAPER & PRINTING	$198,000,000	$221,000,000	$248,000,000
9	3500 CHEMICALS	$3,000,000,000	$3,541,000,000	$3,907,000,000
10	351+352-3522 INDUSTRIAL CHEMICALS	$1,419,000,000	$1,643,000,000	$1,766,000,000
11	3522 PHARMACEUTICALS	$696,000,000	$807,000,000	$991,000,000
12	353+354 PETROLEUM REFINING	$439,000,000	$622,000,000	$693,000,000
13	356+356 RUBBER & PLASTICS PRODUCTS	$344,000,000	$387,000,000	$357,000,000
14	3600 STONE, CLAY & GLASS	$199,000,000	$217,000,000	$233,000,000
15	3700 BASIC METAL INDUSTRIES	$308,000,000	$358,000,000	$443,000,000
16	3710 FERROUS METALS	$163,000,000	$181,000,000	$215,000,000
17	3720 NON-FERROUS METALS	$145,000,000	$177,000,000	$228,000,000
18	3800 FABRICATED METAL PRODUCTS AND MACHINERY	$16,231,000,000	$17,137,000,000	$17,940,000,000
19	3810 FABRICATED METAL PRODUCTS	$291,000,000	$313,000,000	$324,000,000
20	382-3825 NON-ELECTRICAL MACHINERY	$816,000,000	$882,000,000	$976,000,000
21	3825 OFFICE MACHINERY & COMPUTERS	$1,733,000,000	$2,103,000,000	$2,220,000,000
22	383-3832 ELECTRICAL MACHINERY	$1,834,000,000	$2,047,000,000	$2,121,000,000
23	3832 ELECTRONIC EQUIPMENT & COMPONENTS	$3,068,000,000	$2,964,000,000	$2,984,000,000
24	3841 SHIPBUILDING	..	..	..
25	3843 MOTOR VEHICLES	$2,405,000,000	$2,389,000,000	$2,340,000,000
26	3845 AEROSPACE	$5,052,000,000	$5,278,000,000	$5,713,000,000
27	3842+3844+3849 OTH TRANSPORT EQUIPMENT	$72,000,000	$87,000,000	$90,000,000
28	3850 INSTRUMENTS	$961,000,000	$1,075,000,000	$1,173,000,000
29	3900 OTHER MANUFACTURING	$158,000,000	$177,000,000	$205,000,000
30	4000 ELECTRICITY, GAS, AND WATER	..	..	..
31	5000 CONSTRUCTION	..	..	..
32	7100 TRANSPORT AND STORAGE	..	..	..
33	7200 COMMUNICATION SERVICES	..	..	..
34	8324 ENGINEERING, ARCHITECTURAL, AND TECHNICAL SERVICES	..	..	..
35	6+8-8324+9 OTHER SERVICES	..	..	..
36	TOTAL SERVICES	$715,000,000	$768,000,000	$735,000,000
37	TOTAL INDUSTRIES	$21,250,000,000	$22,887,000,000	$24,206,000,000
38				
39	SOURCE: OECD, DSTI (STAN/ANBERD), 1994			

	E	F	G	H	I	J
1						
2						
3	1976	1977	1978	1979	1980	1981
4	$26,151,000,000	$28,867,000,000	$32,075,000,000	$36,686,000,000	$42,690,000,000	$49,904,000,000
5	$355,000,000	$415,000,000	$472,000,000	$528,000,000	$620,000,000	$637,910,000
6	$82,000,000	$83,000,000	$89,000,000	$101,000,000	$115,000,000	$116,000,000
7	$197,000,000	$199,000,000	$226,000,000	$270,000,000	$340,000,000	$351,000,000
8	$212,000,000	$234,000,000	$287,000,000	$345,000,000	$435,000,000	$508,000,000
9	$4,285,000,000	$4,811,000,000	$5,133,000,000	$5,877,000,000	$6,844,000,000	$8,335,330,000
10	$1,925,000,000	$2,085,000,000	$2,272,000,000	$2,523,000,000	$2,859,000,000	$3,540,000,000
11	$1,091,000,000	$1,117,000,000	$1,308,000,000	$1,517,000,000	$1,777,000,000	$2,084,840,000
12	$797,000,000	$919,000,000	$1,060,000,000	$1,367,000,000	$1,650,000,000	$1,235,970,000
13	$502,000,000	$591,000,000	$723,000,000	$917,000,000	$1,085,000,000	$774,510,000
14	$263,000,000	$287,000,000	$324,000,000	$356,000,000	$406,000,000	$460,000,000
15	$506,000,000	$530,000,000	$560,000,000	$634,000,000	$728,000,000	$878,000,000
16	$256,000,000	$283,000,000	$314,000,000	$375,000,000	$403,000,000	$515,000,000
17	$250,000,000	$254,000,000	$246,000,000	$259,000,000	$285,000,000	$323,000,000
18	$20,022,000,000	$22,233,000,000	$24,717,000,000	$28,317,000,000	$32,969,000,000	$38,305,000,000
19	$358,000,000	$386,000,000	$384,000,000	$455,000,000	$550,000,000	$624,000,000
20	$1,085,000,000	$1,225,000,000	$1,400,000,000	$1,611,000,000	$1,939,000,000	$2,417,190,000
21	$2,402,000,000	$2,655,000,000	$2,883,000,000	$3,214,000,000	$3,962,000,000	$4,400,800,000
22	$2,382,000,000	$2,295,000,000	$2,476,000,000	$2,775,000,000	$3,048,000,000	$3,476,000,000
23	$3,254,000,000	$3,591,000,000	$4,031,000,000	$5,049,000,000	$6,127,000,000	$6,853,000,000
24	..	..	..	..	..	..
25	$2,778,000,000	$3,358,000,000	$3,879,000,000	$4,509,000,000	$4,955,000,000	$4,806,000,000
26	$6,339,000,000	$7,033,000,000	$7,536,000,000	$8,041,000,000	$9,198,000,000	$11,968,000,000
27	$94,000,000	$120,000,000	$131,000,000	$159,000,000	$162,000,000	$147,000,000
28	$1,331,000,000	$1,571,000,000	$1,998,000,000	$2,505,000,000	$3,029,000,000	$3,614,000,000
29	$217,000,000	$243,000,000	$266,000,000	$288,000,000	$364,000,000	$444,000,000
30	..	..	..	..	..	..
31	..	..	..	..	..	..
32	..	..	..	..	..	..
33	..	..	..	..	..	..
34	..	..	..	..	..	..
35	..	..	..	..	..	..
36	$845,000,000	$958,000,000	$1,229,000,000	$1,540,000,000	$1,815,000,000	$1,906,000,000
37	$26,997,000,000	$29,825,000,000	$33,304,000,000	$38,226,000,000	$44,505,000,000	$51,810,000,000
38						
39						

