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Appendices to "Internationally Comparable Science, Technology and Competitiveness Indicators"

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APPENDICES TO

"INTERNATIONALLY COMPARABLE SCIENCE, TECHNOLOGY AND COMPETITIVENESS INDICATORS"

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Appendix A, Detailed discussion of sources and methods

R&D Input Prices

In the main text we have given a broad description of the construction and selection of PPPs to cover the different cost categories. In this part of the appendix we deal with a few issues in further detail. The most important issue turned out to be deriving an internationally comparable estimate for total R&D personnel in the United States. Since labor is the largest cost component of R&D, the labor PPP is the most critical. As the labor PPP at the industry level is calculated as R&D labor cost over R&D personnel, consistent personnel estimates are essential.

1. Assessment about technicians

In the United States only the total number of researchers, scientists and engineers (RSEs) is available from the R&D survey. One important question is whether RSEs also include technicians or not. Interviews with firms suggested that there is not a major distinction between technicians and RSEs. Distinctions are usually only made between those staff members that work directly on R&D projects from those that do not. The latter group is basically overhead labor and consists of administrative support, R&D managers, finance and human resources, etc. This observation suggests that the figures reported as RSE likely include technicians as well.

We also have quantitative findings that are confirmatory. If a labor PPP is calculated on the basis of scientists and engineers in both the Netherlands and the United States, the resulting PPP is implausibly high. (The level of detail in the Netherlands R&D survey makes this comparison possible.) The labor cost level in the Netherlands would be more than twice as high as in the United States, an implausible finding based on interviews. If, however, we also include the technician category with scientists and engineers, the relative labor cost level in the Netherlands is much closer to that in the United States (about 90% of the U.S. level). This finding suggests that it is plausible that RSE includes all personnel engaged in research.

2. Estimation of U.S. support personnel

The proportion of support personnel in the United States is much harder to determine. The data from the 1975 R&D survey suggests that firms spend about 35% of their R&D wages on support personnel. However, with the advent of PCs, and the subsequent restructuring and reorganization in U.S. manufacturing this number has probably been reduced. And even if this percentage were still correct, it would not tell us the share of support staff in total personnel.

As mentioned in the main text, for 1997 we use the share of support personnel in total industry employment as our measure of the R&D support share. The source for these data is the Occupational Employment and Wage Survey of the U.S. Bureau of Labor Statistics (BLS, 1997). In manufacturing industries, clerical and administrative support makes up between 7% and 11% of total employment. If we include managerial and administrative personnel, the percentage rises to between 12% and 20%. Including these seems reasonable, based on our interviews. The firms we have met with consider all personnel not directly involved in R&D projects to be part of support, so this includes the R&D managers.

In Table A1 we show this measure, as well as measures based on national R&D surveys for the other countries. For 1987 we calculated the average support share for each industry for France, Germany, Japan and the United Kingdom and applied this to the United States. The resulting support share for total manufacturing is below the aggregate share for each of the other countries. This is due to the higher concentration of R&D efforts in low-support share industries in the U.S., such as electrical machinery and electronic equipment. We decided to rely on this simpler procedure because our estimates for 1997 placed the U.S. support share in the same range as that of other countries and the BLS survey we used in 1997 was not available for 1987.

Table A1 about here

The U.S. support share turns out to be a crucial factor for estimating reliable R&D PPPs. The reason is that the estimate will affect the average price of R&D labor directly,

which represents about half of the R&D PPP as a whole. We therefore collected as much evidence as possible on this problem.

First of all, our research indicated that the support share from 1975 of 35 percent is probably too high in both 1987 and 1997. The results from data collected in firm interviews suggested a much lower percentage, between 10-25% and on average 16%. This is based on headcount data for five U.S. firms that supplied these figures. The exception to this ranking is a dedicated R&D firm, which has a support staff around 35% of total. In a sense, this figure gives a better picture of how much support is needed in total, since for R&D labs, a part of the support services, like those of headquarters they receive may not be attributed to R&D as a direct cost. We observed this in the case of many of the dedicated R&D laboratories we interviewed. Also, some support services, like IT support, may be outsourced. Then these costs would show up as overhead instead of labor cost. But what we really want is a *consistent* internationally comparable share.

Data on support staff from the R&D surveys of other countries put the percentage between 15-25%. Also, we can track the support percentage for these countries for total manufacturing since the early 1980s. In all countries, the support percentage dropped during this period. The most dramatic example is the Netherlands, which had a support percentage of 30% in 1981. By 1989, it had dropped to 16% and from there on it stayed in this range.

In the 1997 Economic Census, there is also information on the occupation of personnel in R&D establishments (separate R&D labs). The share of workers engaged in R&D to total employment in R&D establishments is about 80%. By deduction, this implies a support percentage of about 20%.[1] However, since this is on an establishment basis (and the R&D survey is on a firm basis), the support services from corporate headquarters will not be included in these figures.

The occupational wage and employment data also allow us to make a direct estimate of wages of RSEs and support staff from interviews. If we have average scientists and engineers' wages, we can calculate the wage sum of RSEs. We therefore

[1] The number of R&D workers in R&D establishments make up about 20% of total RSEs, as given by the NSF R&D Survey. So the 20% support personnel is applicable to a sizable part of the R&D performed in the United States.

use the occupational employment and wage data to get the number of persons and their wage in over 200 occupations by 2-digit and 3-digit SIC industry (BLS, 1997). The first step is to calculate the average wage for a scientist or engineer.[2] This allows us to estimate how much of the total labor cost is spent on this group of R&D workers.[3] By inference, the remainder is then spent on support personnel. The wage for this group (which we assume to consist of both managerial & administrative and clerical & administrative support) is then used to estimate the number of support personnel:

$$w_T T = w_{RSEs} RSEs + w_{Sup} Sup \quad (1)$$

In equation (1), w_i is the wage of group *i*. From the R&D survey, we have information on the total wage sum $w_T T$ and on the number of RSEs. From the occupational wage data, we estimate $w_{S\&E}$ and w_{Sup}. Calculation of the total number of R&D personnel *T* is then straightforward.

We had to adjust the wage data to include bonuses (using Watson Wyatt, 1998), because the Occupational Employment Survey only asks for the base pay. The Table shows the support percentage based on a variety of assumptions, which seem plausible based on what we were told in interviews.

Support staff as a percentage of total personnel under various assumptions

	Support	
	Assumption 1	Assumption 2
Researchers, scientists and engineers		
Assumption A	25.2%	25.5%
Assumption B	31.3%	15.7%

Assumption A: researchers do not include technicians
Assumption B: researcher do include technicians
Assumption 1: support consists of both managers and secretarial workers
Assumtpion 2: support consists only of managerial support

Above, we argued that technicians would likely be included with other researchers, but this is not necessarily the case. Also, most interviews suggest very lean organizations with little or no administrative support in the form of secretaries and such. We would

[2] For the calculation of the average wage, we included two technician occupations as well, for the above-mentioned reasons.
[3] For transport equipment, this leads to the implausible result that the wage sum for S&E was higher than the total labor cost. Here we assumed that the wage is equal to that in total manufacturing.

however argue that most managers within R&D would be classified as support staff, since they do not actually do (much) research. These assumptions together define a fairly broad range over which the support percentage can vary. The sensitivity to various assumptions, in particular, argues against using these data for our support estimates and argues for using the total industry support shares directly.

Another approach to the problem can be taken through international wage surveys. The "Global Remuneration Planning Report" by Watson Wyatt (1998) supplies data on comparable pay grades and the occupations that fall in such a pay grade economy-wide. This allows us to directly calculate PPPs for each of the categories of R&D workers and compare these to the labor PPPs we used above. We do this for both scientists and engineers and support personnel and use the support percentages to come up with an overall R&D labor PPP. If we exclude an inconsistent outlier from the data, the resulting labor PPPs are generally closer to the labor PPP using the lower support estimate than that based on the high support estimate for the U.S. If we include the outlier, the high support estimate results in an implausibly high relative labor cost level of each country relative to the U.S.

Finally, we looked at data on occupational employment from the ILO. This refers to aggregate employment in several broad employment categories. If we calculate the support percentage based on a narrow definition, including only clerical workers, the support percentages are broadly comparable to those found based on the international R&D surveys. A broader definition, including administrative personnel and managers (but even legislators) puts the support percentage of around 30% of total employment. The narrow definition seems more comparable to our R&D support figures so this once again suggests that the low support figure in the U.S. (around 15-20%) is the most plausible.

Overall, it is not entirely clear which support percentage is 'better'. If we are interested in asking how much support staff is needed to run an R&D lab, then the information from the independent R&D firms is the most useful. The support staff within the R&D industry may be a good proxy as well. However, from the perspective of international comparability, this is probably not the best answer. Since most R&D is done within a larger firm, there are always going to be hidden support costs and the extent of

this is hard, if not impossible, to disentangle. For this purpose, the support percentages from firm interviews or those derived from industry estimates are probably more applicable. Also, since support percentages have dropped considerably over time in the other countries, we can expect that a similar shift has taken place in the United States over this period. We have therefore chosen to apply the (lower) industry-wide support percentages for the United States from the Occupational Employment and Wage Estimates (BLS, 1997).

3. *FTE vs. headcount*

One other issue with R&D personnel is that the R&D surveys collect data on the number of full-time equivalent (FTE) workers. This is in line with the Frascati Manual's recommendations. The motivation is that a significant part of R&D personnel also has functions outside of R&D. These workers should not be fully counted as R&D personnel, nor should they be excluded. The FTE measure allows a more exact allocation of work time to R&D. The exception, however, is Japan, which reports on the number of persons employed in R&D, which is likely to include persons that are only part-time employed in the R&D operation. In NSF (1998) a 30% downward adjustment was made based on studies by Japanese authorities, but the exact basis for these rather large adjustments is not entirely clear. Moreover, higher working hours in Japan that are shown in statistics and confirmed in our interviews suggest that there may be an under-representation of labor input. But without better information we decided not to make any adjustments.

4. Sensitivity test: hedonic experiment

The implicit assumption that R&D labor in each of the six countries in our study is of comparable quality is subject to debate. If we were able to further disaggregate the labor data or to measure its quality on an internationally consistent basis, we could improve the comparison of labor costs. However, there is only one internationally comparable measure of R&D labor quality that we identified – the support share in personnel. This is a very imperfect measure, but we thought it would be worthwhile to attempt a "hedonic" regression of labor costs on this measure. Several functional forms with country-specific coefficients for the support share and dummy variables for industries were experimented with. Unfortunately, none of the specifications yielded an

estimate with significant coefficients. This suggests that either R&D labor quality does not vary much across the countries in our study or the support share is a poor proxy measure of quality.

5. Margin adjustments

For some of our R&D input prices we have to make adjustments so they reflect the right valuation concept. So in the case of purchases of materials, the firm in question pays the purchaser price, while in the case of an industry's output, the right comparison is across countries is to look at producer prices. In general, the PPPs developed using the industry-of-origin approach in the ICOP project are valued at producer prices, while ICP PPPs are valued at purchaser prices. This means the prices used to calculate ICP PPPs include transport costs, distribution costs and indirect taxes on products, while ICOP PPPs do not include these.