	K	L	M	N	O	P
1						
2						
3	1982	1983	1984	1985	1986	1987
4	$56,178,000,000	$61,931,000,000	$69,895,000,000	$77,525,000,000	$80,377,000,000	$84,311,000,000
5	$779,230,000	$826,820,000	$1,081,980,000	$1,136,000,000	$1,285,830,000	$1,206,000,000
6	$135,980,000	$150,060,000	$181,610,000	$218,000,000	$246,370,000	$243,000,000
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	$512,920,000	$523,680,000	$732,700,000	$334,660,000	$950,000,000	$995,000,000
15	$987,000,000	$1,085,000,000	$716,590,000	$740,010,000	$803,470,000	$730,000,000
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	$374,270,000	$447,640,000	$336,000,000	$416,000,000	$458,000,000	$478,230,000
18	$43,002,330,000	$47,778,690,000	$55,039,240,000	$62,074,890,000	$64,441,560,000	$67,873,000,000
19	$625,000,000	$701,000,000	$842,000,000	$829,000,000	$895,000,000	$783,000,000
20	$2,410,770,000	$2,391,800,000	$2,404,380,000	$2,393,970,000	$2,396,000,000	$2,428,000,000
21	$5,667,220,000	$6,635,190,000	$8,099,610,000	$9,822,020,000	$9,793,560,000	$9,347,000,000
22	$2,858,000,000	$2,815,000,000	$1,848,000,000	$1,277,000,000	$1,250,000,000	$1,239,000,000
23	$8,065,000,000	$9,866,000,000	$11,930,000,000	$13,155,000,000	$13,730,000,000	$14,609,000,000
24	..	..	..	..	..	..
25	$4,797,000,000	$5,318,000,000	$6,057,000,000	$6,984,000,000	$9,732,460,000	$9,279,420,000
26	$14,451,000,000	$15,406,000,000	$18,858,000,000	$22,231,000,000	$21,050,000,000	$24,458,000,000
27	$199,330,000	$380,690,000	$399,240,000	$370,890,000	$492,530,000	$508,570,000
28	$3,930,000,000	$4,266,000,000	$4,602,000,000	$5,013,000,000	$5,103,000,000	$5,222,000,000
29	$518,820,000	$541,480,000	$378,970,000	$360,810,000	$382,000,000	$383,000,000
30	..	..	..	..	..	..
31	..	..	..	..	..	..
32	..	..	..	..	..	..
33	..	..	..	..	..	..
34	..	..	..	..	..	..
35	..	..	..	..	..	..
36	$2,472,000,000	$3,337,000,000	$4,905,000,000	$6,714,000,000	$7,446,000,000	$7,844,000,000
37	$58,650,000,000	$65,268,000,000	$74,800,000,000	$84,239,000,000	$87,823,000,000	$92,155,000,000
38						
39						