To be even more specific, firms do pay for transport and trade, but taxes on purchased goods can usually be reclaimed. This means purchases should be valued at purchaser prices excluding tax margins. We estimate each of these three cost types from Input/Output tables, recently compiled by the OECD in preliminary form. Transport and distribution margins are calculated as the services provided by the transport industry (ISIC 60-63) and trade (ISIC 50-52) as a percentage of gross output. For indirect taxes we perform a similar calculation using the Taxes on Products line from these tables.

We then apply these margins to our PPPs. For example, if we have an ICOP PPP (at producer prices) and we want to adjust so as to include transport and distribution margins we perform the following calculation:

$$PPP^{ADJ} = \left(\frac{1+T^X}{1+T^U}\right)\left(\frac{1+D^X}{1+D^U}\right)PPP$$

So we multiply the unadjusted PPP by one plus the trade margin (T) in country X over one plus the trade margin in country U, where country U is the base country (the United States in our comparisons). Margins can similarly be 'peeled-off' by dividing the PPP by the relevant ratio of margins.

6. Other current and capital costs

Table A2a and A2b give an overview of which PPPs we selected to cover other current expenditure and capital expenditure, for 1997 and 1987. These selections were mostly based on interviews with firms that told us what their overhead and capital expenditure generally consists of. We include some machinery categories in both other current expenditure and capital expenditure since at least in the United States, much equipment cannot be capitalized since they do not directly contribute to revenues. We performed the margin adjustments noted above to the ICOP and ICP PPPs.

Tables A2a and A2b about here

In both tables we have marked a few PPPs in italics. These PPPs have a particularly large impact on the average we use as the PPP for these cost categories, since they are outside of a 95% confidence interval around the mean. The means with outliers excluded give an indication of the sensitivity of the PPPs. In both tables we show what the PPP would be if the extreme PPPs are been omitted, and indeed the resulting average is substantially lower.

However, the impact on the overall R&D PPP is much more limited. Looking at our preferred R&D PPP (lab+mat+oc+cap), the use of the excluded outliers PPPs reduces the relative cost level by 3.5% in the case of Japan in 1997 and this is the largest adjustment. Furthermore, a very high price level need not only be ascribed to measurement error but may reflect a relatively low productivity level in the industries that produce these goods or services.

R&D expenditure weights

To weight the R&D input prices we use information from the R&D surveys on expenditure by cost category. These data were not always complete and organized according to a common classification. The problems basically fall into two categories, first of all problems in collecting R&D expenditure performed by business enterprises for each industry, and second in calculating and estimating the cost shares for each of the cost categories.

1. R&D expenditure

In collecting a consistent dataset of R&D expenditure by industry we made extensive use of OECD databases, where considerable effort has been made to reconcile differences in classification. Despite these efforts, for some industries no data could be found in the OECD databases or from national sources, so we had to combine some industries. In Tables A3a and A3b we show which methods we used to estimate missing R&D expenditure data for 1997 and 1987 respectively. In many cases we had to use the average share for detailed industries from other countries and apply them to available aggregates. In some cases for 1987, we used the shares from 1997.

In cases where we did not have expenditure data for detailed industries, we were also forced to use the same labor PPPs and input expenditure shares as for the aggregate industry. However, we still were able to use our industry-specific materials PPPs for those industries.

Tables A3a and A3b about here

In addition, for a number of industries in the United States in both 1987 and 1997, data is only available for business-funded, business enterprise R&D. This means the amount of federal funding has to be imputed. For some industries the information is available for years close to either benchmark year. If no reasonable proxy is available, the amount of federal funding is distributed according to the industry's business-funded, business enterprise R&D expenditure share.

2. U.K. expenditure shares

For the United Kingdom, no cost breakdown is available in 1987. The closest year for which data is available is 1989. We therefore use those shares for the 1987 calculations. In the case of materials expenditure, we relied on the data from Cameron (1996), who presents these data for 1989 for a number of industries. We use the 1989 share of materials in total non-labor current expenditure to calculate the 1987 share of materials in total R&D expenditure. We use the average of the share of materials in total

non-labor current expenditure from this study over the period 1989-1992 to calculate the 1997 share of materials in total R&D expenditure.

3. Share of materials expenditure

For Japan, the United Kindgom, and the United States, we only have information on the share of materials expenditure for 1997. For 1987 we only have information for the United Kingdom and United States. For France, Germany and the Netherlands, these costs are included in other current expenditure. We use the average share of materials expenditure in total non-labor current expenditure (materials + overhead) for these countries.

Looking at 1997, the materials share in non-labor current expenditure did not differ that much when comparing Japan, the United Kingdom and the United States. For total manufacturing the share varied between 43 percent (Japan) and 51 percent (United Kingdom). For some industries, the difference is larger with the largest difference occurring in pharmaceuticals with a share of 58 percent in the United Kingdom and only 20 percent in Japan and the United States. The final R&D PPPs are not affected to a large degree by these variations. To take pharmaceuticals, if we assume a 20 percent materials share instead of 33 percent (the average over the three countries), the German relative cost level in pharmaceuticals rises from 102.8 percent of the U.S. level to 103.2 percent. France and the Netherlands were even less affected. These small differences are due to the relatively small differences between the materials PPP and the other current PPP in many cases. For 1987 we use the average of the materials share for the U.K. and U.S. and apply it to the other four countries. Here too this choice has no dramatic impact on the PPPs.

4. Share of capital expenditure

Since 1998, the NSF has included a cost category in the U.S. R&D Survey called 'R&D Depreciation,' which is intended to reflect depreciation on capital (assets) related to R&D. In the other countries, firms report on capital expenditure. If capital expenditure were to remain constant over time, capital expenditure and depreciation would be equal. However, if capital expenditure rises over time, depreciation will be lower. In Japan, both capital depreciation and capital expenditure are collected. For 1997, 22 of the 26

industries had a higher capital expenditure than depreciation figure. On average, capital expenditure was 25% higher than depreciation. This suggests that in practice there may be important differences between the two measures.

As mentioned above, the dividing line between these expenditure categories will differ across countries, depending on accounting rules. Interviews of United States, European, and Japanese companies suggest that many purchases of capital dedicated to R&D are expensed since R&D expenditure does not directly contribute to revenue. At least in the United States, FASB rules prevent depreciation from being charged on most assets dedicated to R&D. If we look at the cost shares, the U.S. capital share is much lower than the capital share in most other countries (just 1.3% for overall manufacturing in the United States versus 6-12% in the other countries).

This could partly be caused by the fact that capital depreciation understates capital expenditure if capital expenditure rises over time. However, the Japanese evidence suggests that this could add 25% to capital depreciation under analogous circumstances, which still leaves the United States with much lower capital expenditure than the other countries. Part of the difference may come from different business practices. For example, if the firm owns the building in which R&D is performed, then it will be a capital expenditure. If on the other hand the building is leased, the rent will show up as a current cost. Interviews have suggested that this treatment is often different depending on countries and corporate policy. Accounting rules may also be important. If a piece of equipment can only be capitalized if it directly contributes to revenue, as in the United States, certain R&D equipment will be expensed instead. Still, the figures seem to be too low. Interview responses have put capital depreciation much closer to the international average.

Another possibility is that firms interpret the question on R&D depreciation in a different way than firms in other countries interpret capital expenditure. When we asked firms how large their R&D depreciation was, some respondents interpreted this as a question of whether they capitalize R&D expenditure. In most cases, this would only be possible if software developed by R&D was also going to be sold. In that case, R&D expenditure can be classified as an investment. This ambiguity may lead to underreporting of capital depreciation.

Based on these considerations we decided to use the average share of capital expenditure in total R&D expenditure for each industry from the other countries. Since the accounting considerations lead us to believe the capital expenditure will be included in the non-labor part of R&D expenditure, we keep the labor share fixed.

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TABLE A1
Share of support staff in R&D personnel, in total manufacturing

	Support share	
Country	1997	1987
France	15.3%	22.1%
Germany	28.9%	33.2%
Japan	20.4%	25.4%
Netherlands	18.6%	-
U.K.	17.5%	23.5%
U.S.	14.1%*	19.2%**

Note: Measured in full-time equivalents.

** Calculated based on the industry share of support personnel in total employment based on BLS (1997).*

*** Calculated based on average of France, Germany, Japan and U.K. at the industry-level. The U.S. share is much lower than in other countries due to industry composition differences.*

TABLE A2a

Prices used for 'Other current' and Capital R&D input categories, 1997

Other current costs		France	Germany	Japan	Netherlands	U.K.	U.S.
Printing and publishing	ICOP 21-22	1.00	0.84	162.3	0.78	0.77	1.00
Industrial Machinery	ICOP 29	0.61	1.02	110.3	0.66	0.57	1.00
Office, accounting and computing machinery	ICOP 30	1.06	0.82	117.0	0.94	0.43	1.00
Electrical machinery	ICOP 31-33	0.68	1.02	99.6	*1.46*	0.71	1.00
Electricity, gas and water	ICOP 40-41	0.79	*1.89*	185.1	0.73	0.87	1.00
Wholesale and retail trade	ICOP 50-52	1.11	*1.72*	*456.0*	1.07	0.78	1.00
Transport and storage	ICOP 60-63	1.27	*1.83*	276.6	0.61	0.86	1.00
Communications	ICOP 64	0.67	0.89	154.1	0.79	0.55	1.00
Insurance charges (except car and health)	ICP 1185011	1.24	1.02	*221.0*	0.95	0.77	1.00
Rents of tenants	ICP 1131011	0.76	0.89	179.8	0.64	0.40	1.00
Imputed rents of owner-occupiers	ICP 1131012	0.80	1.03	184.9	0.63	0.46	1.00
Average price (unweighted)		0.91	1.18	195.1	0.84	0.65	1.00
	Excl. outliers		*0.94*	*149.1*	*0.78*		
Price level relative to the U.S.		102.0	133.2	161.3	95.0	107.1	100.0

Capital (expenditure) costs		France	Germany	Japan	Netherlands	U.K.	U.S.
Industrial Machinery	ICOP 29	0.61	1.02	110.3	0.66	0.57	1.00
Office, accounting and computing machinery	ICOP 30	1.06	0.82	117.0	0.94	0.43	1.00
Electrical machinery	ICOP 31-33	0.68	1.02	99.6	1.46	0.71	1.00
Industrial buildings	ICP 1422012	1.20	1.16	163.5	1.08	0.68	1.00
Buildings for market services	ICP 1422013	1.30	1.25	134.4	1.10	0.82	1.00
Average price (unweighted)		0.97	1.05	125.0	1.05	0.64	1.00
Price level relative to the U.S.		108.8	119.1	103.3	118.4	105.2	100.0

Note: ICOP PPPs refer to industry-of-origin benchmark studies from the University of Groningen and The Conference Board. Transport and distribution margins were added. ICP PPPs refer to price comparisons of final expenditures at the basic heading level from the 1999 OECD-Eurostat PPP benchmark, adjusted to 1997 prices. Tax margins were removed ('peeled off').

Sources: ICOP PPPs: O'Mahony and van Ark (2003) and Inklaar et al. (2003a, 2003b), ICP PPPs: OECD (2002), Input-Output tables from unpublished OECD work, based on national sources. Prices used to convert 1999 ICP PPPs to 1997 PPPs based on GGDC (2003).

TABLE A2b

Prices used for 'Other current' and Capital R&D input categories, 1987

Other current costs		France	Germany	Japan	Netherlands	U.K.	U.S.
Printing and publishing	ICOP 21-22	1.20	1.16	184.2	1.12	1.05	1.00
Industrial Machinery	ICOP 29	0.97	0.97	120.2	1.31	0.61	1.00
Office, accounting and computing machinery	ICOP 30	1.51	1.34	155.6	1.43	0.75	1.00
Electrical machinery	ICOP 31-33	1.41	1.28	142.0	1.34	0.72	1.00
Electricity, gas and water	ICP	1.34	*1.47*	*287.0*	1.27	0.89	1.00
Wholesale and retail trade	ICP	1.01	1.05	*198.6*	0.96	0.52	1.00
Transport and storage	ICP	0.91	0.89	133.7	0.77	0.54	1.00
Communications	ICP	1.13	1.23	165.5	0.78	0.59	1.00
Insurance charges (except car and health)	ICP	0.75	0.92	115.0	0.73	0.46	1.00
Rents of tenants	ICP	0.62	0.87	178.4	0.77	0.27	1.00
Average price (unweighted)		1.09	1.12	168.0	1.05	0.64	1.00
	Excl. outliers		*1.08*	*149.3*			
Price level relative to the U.S.		118.5	121.5	116.2	114.1	104.5	100.0

Capital (expenditure) costs		France	Germany	Japan	Netherlands	U.K.	U.S.
Industrial Machinery	ICOP 29	0.96	0.97	120.7	1.36	0.61	1.00
Office, accounting and computing machinery	ICOP 30	1.39	1.27	143.4	1.35	0.74	1.00
Electrical machinery	ICOP 31-33	1.39	1.27	143.4	1.35	0.74	1.00
Industrial buildings	ICP	1.02	1.08	184.2	1.17	0.73	1.00
Average price (unweighted)		1.19	1.15	147.9	1.30	0.71	1.00
Price level relative to the U.S.		129.9	125.2	102.3	141.9	115.3	100.0

Note: ICOP PPPs refer to industry-of-origin benchmark studies from the University of Groningen and The Conference Board. Transport and distribution margins were added. ICP PPPs refer to price comparisons of final expenditures at the basic heading level from the 1990 OECD-Eurostat PPP benchmark, adjusted to 1987 prices. Tax margins were removed ('peeled off').

Sources: ICOP PPPs: van Ark (1993), ICP PPPs: unpublished heading from 1990 ICP PPPs, Input-Output tables from unpublished OECD work, based on national sources. Prices used to convert 1990 ICP PPPs to 1987 PPPs based on GGDC (2003).

TABLE A3a

Estimation procedures for total industry R&D expenditure, 1997

Japan	
Computers & Electronic equipment	
Office, accounting & computing machinery	SHint
Electronic equipment	SHint
Netherlands	
Minerals, computers and misc manufacturing	
Non-metallic mineral products	SHint
Furniture, other manufacturing nec	SHint
Office, accounting & computing machinery	SHint
Basic metal	
Basic metals, ferrous	SHint
Basic metals, non-ferrous	SHint
Electrical and electronic equipment	
Electrical machinery	SHint
Electronic equipment	SHint
Instruments, watches & clocks	SHint
Transport equipment	
Motor vehicles	SHint
Other transport equipment	SHint

Notes: SHint: data for detailed (indented) industries were estimated using shares of these industries in the aggregate (non-indented) industries from other countries in 1997.

TABLE A3b

Estimation procedures for total industry R&D expenditure, 1987

Japan	
Computers and electronic equipment	
Office, accounting & computing machinery	SHint
Electronic equipment	SHint
Germany	
Chemical products	
Chemicals (excluding pharmaceuticals)	SH97
Pharmaceuticals	SH97
Machinery and computers	
Machinery, nec	SH97
Office, accounting & computing machinery	SH97
Electrical and electronic equipment	
Electrical machinery	SH97
Electronic equipment	SH97
Netherlands	
Wood, paper and printing	
Wood and wood products	SHint
Paper, printing and publishing	SHint
Chemical products	
Coke, refining of petroleum products	SH97
Chemicals (excluding pharmaceuticals)	SH97
Metal, electrical and transport	
Basic metal	SH97
Basic metals, ferrous	SHint
Basic metals, non-ferrous	SHint
Fabricated metal products	SH97
Machinery, nec	SH97
Computers and other manufacturing	SH97
Office, accounting and computing machinery	SHint
Miscellaneous manufacturing	SHint
Electrical and optical equipment	SH97
Electrical machinery	SHint
Electronic equipment	SHint
Instruments, watches & clocks	SHint
Transport equipment	SH97
Motor vehicles	SHint
Other transport equipment	SHint
United States	
Shipbuilding and other transport equipment	
Shipbuilding and repairing	Shint
Other Transport Equipment	Shint

Notes: SH97: data for detailed (indented) industries were estimated using the share of these industries in the aggregate (non-indented) industries for that country in 1997. SHint: data for detailed industries were estimated using shares of these industries from other countries in 1987.

Appendix B, Extra tables

The following set of tables give the detailed industry material underlying our estimates of R&D PPPs at the manufacturing level. These tables provide all data necessary to replicate the manufacturing PPPs. As Tables A3a and A3b make clear, for some countries and industries imputations had to be made for R&D expenditure. This is also the case for other variables, so the data in these tables should be used with care.

TABLE B1
R&D expenditure of manufacturing industries, 1997

Industry	*ISIC rev3 code*	*France mil. EUR*	*Germany mil. EUR*	*Japan mil. YEN*	*Netherlands mil. EUR*	*UK mil. GBP*	*U.S. mil. USD*
Food, beverages and tobacco	15-16	308	190	235301	196	180	1787
Textiles, fur and leather	17-19	107	190	81652	13	32	504
Wood, paper, printing and publishing	20-22	73	111	86961	15	44	1889
Coke, refining of petroleum products	23	246	76	65351	37	350	1617
Chemicals (excluding pharmaceuticals)	24ex24.4	1075	3537	965963	519	681	7461
Pharmaceuticals	24.4	2179	1893	643290	308	2151	11589
Rubber and plastic products	25	453	482	259064	47	60	1451
Non-metallic mineral products	26	212	266	215391	8	47	608
Basic metals, ferrous	271+2731	208	188	213632	37	39	533
Basic metals, non-ferrous	272+2732	76	88	165951	20	16	455
Fabricated metal products	28	205	433	134716	45	88	1798
Machinery, nec	29	766	3190	790057	244	622	5659
Office, accounting and computing machinery	30	410	673	561280	24	103	12840
Electrical machinery	31	614	877	1141846	241	423	4909
Electronic equipment	32	2006	3276	2016321	596	654	19676
Instruments, watches and clocks	33	1672	1500	426181	314	336	13458
Motor vehicles	34	2045	6992	1445220	86	924	15354
Other transport equipment	35	2044	2919	208818	55	956	16639
Furniture, other manufacturing nec	36-37	114	141	159443	6	24	2798
Total manufacturing	15-37	14813	27022	9816438	2812	7730	121025

Note: see Table A3a for estimation procedures for some detailed industries
Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B2
Labor expenditure share in total R&D expenditure, 1997 in percentage points

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	15-16	54.6	62.5	54.8	64.4	51.7	48.2
Textiles, fur and leather	17-19	56.4	62.1	48.7	65.5	56.3	48.5
Wood, paper, printing and publishing	20-22	56.5	56.4	50.2	73.5	31.8	49.8
Coke, refining of petroleum products	23	50.2	52.7	47.5	73.2	32.3	43.2
Chemicals (excluding pharmaceuticals)	24ex24.4	56.0	56.5	51.3	49.4	44.2	47.0
Pharmaceuticals	24.4	49.5	56.6	44.6	47.2	29.2	38.8
Rubber and plastic products	25	49.8	52.7	49.8	55.8	41.7	45.9
Non-metallic mineral products	26	55.2	63.1	45.9	60.0	46.8	41.0
Basic metals, ferrous	271+2731	56.0	63.9	39.4	47.6	59.0	54.0
Basic metals, non-ferrous	272+2732	62.1	58.7	43.6	47.6	43.8	50.3
Fabricated metal products	28	62.3	62.2	54.8	69.7	38.6	49.9
Machinery, nec	29	63.1	65.9	48.4	55.3	44.5	48.6
Office, accounting and computing machinery	30	59.2	59.8	39.1	60.0	30.1	51.5
Electrical machinery	31	55.7	67.5	39.9	49.0	39.5	43.1
Electronic equipment	32	52.3	62.7	39.1	49.0	42.4	50.4
Instruments, watches and clocks	33	57.2	68.3	38.4	49.0	48.2	54.0
Motor vehicles	34	49.2	58.8	37.3	59.0	36.1	38.5
Other transport equipment	35	47.5	68.9	38.4	59.0	33.8	37.9
Furniture, other manufacturing nec	36-37	56.0	68.0	47.3	60.0	33.3	81.2
Total manufacturing	15-37	52.8	61.7	42.7	52.1	37.0	46.5

Note: see Table A3a for detailed industries where shares had to be assumed equal to higher aggregates
Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B3

Materials expenditure share in total R&D expenditure, 1997 in percentage points

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	15-16	12.2	7.8	9.3	8.6	20.2	8.6
Textiles, fur and leather	17-19	16.8	12.6	18.5	9.9	17.8	18.3
Wood, paper, printing and publishing	20-22	15.3	8.7	13.4	7.4	34.2	12.9
Coke, refining of petroleum products	23	12.3	8.4	13.7	7.5	25.4	9.3
Chemicals (excluding pharmaceuticals)	24ex24.4	12.3	11.4	12.4	13.5	19.9	9.8
Pharmaceuticals	24.4	13.7	12.1	9.0	14.7	28.8	10.0
Rubber and plastic products	25	15.6	9.6	10.8	9.8	23.4	16.1
Non-metallic mineral products	26	13.0	9.2	14.7	9.9	24.3	11.3
Basic metals, ferrous	271+2731	15.3	10.4	23.1	13.8	19.9	8.0
Basic metals, non-ferrous	272+2732	15.4	14.6	17.7	13.8	25.9	18.9
Fabricated metal products	28	14.0	10.2	15.0	8.4	25.9	13.7
Machinery, nec	29	14.8	12.7	18.7	13.8	26.2	20.5
Office, accounting and computing machinery	30	14.0	14.0	22.4	9.9	26.7	10.9
Electrical machinery	31	14.2	9.8	22.2	17.2	25.7	13.9
Electronic equipment	32	18.0	14.7	22.4	17.2	24.3	18.7
Instruments, watches and clocks	33	16.1	10.5	24.2	17.2	21.7	11.3
Motor vehicles	34	21.9	18.6	30.2	17.5	26.1	25.5
Other transport equipment	35	21.9	13.0	28.3	17.5	29.8	20.9
Furniture, other manufacturing nec	36-37	16.7	9.5	15.7	9.9	15.1	2.1
Total manufacturing	15-37	16.9	13.9	20.3	14.7	26.1	15.8

Note: see Table A3a for detailed industries where shares had to be assumed equal to higher aggregates

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B4

Other current expenditure share in total R&D expenditure, 1997 in percentage points