	Q	R	S	T	U	V	W
1							
2							
3	1988	1989	1990	1991	1992		
4	$86,502,000,000	$88,024,000,000	$88,934,000,000	$88,506,000,000	$91,211,000,000		
5	$1,221,150,000	$1,272,040,000	$1,419,310,000	$1,277,000,000	$1,411,000,000		
6	$258,180,000	$259,720,000	$297,960,000	$297,990,000	$306,480,000		
7	$1,71[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
9	$43,811,470,000	$45,[illegible]	[illegible]	[illegible]	[illegible]		
10	$5,832,050,000	$6,331,350,000	$7,003,650,000	$7,587,200,000	$7,882,000,000		
11	$5,334,950,000	$5,907,650,000	$6,287,350,000	$7,060,800,000	$8,031,000,000		
12	$1,997,000,000	$2,180,000,000	$2,306,000,000	$2,498,000,000	$2,339,000,000		
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
14	$732,960,000	$676,150,000	$617,960,000	$598,070,000	$525,270,000		
15	$637,000,000	$686,000,000	$739,000,000	$714,000,000	$555,000,000		
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
17	$378,090,000	$434,670,000	$500,910,000	$486,450,000	$325,620,000		
18	$68,481,440,000	$68,539,430,000	$67,201,000,000	$65,297,000,000	$65,874,000,000		
19	$881,000,000	$904,000,000	$939,000,000	$974,000,000	$1,057,000,000		
20	$2,850,050,000	$2,838,420,000	$2,752,980,000	$3,554,830,000	$3,681,310,000		
21	$10,317,380,000	$11,628,010,000	$11,693,010,000	$11,220,160,000	$11,453,680,000		
22	$1,104,530,000	$1,041,200,000	$1,047,610,000	$1,048,780,000	$1,059,020,000		
23	$13,023,460,000	$12,276,790,000	$12,352,380,000	$12,366,210,000	$12,486,970,000		
24	..	..	..	..	..		
25	$10,085,370,000	$11,020,110,000	$10,255,580,000	$10,387,580,000	$9,967,740,000		
26	$24,168,000,000	$22,331,000,000	$20,635,000,000	$16,629,000,000	$16,119,000,000		
27	$521,620,000	$507,880,000	$470,410,000	$411,420,000	$397,260,000		
28	$5,530,000,000	$5,992,000,000	$7,055,000,000	$8,705,000,000	$9,652,000,000		
29	$405,230,000	$405,030,000	$455,130,000	$441,200,000	$454,130,000		
30	..	..	..	..	..		
31	..	..	..	..	..		
32	..	..	..	..	..		
33	..	..	..	..	..		
34	..	..	..	..	..		
35	..	..	..	..	..		
36	..	..	..	..	..		
37	$97,015,000,000	$102,055,000,000	$109,727,000,000	$116,952,000,000	$121,314,000,000		
38							
39							

	A	B	C	D
1	JAPAN: Business R&D Expenditures, 1973-1992, in current US dollars			
2				
3	INDUSTRY BY MODIFIED ISIC CATEGORISATION	1973	1974	1975
4	3000 TOTAL MANUFACTURING INDUSTRY	$4,545,[illegible],598	$5,174,609,696	$5,352,943,159
5	3100 FOOD, DRINK & TOBACCO	$129,779,168	$132,244,521	$155,439,872
6	3200 TEXTILES, FOOTWEAR & LEATHER	$73,601,472	$71,[illegible]	$76,144,749
7	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]
9	3500 CHEMICALS	$1,076,541,406	$1,271,739,934	$1,334,687,153
10	[illegible]	[illegible]	[illegible]	[illegible]
11	3522 PHARMACEUTICALS	$237,048,215	$271,011,367	$320,735,200
12	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]
14	3600 STONE, CLAY & GLASS	$102,171,513	$130,450,561	$140,655,009
15	3700 BASIC METAL INDUSTRIES	$[illegible]	$367,365,105	$388,173,456
16	[illegible]	[illegible]	[illegible]	[illegible]
17	3720 NON-FERROUS METALS	$74,273,095	$92,015,886	$87,587,183
18	3800 FABRICATED METAL PRODUCTS AND MACHINERY	$2,710,971,356	$3,066,994,885	$3,109,577,471
19	3810 FABRICATED METAL PRODUCTS	$[illegible]	$[illegible]	$99,154,284
20	382-3825 NON-ELECTRICAL MACHINERY	$441,694,297	$633,024,253	$642,190,105
21	3825 OFFICE MACHINERY & COMPUTERS	$140,671,616	$106,922,870	$147,266,631
22	383-3832 ELECTRICAL MACHINERY	$540,669,856	$546,425,637	$561,676,606
23	3832 ELECTRONIC EQUIPMENT & COMPONENTS	$716,824,807	$846,997,249	$769,140,894
24	3841 SHIPBUILDING	$41,974,428	$44,981,114	$42,039,834
25	3843 MOTOR VEHICLES	$559,537,371	$617,468,016	$644,050,262
26	3845 AEROSPACE	$53,292,952	$60,998,458	$69,954,521
27	3842+3844+3849 OTH TRANSPORT EQUIPMENT	$26,644,637	$11,926,810	$13,116,428
28	3850 INSTRUMENTS	$113,640,044	$118,601,068	$120,987,904
29	3900 OTHER MANUFACTURING	$50,055,208	$57,860,860	$63,007,514
30	4000 ELECTRICITY, GAS, AND WATER			
31	5000 CONSTRUCTION	$128,005,153	$143,135,442	$178,715,590
32	7100 TRANSPORT AND STORAGE	$236,761,134	$251,650,233	$271,983,557
33	7200 COMMUNICATION SERVICES	$0	$0	$0
34	8324 ENGINEERING, ARCHITECTURAL, AND TECHNICAL SERVICES			
35	6+8-8324+9 OTHER SERVICES			
36	TOTAL SERVICES	$213,470,740	$215,351,958	$276,626,571
37	TOTAL INDUSTRIES	$4,791,792,418	$5,440,461,517	$5,676,909,599
38				
39	SOURCE: OECD, DSTI (STAN/ANBERD), 1994			

	E	F	G	H	I	J
1						
2						
3	1976	1977	1978	1979	1980	1981
4	$6,008,767,493	$7,414,993,855	$10,320,281,315	$11,539,198,686	$13,161,771,192	$15,728,212,569
5	$171,724,836	$215,723,809	$292,316,100	$340,403,395	$430,537,179	$452,457,604
6	$70,534,480	$70,272,988	$115,363,049	$149,949,804	$150,873,247	$292,250,839
7	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]
8	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]
9	$1,448,634,532	$1,796,119,123	$2,485,780,745	$3,716,779,101	$3,145,209,889	$2,421,683,141
10	$817,339,103	$939,477,152	$1,280,621,555	$1,427,963,859	$1,634,830,202	$1,808,832,865
11	$369,371,101	$448,510,655	$640,153,263	$807,289,326	$837,249,713	$990,455,246
12	$60,930,703	$100,729,994	$118,255,985	$118,755,134	$286,257,387	$183,930,353
13	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]
14	$175,811,836	$206,745,000	$277,580,060	$332,041,234	$367,037,135	$381,336,719
15	$433,218,682	$501,202,935	$676,373,313	$728,132,701	$890,989,680	$1,076,067,833
16	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]
17	$96,546,957	$115,068,340	$163,538,301	$180,574,062	$242,387,757	$306,806,022
18	$[illegible] 557,704,829	$4,446,372,623	$6,307,819,991	$7,022,610,498	$7,879,724,798	$9,801,441,116
19	$[illegible]136,469,398	$143,670,627	$189,830,831	$249,009,765	$229,456,646	$293,021,674
20	$[illegible]3,291,860	$889,088,955	$998,937,860	$1,110,175,237	$1,298,182,759	$1,498,244,029
21	$16[illegible],528,186	$251,833,698	$370,172,083	$429,862,766	$496,584,700	$629,044,169
22	$696 004,047	$853,227,068	$1,268,770,196	$1,421,465,730	$1,240,186,998	$1,550,367,280
23	$944, 33,868	$972,978,672	$1,416,096,000	$1,610,171,068	$2,189,427,481	$2,719,209,876
24	$39,5[illegible]9,849	$36,643,186	$39,207,580	$37,354,392	$37,513,460	$36,817,531
25	$727,06[illegible] 358	$977,026,983	$1,539,136,602	$1,636,[illegible]370	$1,770,193,961	$2,267,232,651
26	$26,262,[illegible]49	$70,670,124	$96,110,081	$111,607,[illegible]38	$100,183,051	$111,362,329
27	$25,235,8[illegible]7	$38,138,826	$60,723,936	$64,231,332	$79,8[illegible]39	$121,36[illegible]421
28	$145,756,19[illegible]	$213,094,484	$328,834,822	$352,427,672	$438,114,140	$[illegible]74,780,035
29	$66,093,408	$84,540,613	$116,897,928	$112,398,467	$153,025,492	$152,[illegible]87,556
30				$172,597,426	$204,873,423	$238,455,609
31	$171,971,000	$229,157,201	$243,356,776	$264,127,955	$333,818,470	$330,511,472
32	$299,210,926	$417,187,442	$591,156,624	$120,101,305	$77,723,384	$81,132,674
33	$0	$0	$0	$0	$0	$0
34						
35				$3,860,546	$7,607,833	$6,456,879
36	$285,955,151	$393,281,442	$488,500,285	$550,333,120	$618,329,364	$649,315,317
37	$6,347,091,553	$7,856,[illegible]18,200	$10,886,713,553	$12,160,764,808	$13,858,428,156	$16,458,546,957
38						
39						

	K	L	M	N	O	P
1						
2						
3	1982	1983	1984	1985	1986	1987
4	$15,552,432,953	$18,385,331,144	$20,708,150,893	$23,988,439,613	$34,989,912,177	$43,328,263,274
5	$458,017,504	$503,856,680	$560,167,565	$611,201,476	$950,308,569	$1,336,255,531
6	$208,242,332	$214,799,377	$250,353,654	$262,379,475	$372,270,354	$459,561,670
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	$3,353,[illegible]	$3,93[illegible]	$4,385,630,852	$4,820,973,422	$7,134,756,519	$9,244,690,265
10	$1,727,322,145	$2,040,466,718	$2,347,208,656	$2,498,[illegible]	$3,607,304,771	$4,944,593,[illegible]
11	$962,811,145	$1,220,563,345	$1,243,196,362	$1,433,218,747	$2,029,302,160	$2,632,058,905
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	$375,814,998	$477,045,173	$552,673,459	$730,176,457	$1,113,109,989	$1,229,825,774
15	$1,023,072,909	$1,094,850,161	$1,177,787,134	$1,409,289,062	$2,160,080,844	$2,417,209,241
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	$289,284,567	$311,363,732	$369,051,027	$421,463,905	$654,094,469	$722,130,808
18	$9,822,692,044	$11,761,738,446	$13,359,834,863	$15,676,780,715	$22,546,753,444	$27,770,926,648
19	$260,293,881	$348,722,159	$351,507,241	$430,535,759	$561,779,017	$655,662,334
20	$1,461,710,896	$1,666,781,016	$1,855,224,142	$2,098,854,119	$3,002,780,896	$3,679,723,645
21	$654,587,049	$847,353,290	$1,278,839,732	$1,450,961,526	$2,207,650,165	$3,227,524,961
22	$1,548,775,494	$1,926,600,985	$2,265,792,354	$2,583,252,285	$3,676,447,899	$4,602,488,938
23	$2,927,643,826	$3,536,627,787	$3,862,245,060	$4,721,211,132	$6,586,630,918	$8,102,928,364
24	$37,254,271	$48,448,012	$37,515,849	$46,029,109	$48,331,968	$60,768,123
25	$2,174,768,160	$2,422,818,279	$2,804,415,089	$3,189,398,778	$4,741,837,544	$5,476,036,565
26	$109,760,440	$185,868,575	$96,108,158	$160,265,528	$320,655,822	$408,804,320
27	$108,958,729	$109,843,339	$103,273,966	$150,640,719	$218,672,682	$145,014,840
28	$539,939,297	$668,675,003	$704,913,270	$845,631,760	$1,181,966,532	$1,411,974,558
29	$147,364,140	$157,361,795	$187,142,135	$193,137,419	$312,419,891	$377,191,648
30	$194,772,764	$238,503,642	$271,577,130	$265,586,484	$412,402,089	$449,343,197
31	$323,707,241	$[illegible],565,192	$[illegible].918,328	$464,467,175	$718,626,869	$887,050,608
32	$71,563,378	$65,588,817	$65,194,510	$78,624,130	$40,861,619	$58,621,405
33	$0	$0	$0	$0	$0	$0
34						
35						
36	$583,748,193	$724,180,035	$820,983,496	$804,477,237	$1,175,528,127	$1,394,496,681
37	$16,215,753,975	$19,199,738,958	$21,626,094,645	$24,901,274,419	$36,317,113,696	$44,899,543,695
38						
39						