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	15-16	23.3	14.9	22.2	16.5	18.7	31.5
Textiles, fur and leather	17-19	18.3	13.7	21.2	10.8	16.5	22.4
Wood, paper, printing and publishing	20-22	21.1	12.0	19.4	10.2	31.7	25.7
Coke, refining of petroleum products	23	24.9	17.0	26.3	15.3	32.6	35.4
Chemicals (excluding pharmaceuticals)	24ex24.4	24.6	22.8	24.5	27.0	25.5	33.6
Pharmaceuticals	24.4	28.1	24.9	35.3	30.3	21.0	40.2
Rubber and plastic products	25	25.6	15.8	25.4	16.1	29.9	24.4
Non-metallic mineral products	26	21.9	15.5	25.4	14.8	22.5	37.3
Basic metals, ferrous	271+2731	22.4	15.4	25.7	20.3	18.5	28.1
Basic metals, non-ferrous	272+2732	16.0	15.1	21.3	20.3	24.1	18.7
Fabricated metal products	28	18.0	13.1	18.7	10.8	24.1	25.5
Machinery, nec	29	16.5	14.0	23.8	15.3	25.4	22.5
Office, accounting and computing machinery	30	21.1	21.1	29.6	14.8	27.6	28.8
Electrical machinery	31	21.7	15.0	29.1	26.3	28.9	35.3
Electronic equipment	32	21.4	17.5	29.6	26.3	25.1	23.2
Instruments, watches and clocks	33	22.4	14.5	25.0	26.3	24.5	27.3
Motor vehicles	34	19.2	16.3	26.1	15.4	19.9	26.3
Other transport equipment	35	28.0	16.6	29.6	15.4	33.7	37.4
Furniture, other manufacturing nec	36-37	20.5	11.6	28.4	14.8	14.0	2.3
Total manufacturing	15-37	23.2	17.5	27.3	23.7	24.8	29.3

Note: see Table A3a for detailed industries where shares had to be assumed equal to higher aggregates

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B5

Capital expenditure share in total R&D expenditure, 1997 in percentage points

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	15-16	10.0	14.8	13.7	10.4	9.4	11.7
Textiles, fur and leather	17-19	8.5	11.6	11.5	13.8	9.4	10.8
Wood, paper, printing and publishing	20-22	7.2	22.9	17.0	8.8	2.3	11.5
Coke, refining of petroleum products	23	12.6	21.9	12.5	4.0	9.7	12.1
Chemicals (excluding pharmaceuticals)	24ex24.4	7.1	9.2	11.7	10.1	10.4	9.7
Pharmaceuticals	24.4	8.7	6.5	11.1	7.8	21.1	11.0
Rubber and plastic products	25	9.0	21.9	14.0	18.3	5.0	13.7
Non-metallic mineral products	26	9.9	12.1	14.0	15.3	6.4	10.4
Basic metals, ferrous	271+2731	6.3	10.3	11.9	18.3	2.6	9.9
Basic metals, non-ferrous	272+2732	6.5	11.6	17.5	18.3	6.3	12.1
Fabricated metal products	28	5.7	14.5	11.5	11.1	11.4	10.9
Machinery, nec	29	5.6	7.4	9.1	15.6	3.9	8.3
Office, accounting and computing machinery	30	5.8	5.1	8.9	15.3	15.5	8.8
Electrical machinery	31	8.4	7.8	8.8	7.5	5.9	7.7
Electronic equipment	32	8.4	5.2	8.9	7.5	8.3	7.6
Instruments, watches and clocks	33	4.4	6.8	12.4	7.5	5.7	7.4
Motor vehicles	34	9.7	6.2	6.4	8.1	17.9	9.6
Other transport equipment	35	2.7	1.5	3.7	8.1	2.7	3.8
Furniture, other manufacturing nec	36-37	6.8	10.9	8.7	15.3	37.5	14.4
Total manufacturing	15-37	7.1	6.9	9.7	9.5	12.1	8.4

Note: see Table A3a for detailed industries where shares had to be assumed equal to higher aggregates

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B6

R&D Labor PPP for 1997 for manufacturing industries in national currency per U.S. dollar

Industry	*ISIC rev3 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	15-16	0.69	0.63	94.4	0.67	0.43	1.00
Textiles, fur and leather	17-19	0.63	0.70	110.3	0.64	0.29	1.00
Wood, paper, printing and publishing	20-22	0.83	0.84	91.1	0.71	0.26	1.00
Coke, refining of petroleum products	23	0.85	0.73	133.1	1.57	0.81	1.00
Chemicals (excluding pharmaceuticals)	24ex24.4	0.82	1.01	126.3	0.79	0.42	1.00
Pharmaceuticals	24.4	0.70	0.74	119.8	0.57	0.37	1.00
Rubber and plastic products	25	0.79	0.93	135.8	0.73	0.46	1.00
Non-metallic mineral products	26	0.95	0.99	118.7	0.41	0.38	1.00
Basic metals, ferrous	271+2731	0.55	0.69	89.2	0.56	0.33	1.00
Basic metals, non-ferrous	272+2732	0.83	0.82	125.5	0.56	0.47	1.00
Fabricated metal products	28	0.70	0.73	97.7	0.54	0.25	1.00
Machinery, nec	29	0.95	1.03	148.4	0.85	0.53	1.00
Office, accounting and computing machinery	30	0.62	0.56	104.8	0.41	0.15	1.00
Electrical machinery	31	0.77	0.85	128.6	0.76	0.37	1.00
Electronic equipment	32	0.87	0.85	104.8	0.76	0.37	1.00
Instruments, watches and clocks	33	0.66	0.61	72.1	0.76	0.25	1.00
Motor vehicles	34	0.61	0.84	97.5	0.52	0.37	1.00
Other transport equipment	35	0.96	1.46	160.4	0.52	0.43	1.00
Furniture, other manufacturing nec	36-37	0.71	0.68	180.4	0.41	0.13	1.00
Total manufacturing	15-37	0.76	0.86	113.7	0.68	0.36	1.00

Note: R&D Labor PPP is calculated as R&D labor compensation divided by R&D personnel in each country relative to the U.S. Total manufacturing is a Fisher index of the labor PPPs of the individual manufacturing industries.

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B7

R&D Materials PPP for 1997 for manufacturing industries in national currency per U.S. dollar

Industry	*ISIC rev3 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	15-16	0.96	0.81	210.7	0.78	0.69	1.00
Textiles, fur and leather	17-19	1.42	1.40	162.1	1.22	0.88	1.00
Wood, paper, printing and publishing	20-22	0.85	0.89	165.9	0.89	0.59	1.00
Coke, refining of petroleum products	23	0.95	0.96	158.0	0.85	0.71	1.00
Chemicals (excluding pharmaceuticals)	24ex24.4	0.93	0.97	170.6	0.80	0.67	1.00
Pharmaceuticals	24.4	0.93	0.97	170.6	0.80	0.67	1.00
Rubber and plastic products	25	0.87	0.98	113.6	0.67	0.52	1.00
Non-metallic mineral products	26	0.70	0.75	124.5	0.64	0.48	1.00
Basic metals, ferrous	271+2731	0.91	0.89	136.4	0.87	0.66	1.00
Basic metals, non-ferrous	272+2732	0.91	0.89	136.4	0.87	0.66	1.00
Fabricated metal products	28	0.64	0.77	175.6	0.62	0.46	1.00
Machinery, nec	29	0.97	1.00	109.4	0.72	0.69	1.00
Office, accounting and computing machinery	30	0.89	0.90	137.7	0.68	0.60	1.00
Electrical machinery	31	0.91	1.06	98.8	1.22	0.65	1.00
Electronic equipment	32	0.98	1.12	99.5	1.47	1.07	1.00
Instruments, watches and clocks	33	0.85	0.95	94.9	1.17	0.55	1.00
Motor vehicles	34	1.66	1.57	137.5	1.23	1.73	1.00
Other transport equipment	35	1.00	1.13	125.1	1.01	1.26	1.00
Furniture, other manufacturing nec	36-37	1.08	0.92	137.1	1.01	0.48	1.00
Total manufacturing	15-37	1.05	1.15	122.2	1.04	0.91	1.00

Note: R&D Materials PPP is calculated as the output PPP for each industry including transport and trade margins. Total manufacturing is a Fisher index of the materials PPPs of the individual manufacturing industries.

Source: O'Mahony and van Ark (2003) and Inklaar et al. (2003) and unpublished OECD compilation of I/O tables

TABLE B8

R&D PPP for 1997 for manufacturing industries in national currency per U.S. dollar

Based on labor, materials, other current and capital PPPs

Industry	*ISIC rev3 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	15-16	0.81	0.80	130.7	0.76	0.53	1.00
Textiles, fur and leather	17-19	0.82	0.90	138.2	0.78	0.45	1.00
Wood, paper, printing and publishing	20-22	0.87	0.94	125.2	0.78	0.43	1.00
Coke, refining of petroleum products	23	0.90	0.90	154.8	1.24	0.71	1.00
Chemicals (excluding pharmaceuticals)	24ex24.4	0.87	1.05	151.0	0.83	0.53	1.00
Pharmaceuticals	24.4	0.82	0.91	153.1	0.72	0.54	1.00
Rubber and plastic products	25	0.86	1.00	146.1	0.79	0.53	1.00
Non-metallic mineral products	26	0.91	1.01	143.9	0.58	0.49	1.00
Basic metals, ferrous	271+2731	0.70	0.83	125.0	0.70	0.44	1.00
Basic metals, non-ferrous	272+2732	0.87	0.91	141.3	0.71	0.56	1.00
Fabricated metal products	28	0.76	0.85	129.7	0.64	0.40	1.00
Machinery, nec	29	0.95	1.05	148.9	0.85	0.60	1.00
Office, accounting and computing machinery	30	0.74	0.75	136.4	0.57	0.36	1.00
Electrical machinery	31	0.85	0.96	142.5	0.87	0.51	1.00
Electronic equipment	32	0.91	0.97	126.0	0.91	0.56	1.00
Instruments, watches and clocks	33	0.76	0.76	107.0	0.85	0.39	1.00
Motor vehicles	34	0.89	1.05	133.5	0.74	0.69	1.00
Other transport equipment	35	0.96	1.30	162.3	0.70	0.66	1.00
Furniture, other manufacturing nec	36-37	0.79	0.76	172.3	0.53	0.24	1.00
Total manufacturing	15-37						
Aggregated across cost categories		0.86	0.98	138.1	0.80	0.54	1.00
Aggregated across industries		0.86	0.99	137.8	0.79	0.54	1.00

Note: R&D PPP is calculated as a Fisher aggregate of labor, materials, other current and capital PPPs, see Tables B1-B7 and A2a

The R&D PPP for total manufacturing can be calculated as a Fisher index of the PPPs of the individual cost categories for total manufacturing or as a Fisher index of the R&D PPPs for the individual manufacturing industries. The 'cost categories' figures are used in the main text.

TABLE B9
R&D PPP for 1997 for manufacturing industries in national currency per U.S. dollar
Based on labor, materials, and GDP PPPs

Industry	*ISIC rev3 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	15-16	0.82	0.76	126.0	0.75	0.53	1.00
Textiles, fur and leather	17-19	0.83	0.87	134.7	0.78	0.44	1.00
Wood, paper, printing and publishing	20-22	0.88	0.90	122.2	0.77	0.43	1.00
Coke, refining of petroleum products	23	0.92	0.85	148.2	1.24	0.71	1.00
Chemicals (excluding pharmaceuticals)	24ex24.4	0.89	1.00	144.5	0.83	0.53	1.00
Pharmaceuticals	24.4	0.84	0.86	144.0	0.73	0.53	1.00
Rubber and plastic products	25	0.87	0.96	142.4	0.78	0.53	1.00
Non-metallic mineral products	26	0.93	0.96	137.2	0.58	0.48	1.00
Basic metals, ferrous	271+2731	0.71	0.79	119.9	0.70	0.44	1.00
Basic metals, non-ferrous	272+2732	0.88	0.88	139.6	0.70	0.56	1.00
Fabricated metal products	28	0.77	0.81	126.0	0.64	0.39	1.00
Machinery, nec	29	0.96	1.01	144.0	0.84	0.60	1.00
Office, accounting and computing machinery	30	0.75	0.72	129.9	0.56	0.35	1.00
Electrical machinery	31	0.86	0.92	134.7	0.87	0.51	1.00
Electronic equipment	32	0.92	0.93	120.8	0.91	0.55	1.00
Instruments, watches and clocks	33	0.77	0.73	102.2	0.86	0.39	1.00
Motor vehicles	34	0.91	1.01	127.9	0.74	0.68	1.00
Other transport equipment	35	0.98	1.25	151.6	0.70	0.65	1.00
Furniture, other manufacturing nec	36-37	0.80	0.74	171.1	0.51	0.24	1.00
Total manufacturing	15-37						
Aggregated across cost categories		0.87	0.94	131.9	0.80	0.54	1.00
Aggregated across industries		0.88	0.95	131.6	0.79	0.54	1.00

Note: R&D PPP is calculated as a Fisher aggregate of labor, materials, and GDP PPPs, see Tables B1-B7 and OECD (2002)
The R&D PPP for total manufacturing can be calculated as a Fisher index of the PPPs of the individual cost categories for total manufacturing or as a Fisher index of the R&D PPPs for the individual manufacturing industries. The 'cost categories' figures are used in the main text.

TABLE B10
R&D PPP for 1997 for manufacturing industries in national currency per U.S. dollar
Based on labor and GDP PPPs

Industry	*ISIC rev3 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	15-16	0.83	0.78	123.1	0.76	0.52	1.00
Textiles, fur and leather	17-19	0.78	0.82	134.8	0.74	0.42	1.00
Wood, paper, printing and publishing	20-22	0.90	0.91	121.9	0.77	0.44	1.00
Coke, refining of petroleum products	23	0.92	0.85	148.7	1.25	0.69	1.00
Chemicals (excluding pharmaceuticals)	24ex24.4	0.90	1.00	143.8	0.84	0.52	1.00
Pharmaceuticals	24.4	0.85	0.86	143.3	0.74	0.52	1.00
Rubber and plastic products	25	0.89	0.96	149.4	0.81	0.55	1.00
Non-metallic mineral products	26	0.97	0.99	142.0	0.60	0.51	1.00
Basic metals, ferrous	271+2731	0.72	0.80	123.0	0.70	0.44	1.00
Basic metals, non-ferrous	272+2732	0.90	0.90	144.2	0.71	0.55	1.00
Fabricated metal products	28	0.82	0.84	124.7	0.66	0.42	1.00
Machinery, nec	29	0.97	1.01	155.7	0.87	0.58	1.00
Office, accounting and computing machinery	30	0.76	0.73	133.5	0.58	0.35	1.00
Electrical machinery	31	0.87	0.91	147.7	0.83	0.50	1.00
Electronic equipment	32	0.93	0.91	133.8	0.83	0.49	1.00
Instruments, watches and clocks	33	0.79	0.74	111.9	0.82	0.40	1.00
Motor vehicles	34	0.80	0.91	134.0	0.69	0.51	1.00
Other transport equipment	35	0.98	1.22	162.0	0.69	0.55	1.00
Furniture, other manufacturing nec	36-37	0.79	0.74	174.0	0.51	0.24	1.00
Total manufacturing	15-37						
Aggregated across cost categories		0.87	0.92	138.8	0.78	0.50	1.00
Aggregated across industries		0.87	0.92	138.8	0.77	0.50	1.00

Note: R&D PPP is calculated as a Fisher aggregate of labor, and GDP PPPs, see Tables B1-B7 and OECD (2002)
The R&D PPP for total manufacturing can be calculated as a Fisher index of the PPPs of the individual cost categories for total manufacturing or as a Fisher index of the R&D PPPs for the individual manufacturing industries. The 'cost categories' figures are used in the main text.

TABLE B11

R&D expenditure of manufacturing industries, 1987

Industry	*ISIC rev2 code*	*France mil. EUR*	*Germany mil. EUR*	*Japan mil. YEN*	*Netherlands mil. EUR*	*UK mil. GBP*	*U.S. mil. USD*
Food, beverages and tobacco	31	161	187	193276	133	121	1206
Textiles, apparel and leather	32	58	90	66471	8	17	273
Wood products and furniture	33	7	92	16100	2	3	137
Paper products, printing and publishing	34	38	54	55149	6	33	604
Chemicals excluding druges	351+352ex3522	1096	2885	715185	555	636	5535
Drugs and medicines	3522	779	1544	380702	160	667	4100
Petroleum refineries and product	353+354	282	116	70178	40	56	1897
Rubber and plastic products	355+356	250	334	171087	13	36	670
Non-metallic mineral products	36	111	218	177882	6	40	995
Iron and steel	371	131	209	245177	32	47	250
Non-ferrous metals	372	88	91	104448	21	21	480
Metal products	381	92	517	94835	42	47	783
Non-electrical machinery	382ex3825	364	2390	418769	229	245	2428
Office and computing machinery	3825	516	504	420339	35	316	9211
Electrical machinery	383ex3832	355	1245	665704	219	451	1239
Radio, TV and communication equipment	3832	2528	4650	1077502	726	574	14609
Shipbuilding and repairing	3841	14	28	123001	4	12	362
Other transport equipment	3842+3844+3849	41	27	30438	2	11	332
Motor vehicles	3843	1098	3279	814766	66	460	9092
Aircraft	3845	1941	1230	1414	60	871	24458
Professional goods	385	135	333	204227	135	247	5222
Other manufacturing, nec	39	19	36	54557	2	18	427
Total manufacturing	31-39	10102	20059	6101207	2494	4929	84310

Note: see Table A3b for estimation procedures for some detailed industries

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B12

Labor expenditure share in total R&D expenditure, 1987 in percentage points

Industry	*ISIC rev2*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	31	57.9	60.7	49.3	58.4	49.1	49.6
Textiles, apparel and leather	32	58.2	61.0	51.3	70.6	56.1	50.4
Wood products and furniture	33	63.6	69.4	58.8	52.9	41.7	60.0
Paper products, printing and publishing	34	57.8	62.3	45.8	52.9	37.9	56.8
Chemicals excluding druges	351+352ex3522	53.1	58.5	49.2	50.2	46.1	42.4
Drugs and medicines	3522	48.6	58.5	44.2	54.0	36.3	45.2
Petroleum refineries and product	353+354	56.2	65.9	41.3	50.2	51.2	42.2
Rubber and plastic products	355+356	55.7	62.7	45.1	67.9	44.2	42.4
Non-metallic mineral products	36	53.1	57.5	42.6	69.2	47.7	44.6
Iron and steel	371	58.7	61.0	35.9	39.6	55.3	38.8
Non-ferrous metals	372	53.9	56.7	39.4	39.6	38.6	40.3
Metal products	381	62.3	61.9	47.1	39.6	41.2	49.1
Non-electrical machinery	382ex3825	56.0	65.2	44.6	39.6	41.9	49.2
Office and computing machinery	3825	57.2	65.2	40.2	39.6	43.0	45.2
Electrical machinery	383ex3832	57.4	58.0	39.2	39.6	41.9	30.3
Radio, TV and communication equipment	3832	53.2	58.0	40.2	39.6	47.5	36.8
Shipbuilding and repairing	3841	35.9	70.9	35.9	39.6	61.0	53.4
Other transport equipment	3842+3844+3849	64.2	67.3	42.5	39.6	41.6	53.4
Motor vehicles	3843	44.0	49.9	35.5	39.6	45.3	44.8
Aircraft	3845	48.4	56.9	58.4	39.6	31.8	36.9
Professional goods	385	55.5	65.0	42.5	39.6	44.0	50.5
Other manufacturing, nec	39	55.8	70.0	53.6	39.6	51.9	58.8
Total manufacturing	31-39	51.9	58.9	41.8	44.4	41.6	41.6

Note: see Table A3b for detailed industries where shares had to be assumed equal to higher aggregates

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B13

Materials expenditure share in total R&D expenditure, 1987 in percentage points

Industry	*ISIC rev2*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	31	10.8	9.6	11.2	8.4	17.6	8.9
Textiles, apparel and leather	32	11.1	13.2	15.7	10.6	14.6	15.6
Wood products and furniture	33	9.5	8.1	14.1	12.6	23.5	10.4
Paper products, printing and publishing	34	12.5	11.1	11.5	12.6	20.7	9.2
Chemicals excluding druges	351+352ex3522	9.0	7.7	7.8	7.2	12.5	8.0
Drugs and medicines	3522	10.9	7.7	10.6	8.3	12.4	8.6
Petroleum refineries and product	353+354	7.7	6.9	8.3	7.2	10.8	7.9
Rubber and plastic products	355+356	12.5	9.1	11.6	8.9	12.0	17.4
Non-metallic mineral products	36	13.9	11.9	13.9	6.2	19.7	13.1
Iron and steel	371	7.9	8.4	12.2	15.5	16.3	4.0
Non-ferrous metals	372	11.5	11.4	13.2	15.5	27.7	10.3
Metal products	381	11.7	12.1	15.1	15.5	23.5	13.6
Non-electrical machinery	382ex3825	13.7	10.4	17.3	15.5	26.9	10.7
Office and computing machinery	3825	8.9	10.4	17.2	15.5	20.3	10.0
Electrical machinery	383ex3832	11.0	10.6	17.9	15.5	20.4	18.2
Radio, TV and communication equipment	3832	14.7	10.6	17.2	15.5	18.0	16.2
Shipbuilding and repairing	3841	25.7	10.8	25.7	15.5	15.2	15.7
Other transport equipment	3842+3844+3849	11.0	11.4	18.3	15.5	20.3	15.7
Motor vehicles	3843	28.0	21.6	30.9	15.5	31.7	21.4
Aircraft	3845	18.4	15.5	16.2	15.5	27.2	22.2
Professional goods	385	13.7	9.8	18.5	15.5	19.0	14.0
Other manufacturing, nec	39	13.5	8.5	13.5	15.5	17.0	8.2
Total manufacturing	31-39	14.9	11.4	16.5	13.2	20.3	16.1

Note: see Table A3b for detailed industries where shares had to be assumed equal to higher aggregates

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B14

Other current expenditure share in total R&D expenditure, 1987 in percentage points