	Q	R	S	T	U	V	W
1							
2							
3	1988	1989	1990	1991	1992		
4	$54,259,851,736	$57,507,973,326	$61,473,168,036	$69,614,727,934	$72,264,848,006		
5	$1,525,189,231	$1,589,025,805	$1,625,802,887	$1,673,962,371	$1,830,430,320		
6	$567,982,833	$589,033,053	$609,503,419	$681,426,769	$936,328,464		
7	$139,110,417	$217,534,068	$170,108,433	$230,561,948	$216,549,546		
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
10	$6,039,851,736	$6,218,701,073	$6,220,733,476	$7,108,618,514	$7,561,010,659		
11	$3,247,912,602	$3,301,942,192	$3,564,472,685	$4,380,558,236	$4,833,336,759		
12	$584,894,901	$610,314,584	$635,126,735	$657,538,416	$699,384,129		
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
14	$1,549,949,279	$1,584,998,952	$1,498,981,145	$1,988,245,881	[illegible]		
15	$2,887,296,137	$2,864,409,974	$3,069,272,740	$3,778,796,301	$3,614,498,644		
16	$1,949,762,748	$1,943,541,606	$2,098,211,202	$2,672,808,255	$2,459,415,713		
17	$938,532,969	$920,868,368	$971,061,537	$1,105,988,046	[illegible]		
18	$35,240,943,235	$37,799,050,579	$41,430,484,236	$46,020,655,493	$47,475,538,887		
19	$699,071,401	$792,432,589	$895,089,440	$1,018,929,552	$1,001,010,659		
20	$4,412,279,877	$4,885,130,943	$5,536,039,726	$6,230,800,404	$6,596,420,445		
21	$4,703,457,474	$5,891,812,442	$6,183,477,222	$6,919,346,304	$6,515,022,666		
22	$5,788,724,151	$6,280,262,395	$6,880,309,414	$7,497,609,680	$7,638,144,493		
23	$10,019,174,319	$9,595,584,318	$10,027,805,828	$11,613,896,086	$12,616,005,025		
24	$73,538,278	$85,004,930	$89,128,251	$108,576,859	$151,674,631		
25	$7,181,716,917	$7,768,869,332	$8,830,605,998	$9,384,142,790	$10,016,969,848		
26	$380,993,334	$449,002,838	$549,278,834	$788,863,898	$521,477,814		
27	$118,912,960	$122,058,360	$119,528,584	$127,780,929	$135,155,456		
28	$1,863,074,522	$1,928,892,433	$2,319,220,941	$2,330,702,992	$2,583,647,848		
29	$443,324,229	$450,224,703	$479,936,460	$575,131,765	$611,259,376		
30	$572,820,913	$546,187,301	$671,109,883	$672,385,124	$868,495,855		
31	$1,158,501,756	$1,342,033,923	$1,468,333,448	$1,518,847,895	$1,922,376,629		
32	$58,837,300	$69,860,829	$107,811,313	$177,767,055	$146,869,325		
33	$0	$0	$0	$0	$0		
34					$0		
35					$0		
36	$1,794,771,752	$1,962,887,794	$2,248,774,087	$2,369,534,556	$2,937,741,808		
37	$56,334,920,016	$59,682,661,641	$64,003,038,884	$72,326,093,089	$75,489,024,872		
38							
39							

cover sheet

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TECHNOLOGY
ASSESSMENT
Washington, DC
20510-8025

Fax to: Mr. Fiarel S. Jones
OSTP

Phone: 395 6175
Fax: 456 6023

Fax from: Paul Doremus

Phone: 228 6350
Fax: -6344
Date and Time:

TOTAL NUMBER OF SHEETS INCLUDING COVER: 6

NOTES

Dear Skip.