Industry	*ISIC rev2*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	31	18.3	16.3	18.9	14.2	18.9	25.4
Textiles, apparel and leather	32	13.6	16.2	19.3	13.0	15.6	22.0
Wood products and furniture	33	12.6	10.8	18.7	16.8	25.1	17.3
Paper products, printing and publishing	34	17.1	15.3	15.8	16.8	22.2	16.5
Chemicals excluding druges	351+352ex3522	26.7	22.7	23.0	21.3	27.2	34.1
Drugs and medicines	3522	29.4	22.7	28.4	22.4	26.8	29.3
Petroleum refineries and product	353+354	23.2	20.6	24.8	21.3	23.5	34.9
Rubber and plastic products	355+356	22.7	16.5	21.1	16.1	26.0	26.6
Non-metallic mineral products	36	20.7	17.7	20.6	9.2	21.1	27.4
Iron and steel	371	20.1	21.3	30.9	23.6	17.5	43.6
Non-ferrous metals	372	21.3	21.1	24.5	23.6	29.7	36.7
Metal products	381	16.7	17.3	21.5	23.6	25.2	26.2
Non-electrical machinery	382ex3825	20.9	15.9	26.5	23.6	24.9	28.7
Office and computing machinery	3825	18.1	15.9	30.1	23.6	27.5	32.3
Electrical machinery	383ex3832	20.1	19.3	32.7	23.6	30.5	41.2
Radio, TV and communication equipment	3832	25.7	19.3	30.1	23.6	24.4	37.3
Shipbuilding and repairing	3841	35.1	14.7	35.0	23.6	21.3	20.9
Other transport equipment	3842+3844+3849	15.0	15.5	24.9	23.6	27.3	20.9
Motor vehicles	3843	20.4	15.8	22.5	23.6	14.6	23.9
Aircraft	3845	28.4	23.9	25.0	23.6	38.1	37.9
Professional goods	385	23.5	16.8	31.6	23.6	28.5	27.6
Other manufacturing, nec	39	22.8	14.4	22.9	23.6	18.2	23.5
Total manufacturing	31-39	24.6	18.9	27.2	21.8	27.3	33.1

Note: see Table A3b for detailed industries where shares had to be assumed equal to higher aggregates

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B15

Capital expenditure share in total R&D expenditure, 1987 in percentage points

Industry	*ISIC rev2*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
Food, beverages and tobacco	31	12.9	13.4	20.7	19.1	14.4	16.1
Textiles, apparel and leather	32	17.1	9.6	13.7	5.9	13.8	12.0
Wood products and furniture	33	14.3	11.7	8.5	17.6	9.8	12.4
Paper products, printing and publishing	34	12.6	11.3	26.9	17.6	19.2	17.5
Chemicals excluding druges	351+352ex3522	11.2	11.2	20.0	21.3	14.1	15.6
Drugs and medicines	3522	11.0	11.2	16.8	15.3	24.5	16.9
Petroleum refineries and product	353+354	12.9	6.6	25.6	21.3	14.6	14.9
Rubber and plastic products	355+356	9.0	11.8	22.2	7.1	17.8	13.6
Non-metallic mineral products	36	12.3	12.9	22.9	15.4	11.4	15.0
Iron and steel	371	13.3	9.3	21.1	21.3	10.9	13.7
Non-ferrous metals	372	13.3	10.7	22.9	21.3	4.0	12.7
Metal products	381	9.4	8.7	16.2	21.3	10.0	11.1
Non-electrical machinery	382ex3825	9.4	8.6	11.5	21.3	6.3	11.4
Office and computing machinery	3825	15.8	8.6	12.5	21.3	9.2	12.5
Electrical machinery	383ex3832	11.5	12.1	10.3	21.3	7.2	10.3
Radio, TV and communication equipment	3832	6.4	12.1	12.5	21.3	10.1	9.7
Shipbuilding and repairing	3841	3.4	3.6	3.4	21.3	2.4	10.0
Other transport equipment	3842+3844+3849	9.9	5.8	14.3	21.3	10.8	10.0
Motor vehicles	3843	7.6	12.7	11.1	21.3	8.4	9.9
Aircraft	3845	4.9	3.8	0.4	21.3	2.9	3.0
Professional goods	385	7.3	8.4	7.4	21.3	8.5	7.9
Other manufacturing, nec	39	7.9	7.1	9.9	21.3	12.9	9.5
Total manufacturing	31-39	8.6	10.8	14.5	20.7	10.8	9.2

Note: see Table A3b for detailed industries where shares had to be assumed equal to higher aggregates

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B16

R&D Labor PPP for 1987 for manufacturing industries in national currency per U.S. dollar

Industry	*ISIC rev2 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	31	0.64	0.68	100.5	0.76	0.25	1.00
Textiles, apparel and leather	32	0.76	0.66	106.6	0.89	0.21	1.00
Wood products and furniture	33	0.75	0.60	86.6	0.71	0.29	1.00
Paper products, printing and publishing	34	0.73	0.80	114.6	0.71	0.30	1.00
Chemicals excluding druges	351+352ex3522	0.90	1.05	135.0	0.96	0.34	1.00
Drugs and medicines	3522	0.93	1.05	160.4	0.86	0.34	1.00
Petroleum refineries and product	353+354	0.87	0.73	103.7	0.96	0.30	1.00
Rubber and plastic products	355+356	0.63	0.71	114.1	0.69	0.23	1.00
Non-metallic mineral products	36	0.91	0.87	134.5	0.92	0.28	1.00
Iron and steel	371	1.07	1.09	184.0	0.80	0.40	1.00
Non-ferrous metals	372	0.82	0.84	122.9	0.80	0.27	1.00
Metal products	381	1.15	1.20	159.7	0.80	0.43	1.00
Non-electrical machinery	382ex3825	0.88	0.96	121.6	0.80	0.27	1.00
Office and computing machinery	3825	1.01	0.96	129.5	0.80	0.38	1.00
Electrical machinery	383ex3832	1.61	1.68	251.1	0.80	0.52	1.00
Radio, TV and communication equipment	3832	1.07	1.68	129.5	0.80	0.34	1.00
Shipbuilding and repairing	3841	0.67	0.61	157.6	0.80	0.29	1.00
Other transport equipment	3842+3844+3849	0.52	0.60	56.9	0.80	0.23	1.00
Motor vehicles	3843	0.52	0.65	84.2	0.80	0.24	1.00
Aircraft	3845	0.77	1.00	98.9	0.80	0.22	1.00
Professional goods	385	0.63	0.65	82.2	0.80	0.23	1.00
Other manufacturing, nec	39	0.93	1.06	154.5	0.80	0.47	1.00
Total manufacturing	31-39	0.84	1.02	120.2	0.82	0.30	1.00

Note: R&D Labor PPP is calculated as R&D labor compensation divided by R&D personnel in each country relative to the U.S. Total manufacturing is a Fisher index of the labor PPPs of the individual manufacturing industries.

Source: National R&D surveys, NSF (2002), OECD (2003)

TABLE B17

R&D Materials PPP for 1987 for manufacturing industries in national currency per U.S. dollar

Industry	*ISIC rev2 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	31	1.38	1.00	236.9	1.03	0.74	1.00
Textiles, apparel and leather	32	1.40	1.38	179.7	1.09	0.68	1.00
Wood products and furniture	33	1.54	1.39	464.5	1.02	0.94	1.00
Paper products, printing and publishing	34	1.50	1.16	184.2	1.04	1.05	1.00
Chemicals excluding druges	351+352ex3522	1.06	1.35	234.3	0.94	0.64	1.00
Drugs and medicines	3522	1.06	1.35	234.3	0.94	0.64	1.00
Petroleum refineries and product	353+354	1.09	1.03	263.4	1.08	0.69	1.00
Rubber and plastic products	355+356	0.96	1.21	120.3	1.05	0.55	1.00
Non-metallic mineral products	36	1.27	1.02	186.0	0.82	0.63	1.00
Iron and steel	371	1.17	1.18	187.4	1.10	0.67	1.00
Non-ferrous metals	372	1.17	1.18	187.4	1.10	0.67	1.00
Metal products	381	1.10	1.12	177.1	1.05	0.66	1.00
Non-electrical machinery	382ex3825	1.18	0.97	124.5	1.01	0.74	1.00
Office and computing machinery	3825	1.27	1.02	135.6	1.12	0.75	1.00
Electrical machinery	383ex3832	1.17	1.31	142.7	1.05	0.61	1.00
Radio, TV and communication equipment	3832	1.17	1.28	143.8	1.06	0.59	1.00
Shipbuilding and repairing	3841	1.17	0.97	121.3	1.03	0.73	1.00
Other transport equipment	3842+3844+3849	1.17	0.97	121.3	1.03	0.73	1.00
Motor vehicles	3843	1.25	1.04	133.4	1.07	0.77	1.00
Aircraft	3845	1.17	0.97	121.3	1.03	0.73	1.00
Professional goods	385	1.16	0.94	120.2	1.02	0.72	1.00
Other manufacturing, nec	39	1.20	1.12	169.2	1.06	0.72	1.00
Total manufacturing	31-39	1.18	1.12	145.2	1.03	0.68	1.00

Note: R&D Materials PPP is calculated as the output PPP for each industry including transport and trade margins. Total manufacturing is a Fisher index of the materials PPPs of the individual manufacturing industries.

Source: van Ark (1993) and unpublished OECD compilation of I/O tables

TABLE B18

R&D PPP for 1987 for manufacturing industries in national currency per U.S. dollar

Based on labor, materials, other current and capital PPPs

Industry	*ISIC rev2 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	31	0.85	0.84	132.7	0.91	0.42	1.00
Textiles, apparel and leather	32	0.94	0.86	133.2	0.97	0.36	1.00
Wood products and furniture	33	0.91	0.77	130.0	0.87	0.46	1.00
Paper products, printing and publishing	34	0.91	0.92	136.3	0.88	0.49	1.00
Chemicals excluding druges	351+352ex3522	1.01	1.10	153.7	1.04	0.49	1.00
Drugs and medicines	3522	1.03	1.10	167.3	0.98	0.51	1.00
Petroleum refineries and product	353+354	0.99	0.88	140.1	1.05	0.46	1.00
Rubber and plastic products	355+356	0.83	0.89	132.9	0.85	0.41	1.00
Non-metallic mineral products	36	1.03	0.97	151.8	0.98	0.44	1.00
Iron and steel	371	1.10	1.11	172.7	0.98	0.52	1.00
Non-ferrous metals	372	0.97	0.98	147.9	0.98	0.47	1.00
Metal products	381	1.14	1.16	163.2	0.96	0.54	1.00
Non-electrical machinery	382ex3825	0.99	1.01	137.2	0.96	0.45	1.00
Office and computing machinery	3825	1.08	1.02	144.6	0.98	0.52	1.00
Electrical machinery	383ex3832	1.32	1.37	186.1	0.98	0.60	1.00
Radio, TV and communication equipment	3832	1.10	1.38	146.9	0.98	0.49	1.00
Shipbuilding and repairing	3841	0.90	0.76	151.8	0.95	0.42	1.00
Other transport equipment	3842+3844+3849	0.72	0.76	93.7	0.95	0.41	1.00
Motor vehicles	3843	0.81	0.85	119.1	0.97	0.43	1.00
Aircraft	3845	0.96	1.03	123.2	0.96	0.46	1.00
Professional goods	385	0.83	0.81	113.7	0.95	0.41	1.00
Other manufacturing, nec	39	1.02	1.08	159.1	0.95	0.56	1.00
Total manufacturing	31-39						
Aggregated across cost categories		0.99	1.06	141.1	0.97	0.48	1.00
Aggregated across industries		0.99	1.07	140.4	0.98	0.48	1.00

Note: R&D PPP is calculated as a Fisher aggregate of labor, materials, other current and capital PPPs, see Tables B11-B17 and A2b

The R&D PPP for total manufacturing can be calculated as a Fisher index of the PPPs of the individual cost categories for total manufacturing or as a Fisher index of the R&D PPPs for the individual manufacturing industries. The 'cost categories' figures are used in the main text.

TABLE B19
R&D PPP for 1987 for manufacturing industries in national currency per U.S. dollar
Based on labor, materials, and GDP PPPs

Industry	*ISIC rev2 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	31	0.82	0.84	147.6	0.88	0.39	1.00
Textiles, apparel and leather	32	0.92	0.86	145.3	0.95	0.34	1.00
Wood products and furniture	33	0.88	0.77	139.2	0.84	0.44	1.00
Paper products, printing and publishing	34	0.88	0.92	151.9	0.85	0.45	1.00
Chemicals excluding druges	351+352ex3522	0.97	1.10	173.0	1.00	0.45	1.00
Drugs and medicines	3522	0.99	1.10	188.2	0.95	0.47	1.00
Petroleum refineries and product	353+354	0.95	0.89	159.1	1.01	0.43	1.00
Rubber and plastic products	355+356	0.80	0.89	148.4	0.84	0.38	1.00
Non-metallic mineral products	36	1.00	0.97	170.1	0.96	0.42	1.00
Iron and steel	371	1.06	1.11	198.1	0.95	0.49	1.00
Non-ferrous metals	372	0.94	0.98	167.3	0.95	0.44	1.00
Metal products	381	1.11	1.16	179.7	0.93	0.51	1.00
Non-electrical machinery	382ex3825	0.97	1.01	151.4	0.93	0.42	1.00
Office and computing machinery	3825	1.04	1.02	161.2	0.95	0.49	1.00
Electrical machinery	383ex3832	1.28	1.37	208.1	0.96	0.56	1.00
Radio, TV and communication equipment	3832	1.07	1.38	163.8	0.95	0.46	1.00
Shipbuilding and repairing	3841	0.87	0.76	164.4	0.92	0.40	1.00
Other transport equipment	3842+3844+3849	0.70	0.76	102.7	0.92	0.39	1.00
Motor vehicles	3843	0.79	0.85	130.0	0.94	0.42	1.00
Aircraft	3845	0.93	1.03	133.0	0.94	0.43	1.00
Professional goods	385	0.81	0.81	124.6	0.93	0.38	1.00
Other manufacturing, nec	39	0.99	1.08	172.8	0.92	0.53	1.00
Total manufacturing	31-39						
Aggregated across cost categories		0.96	1.07	156.4	0.95	0.45	1.00
Aggregated across industries		0.96	1.07	155.5	0.95	0.45	1.00

Note: R&D PPP is calculated as a Fisher aggregate of labor, materials, and GDP PPPs, see Tables B11-B17 and OECD (2002)
The R&D PPP for total manufacturing can be calculated as a Fisher index of the PPPs of the individual cost categories for total manufacturing or as a Fisher index of the R&D PPPs for the individual manufacturing industries. The 'cost categories' figures are used in the main text.

TABLE B20
R&D PPP for 1987 for manufacturing industries in national currency per U.S. dollar
Based on labor, and GDP PPPs

Industry	*ISIC rev2 code*	*France EUR/USD*	*Germany EUR/USD*	*Japan YEN/USD*	*Netherlands EUR/USD*	*UK GBP/USD*	*U.S. USD/USD*
Food, beverages and tobacco	31	0.80	0.85	145.9	0.89	0.38	1.00
Textiles, apparel and leather	32	0.88	0.84	148.9	0.95	0.33	1.00
Wood products and furniture	33	0.85	0.76	124.7	0.85	0.40	1.00
Paper products, printing and publishing	34	0.85	0.92	154.0	0.85	0.42	1.00
Chemicals excluding druges	351+352ex3522	0.97	1.09	171.5	1.01	0.45	1.00
Drugs and medicines	3522	0.99	1.08	186.3	0.96	0.46	1.00
Petroleum refineries and product	353+354	0.95	0.89	156.2	1.01	0.42	1.00
Rubber and plastic products	355+356	0.81	0.88	160.6	0.84	0.38	1.00
Non-metallic mineral products	36	0.97	0.99	172.9	0.98	0.41	1.00
Iron and steel	371	1.05	1.11	200.0	0.95	0.48	1.00
Non-ferrous metals	372	0.93	0.98	169.5	0.95	0.42	1.00
Metal products	381	1.10	1.16	184.1	0.93	0.50	1.00
Non-electrical machinery	382ex3825	0.95	1.03	162.6	0.93	0.40	1.00
Office and computing machinery	3825	1.02	1.03	170.9	0.94	0.47	1.00
Electrical machinery	383ex3832	1.25	1.34	223.5	0.96	0.55	1.00
Radio, TV and communication equipment	3832	1.05	1.36	174.2	0.95	0.46	1.00
Shipbuilding and repairing	3841	0.85	0.77	184.9	0.93	0.38	1.00
Other transport equipment	3842+3844+3849	0.69	0.78	112.1	0.93	0.37	1.00
Motor vehicles	3843	0.76	0.87	145.3	0.94	0.38	1.00
Aircraft	3845	0.91	1.06	146.5	0.95	0.41	1.00
Professional goods	385	0.80	0.83	135.7	0.93	0.37	1.00
Other manufacturing, nec	39	0.97	1.08	176.8	0.92	0.51	1.00
Total manufacturing	31-39						
Aggregated across cost categories		0.94	1.07	166.3	0.95	0.43	1.00
Aggregated across industries		0.94	1.07	164.7	0.95	0.43	1.00

Note: R&D PPP is calculated as a Fisher aggregate of labor, and GDP PPPs, see Tables B11-B17 and OECD (2002)
The R&D PPP for total manufacturing can be calculated as a Fisher index of the PPPs of the individual cost categories for total manufacturing or as a Fisher index of the R&D PPPs for the individual manufacturing industries. The 'cost categories' figures are used in the main text.

TABLE B21

Nominal and real R&D intensity for total manufacturing, based on value added (R&D / value added) using preferred R&D PPP and output PPPs.

	Current practice	With R&D PPP and output PPP Adjustments	
Country	Nominal	Real	Difference
	Year 1987		
France	6.25	7.51	1.26
Germany	6.83	7.23	0.40
Japan	7.73	9.50	1.76
Netherlands	6.73	7.28	0.55
U.K.	5.48	8.19	2.71
U.S.	9.83	9.83	0.00
	Year 1997		
France	6.99	7.55	0.57
Germany	6.89	6.83	-0.06
Japan	10.03	10.25	0.22
Netherlands	5.36	5.90	0.54
U.K.	5.06	6.55	1.49
U.S.	9.10	9.10	0.00
	Change from 1987 to 1997		
France	0.73	0.04	-0.70
Germany	0.06	-0.40	-0.46
Japan	2.30	0.76	-1.54
Netherlands	-1.37	-1.38	-0.01
U.K.	-0.41	-1.63	-1.22
U.S.	-0.72	-0.72	0.00

Note: Adjustments for R&D PPP divide R&D expenditures by the R&D PPP; Adjustments for Output PPP divide value added by the Output PPP; Real intensity includes both adjustments

Sources: R&D PPPs from tables B8 (1997) and B18 (1987). Value added based on GGDC (2003). Output PPPs for Japan, 1997, based on O'Mahony and van Ark (2003) and Inklaar et al. (2003a,2003b) Output PPPs for 1987 from van Ark (1993).

TABLE B22

Nominal R&D Intensity in manufacturing industries, R&D expenditure as a share of industry gross output

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
1987							
Food, beverages and tobacco	15-16	0.20	0.20	0.60	0.42	0.30	0.35
Textiles, fur and leather	17-19	0.17	0.26	0.47	0.20	0.11	0.20
Wood, paper, printing and publishing	20-22	0.11	0.23	0.33	0.06	0.14	0.23
Coke, refining of petroleum products	23	1.18	0.64	0.72	0.53	0.54	1.47
Chemicals	24	3.65	5.68	5.01	3.76	5.07	4.28
Rubber and plastic products	25	1.52	1.14	5.88	0.42	0.40	0.78
Non-metallic mineral products	26	0.59	0.90	2.10	0.17	0.52	1.64
Basic metals	27	0.85	0.60	1.21	1.36	0.47	0.61
Fabricated metal products	28	0.28	1.28	0.80	0.57	0.34	0.54
Machinery, nec	29	1.04	2.56	1.51	3.31	1.35	1.43
Office, accounting and computing machinery	30	7.34	4.06	4.67	1.77	5.99	15.64
Electrical machinery	31	2.21	2.52	6.16	12.07	5.63	2.03
Electronic equipment	32	20.94	27.98	5.34	11.99	7.98	16.32
Instruments, watches and clocks	33	1.03	1.78	5.25	7.58	4.53	4.91
Motor vehicles	34	2.45	3.68	2.63	1.85	3.03	4.44
Other transport equipment	35	12.08	12.69	6.90	1.92	10.07	19.51
Furniture, other manufacturing nec	36-37	0.11	0.17	0.35	0.04	0.29	0.61
Total manufacturing	15-37	2.06	2.71	2.24	2.04	2.07	3.44
1997							
Food, beverages and tobacco	15-16	0.28	0.14	0.65	0.47	0.29	0.35
Textiles, fur and leather	17-19	0.33	0.61	0.78	0.31	0.17	0.30
Wood, paper, printing and publishing	20-22	0.13	0.12	0.33	0.09	0.10	0.40
Coke, refining of petroleum products	23	0.83	0.34	0.50	0.36	2.53	0.93
Chemicals	24	4.39	5.08	5.84	2.92	6.60	4.87
Rubber and plastic products	25	1.82	1.02	7.85	0.97	0.32	0.92
Non-metallic mineral products	26	0.92	0.69	2.24	0.16	0.42	0.71
Basic metals	27	0.89	0.53	1.21	1.04	0.31	0.53
Fabricated metal products	28	0.46	0.53	0.86	0.38	0.38	0.80
Machinery, nec	29	1.69	2.33	2.00	2.00	1.90	1.91
Office, accounting and computing machinery	30	4.60	5.23	4.46	1.41	0.77	11.58
Electrical machinery	31	2.67	1.23	7.03	7.52	3.32	5.32
Electronic equipment	32	9.26	15.14	6.76	6.67	4.15	8.52
Instruments, watches and clocks	33	9.33	5.54	9.74	10.95	3.40	8.86
Motor vehicles	34	2.94	4.53	3.66	1.30	2.75	4.33
Other transport equipment	35	6.66	13.90	5.44	1.25	5.61	10.85
Furniture, other manufacturing nec	36-37	0.55	0.47	0.80	0.08	0.17	2.52
Total manufacturing	15-37	2.22	2.50	2.89	1.59	1.92	3.12

Source: National R&D surveys, NSF (2002), OECD (2003), OECD (2004)