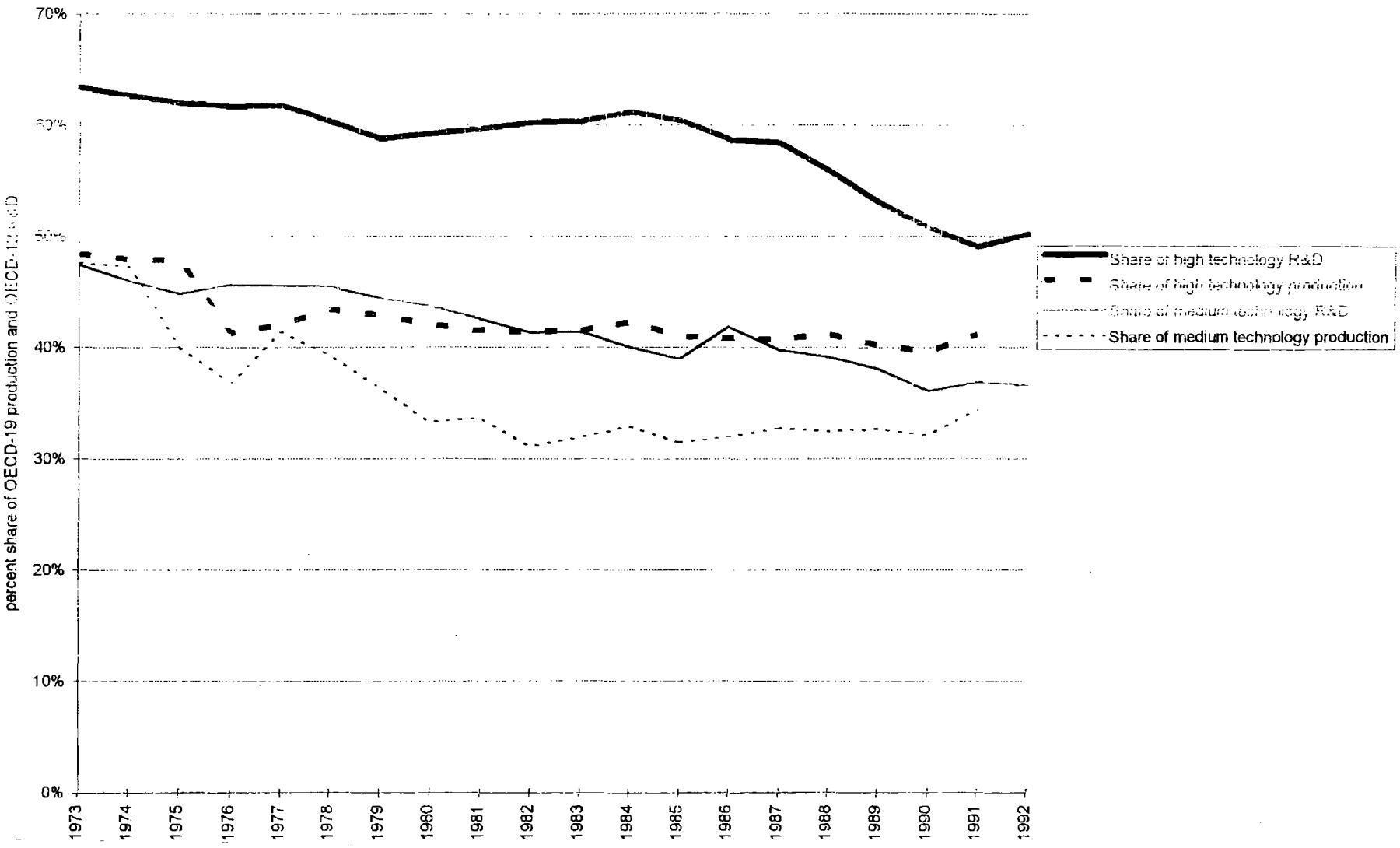
I'm not sure what sort of measures you're looking for, but I have looked at a number of different technology and competitiveness metrics, and am sending a few charts that may be of interest

BEST,

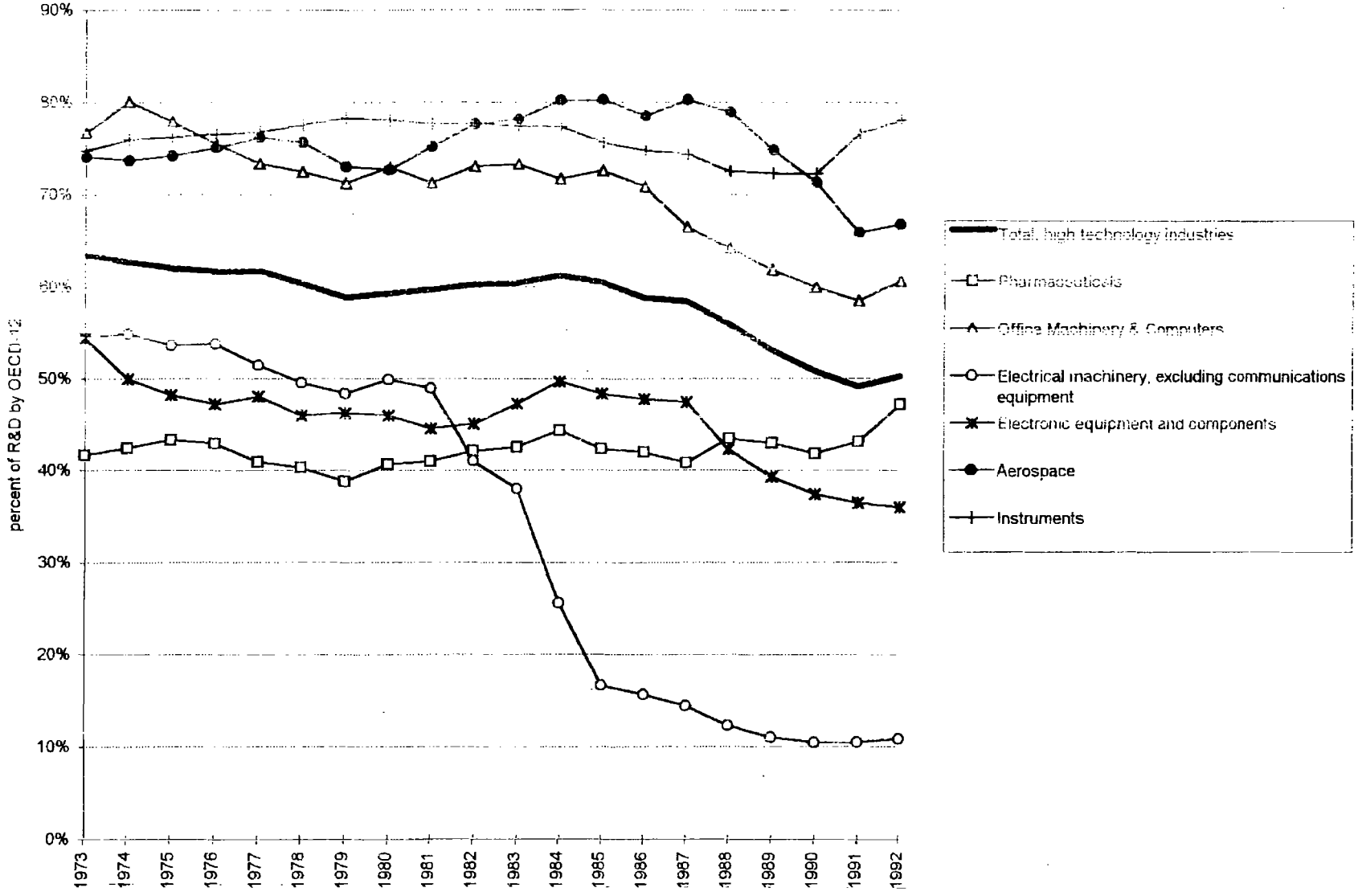
Paul Doremus

If faxed pages are not legible, or if you are not receiving the correct number of pages, please call ↑
or _____ at 202.2_ _-_____.

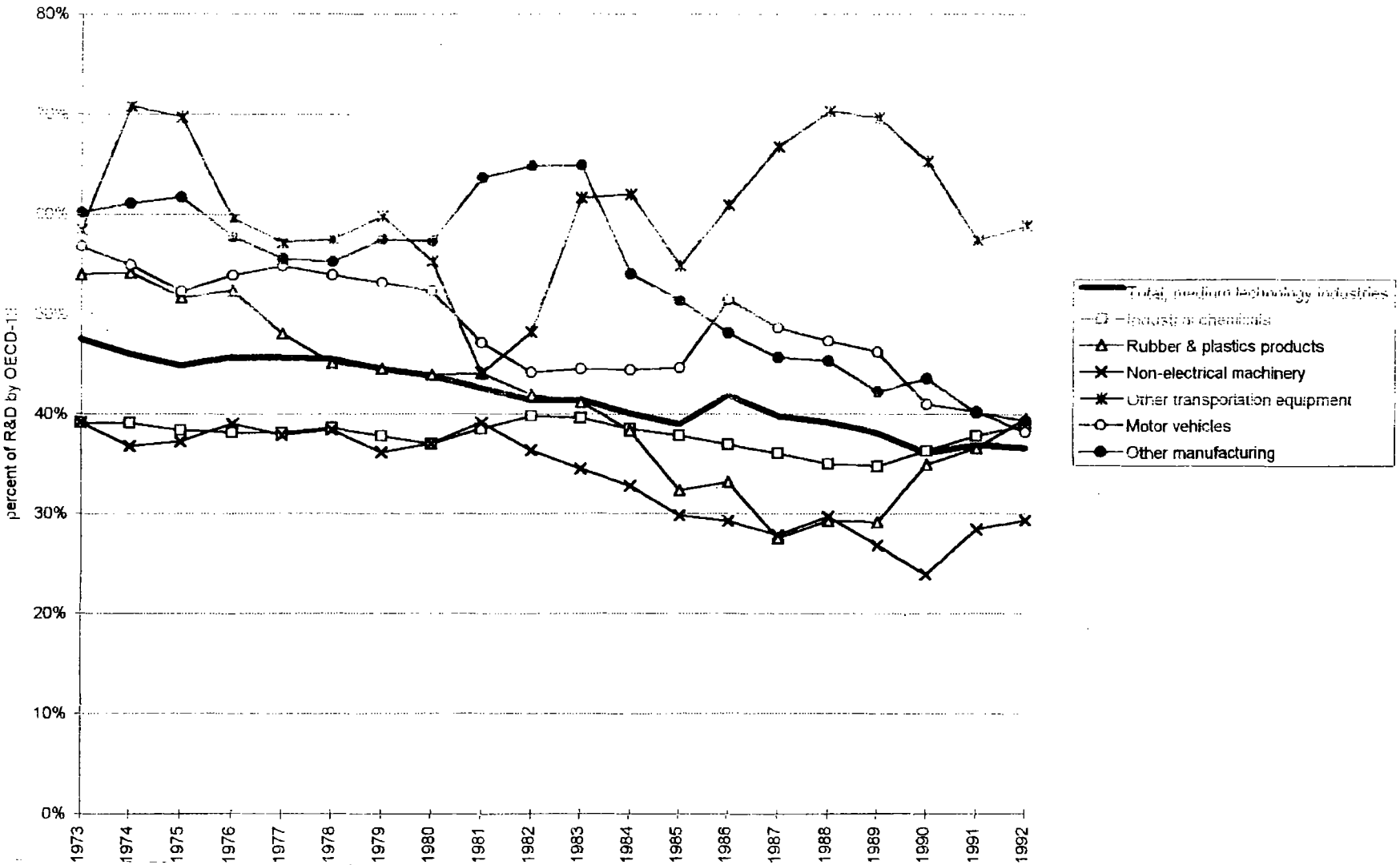
U.S. Share of OECD Production and R&D: High and Medium Technology Industries, 1973-1992



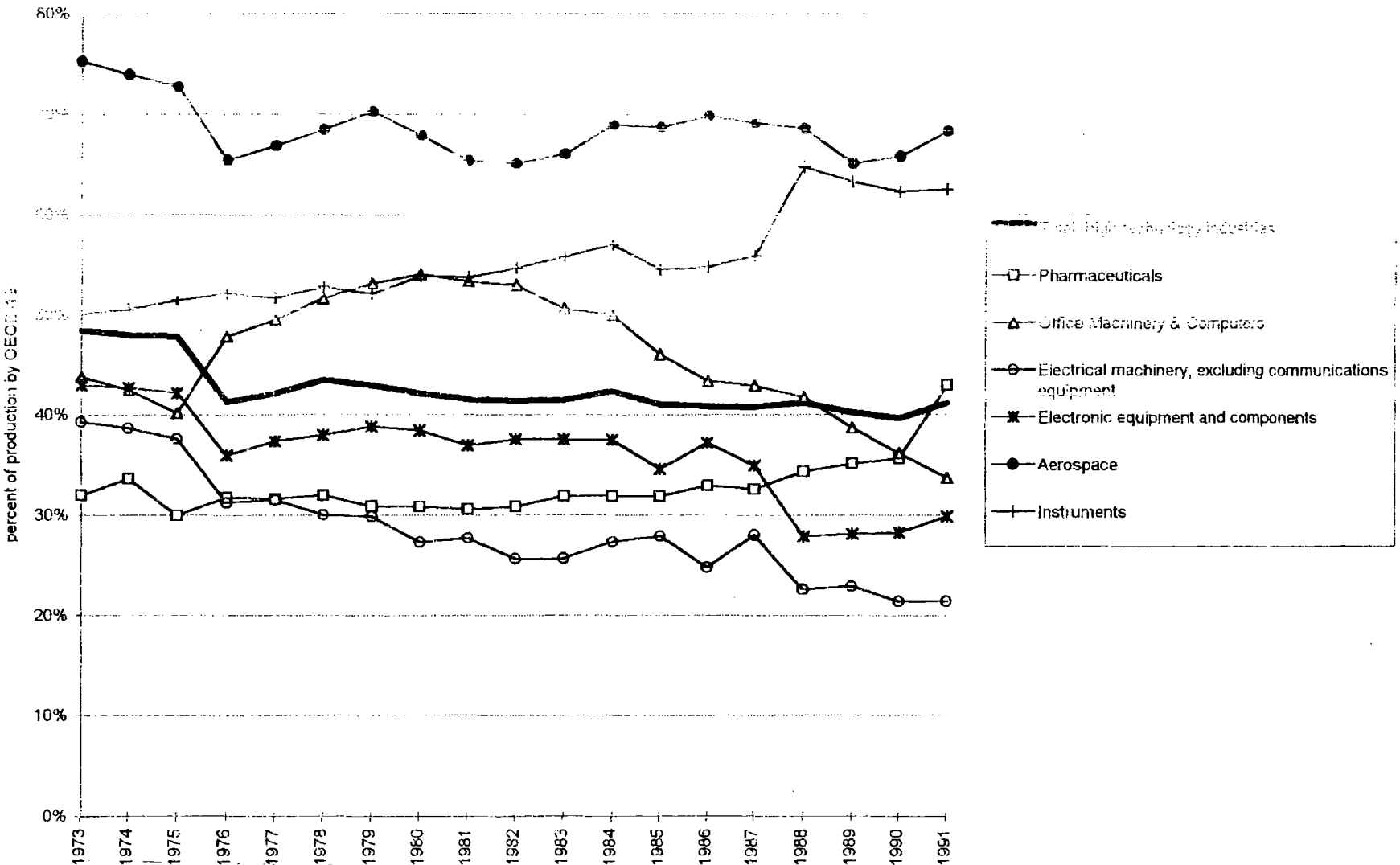
U.S. Share of OECD R&D Expenditures: High Technology Industries, 1973-1992



U.S. Share of OECD R&D: Medium Technology Industries



U.S. Share of OECD Production: High Technology Industries, 1973-1991



U.S. Share of OECD Production: Medium Technology Industries, 1973-1991