TABLE B23

Output PPP for manufacturing industries in national currency per U.S. dollar

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
1987							
Food, beverages and tobacco	15-16	1.33	1.01	243	1.02	0.72	1.00
Textiles, fur and leather	17-19	1.37	1.41	182	1.09	0.68	1.00
Wood, paper, printing and publishing	20-22	1.53	1.22	242	1.04	1.01	1.00
Coke, refining of petroleum products	23	*1.03*	1.01	252	1.02	0.65	1.00
Chemicals	24	*1.03*	1.31	230	0.93	0.63	1.00
Rubber and plastic products	25	0.93	1.19	121	1.05	0.55	1.00
Non-metallic mineral products	26	1.26	1.02	189	0.84	0.65	1.00
Basic metals	27	*1.10*	*1.12*	*178*	*1.05*	*0.67*	*1.00*
Fabricated metal products	28	*1.10*	*1.12*	*178*	*1.05*	*0.67*	*1.00*
Machinery, nec	29	*1.17*	*0.97*	*125*	*1.05*	*0.74*	*1.00*
Office, accounting and computing machinery	30	*1.17*	*0.97*	*125*	*1.05*	*0.74*	*1.00*
Electrical machinery	31	*1.15*	*1.27*	*143*	*1.05*	*0.61*	*1.00*
Electronic equipment	32	*1.15*	*1.27*	*143*	*1.05*	*0.61*	*1.00*
Instruments, watches and clocks	33	*1.17*	*0.97*	*125*	*1.05*	*0.74*	*1.00*
Motor vehicles	34	*1.17*	*0.97*	*125*	*1.05*	*0.74*	*1.00*
Other transport equipment	35	*1.17*	*0.97*	*125*	*1.05*	*0.74*	*1.00*
Furniture, other manufacturing nec	36-37	1.19	1.13	174	*1.05*	0.71	1.00
Total manufacturing	15-37	1.19	1.13	174	1.05	0.71	1.00
1997							
Food, beverages and tobacco	15-16	0.93	0.82	216	0.77	0.68	1.00
Textiles, fur and leather	17-19	1.38	1.43	165	1.22	0.88	1.00
Wood, paper, printing and publishing	20-22	0.87	0.88	169	0.89	0.58	1.00
Coke, refining of petroleum products	23	0.90	0.93	151	0.80	0.66	1.00
Chemicals	24	0.90	0.93	167	0.80	0.66	1.00
Rubber and plastic products	25	0.84	0.96	115	0.67	0.52	1.00
Non-metallic mineral products	26	0.70	0.75	127	0.66	0.49	1.00
Basic metals	27	0.85	0.85	130	0.83	0.66	1.00
Fabricated metal products	28	0.64	0.77	177	0.62	0.46	1.00
Machinery, nec	29	0.96	1.01	110	0.75	0.70	1.00
Office, accounting and computing machinery	30	0.82	0.86	127	0.64	0.60	1.00
Electrical machinery	31	0.89	1.02	99	1.22	0.65	1.00
Electronic equipment	32	0.96	1.11	99	1.45	1.11	1.00
Instruments, watches and clocks	33	0.85	0.97	99	1.21	0.57	1.00
Motor vehicles	34	1.56	1.47	129	1.22	1.65	1.00
Other transport equipment	35	1.00	1.13	129	1.04	1.28	1.00
Furniture, other manufacturing nec	36-37	1.07	0.93	141	1.01	0.47	1.00
Total manufacturing	15-37	0.93	0.97	141	0.88	0.70	1.00

Source: O'Mahony and van Ark (2003) and Inklaar, et al. (2003a, 2003b) for 1997 and van Ark (1993) for 1987.

Note: For 1987 less detail was available. Industries where a PPP for a higher aggregate was used are shown in italics.

For 1997: no PPPs are available for Coke, refining of petroleum products for European countries so the PPP for Chemicals is used. Also no separate PPPs are available for Electrical machinery, Electronic equipment and Instruments, watches and clocks for Japan, so the PPP for the combined industry is used.

TABLE B24

Real R&D Intensity in manufacturing industries, R&D expenditure, converted using R&D PPP as a share of industry gross output, converted using output PPP

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
1987							
Food, beverages and tobacco	15-16	0.31	0.24	1.10	0.47	0.51	0.35
Textiles, fur and leather	17-19	0.24	0.42	0.64	0.22	0.21	0.20
Wood, paper, printing and publishing	20-22	0.18	0.33	0.59	0.07	0.29	0.23
Coke, refining of petroleum products	23	1.22	0.73	1.30	0.52	0.76	1.47
Chemicals	24	3.69	6.76	7.24	3.45	6.46	4.28
Rubber and plastic products	25	1.71	1.52	5.36	0.51	0.54	0.78
Non-metallic mineral products	26	0.72	0.94	2.62	0.15	0.76	1.64
Basic metals	27	0.90	0.64	1.35	1.46	0.64	0.61
Fabricated metal products	28	0.27	1.24	0.87	0.62	0.41	0.54
Machinery, nec	29	1.21	2.46	1.37	3.64	2.23	1.43
Office, accounting and computing machinery	30	7.96	3.77	3.97	1.91	8.69	15.64
Electrical machinery	31	1.92	2.34	4.72	12.92	5.78	2.03
Electronic equipment	32	21.84	25.76	5.18	12.92	9.95	16.32
Instruments, watches and clocks	33	1.45	2.08	5.66	8.40	8.52	4.91
Motor vehicles	34	3.50	4.20	2.76	2.01	5.15	4.44
Other transport equipment	35	14.82	12.11	6.69	2.10	16.30	19.51
Furniture, other manufacturing nec	36-37	0.13	0.18	0.38	0.04	0.37	0.61
Total manufacturing	15-37	2.47	2.87	2.75	2.21	3.09	3.44
1997							
Food, beverages and tobacco	15-16	0.32	0.15	1.07	0.47	0.37	0.35
Textiles, fur and leather	17-19	0.56	0.97	0.93	0.48	0.33	0.30
Wood, paper, printing and publishing	20-22	0.13	0.11	0.44	0.10	0.13	0.40
Coke, refining of petroleum products	23	0.83	0.35	0.49	0.23	2.36	0.93
Chemicals	24	4.68	4.84	6.41	3.01	8.22	4.87
Rubber and plastic products	25	1.78	0.98	6.16	0.83	0.32	0.92
Non-metallic mineral products	26	0.71	0.51	1.97	0.18	0.42	0.71
Basic metals	27	1.01	0.52	1.19	1.23	0.43	0.53
Fabricated metal products	28	0.38	0.49	1.17	0.36	0.44	0.80
Machinery, nec	29	1.70	2.23	1.48	1.77	2.22	1.91
Office, accounting and computing machinery	30	5.08	5.97	4.15	1.60	1.30	11.58
Electrical machinery	31	2.80	1.31	4.86	10.60	4.24	5.32
Electronic equipment	32	9.79	17.47	5.29	10.71	8.24	8.52
Instruments, watches and clocks	33	10.47	7.06	8.99	15.50	4.94	8.86
Motor vehicles	34	5.11	6.32	3.53	2.15	6.59	4.33
Other transport equipment	35	6.97	12.10	4.32	1.86	10.88	10.85
Furniture, other manufacturing nec	36-37	0.74	0.58	0.65	0.16	0.33	2.52
Total manufacturing	15-37	2.40	2.47	2.95	1.74	2.49	3.12

Note: R&D expenditure is converted to a common currency using R&D PPPs and gross output is converted using output PPPs.

Source: Nominal R&D intensity from Table B22, R&D PPPs from Tables B8 (1997) and B18 (1987), Output PPPs from Table B23.

TABLE B25

Nominal R&D Intensity in manufacturing industries, R&D expenditure as a share of industry value added

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
1987							
Food, beverages and tobacco	15-16	0.73	0.78	2.54	2.10	1.04	1.55
Textiles, fur and leather	17-19	0.47	0.68	1.35	0.59	0.29	0.59
Wood, paper, printing and publishing	20-22	0.28	0.57	0.87	0.16	0.31	0.57
Coke, refining of petroleum products	23	7.25	5.16	3.64	6.38	2.45	9.16
Chemicals	24	12.47	13.92	14.40	11.75	13.91	11.81
Rubber and plastic products	25	3.29	2.66	13.22	1.15	0.99	2.33
Non-metallic mineral products	26	1.66	2.01	5.07	0.40	1.02	4.41
Basic metals	27	3.99	1.74	5.00	3.66	1.63	2.20
Fabricated metal products	28	0.60	2.66	1.99	1.46	0.90	1.27
Machinery, nec	29	2.58	5.81	4.95	8.48	2.61	3.50
Office, accounting and computing machinery	30	17.38	9.64	19.18	11.03	11.51	38.18
Electrical machinery	31	4.85	4.91	16.77	32.58	11.52	3.30
Electronic equipment	32	57.09	59.61	27.14	30.10	19.15	46.53
Instruments, watches and clocks	33	2.35	3.27	13.64	19.51	13.12	9.88
Motor vehicles	34	9.46	9.67	16.47	8.16	8.46	15.90
Other transport equipment	35	53.71	29.59	19.64	8.14	21.30	46.12
Furniture, other manufacturing nec	36-37	0.25	0.42	0.87	0.06	1.02	1.44
Total manufacturing	15-37	6.25	6.83	7.73	6.73	5.48	9.83
1997							
Food, beverages and tobacco	15-16	1.00	0.53	2.68	1.99	0.89	1.47
Textiles, fur and leather	17-19	0.97	1.84	2.06	1.06	0.37	0.91
Wood, paper, printing and publishing	20-22	0.34	0.28	0.85	0.21	0.21	1.04
Coke, refining of petroleum products	23	4.06	2.42	1.97	3.59	14.70	5.47
Chemicals	24	13.98	13.82	17.68	10.30	18.46	11.93
Rubber and plastic products	25	4.65	2.47	17.96	2.75	0.75	2.87
Non-metallic mineral products	26	2.60	1.65	5.35	0.41	0.90	1.69
Basic metals	27	3.66	1.81	5.03	3.25	1.06	1.95
Fabricated metal products	28	1.02	1.24	2.08	1.07	0.74	1.88
Machinery, nec	29	4.63	5.62	6.92	6.01	4.64	4.89
Office, accounting and computing machinery	30	15.50	15.37	18.79	6.63	3.55	41.94
Electrical machinery	31	6.70	3.08	18.16	23.21	7.05	9.05
Electronic equipment	32	30.98	40.95	32.07	23.82	10.75	24.41
Instruments, watches and clocks	33	23.31	11.29	25.38	28.60	6.67	18.46
Motor vehicles	34	13.05	14.50	23.78	5.90	9.79	16.22
Other transport equipment	35	27.23	42.18	16.99	5.07	15.48	30.77
Furniture, other manufacturing nec	36-37	1.32	1.18	2.28	0.16	0.40	5.98
Total manufacturing	15-37	6.99	6.89	10.03	5.36	5.06	9.10

Source: National R&D surveys, NSF (2002), OECD (2003), GGDC (2003)

TABLE B26

Real R&D Intensity in manufacturing industries, R&D expenditure, converted using R&D PPP as a share of industry value added, converted using output PPP

Industry	*ISIC rev3*	*France*	*Germany*	*Japan*	*Netherlands*	*UK*	*U.S.*
1987							
Food, beverages and tobacco	15-16	1.15	0.93	4.65	2.35	1.79	1.55
Textiles, fur and leather	17-19	0.68	1.11	1.85	0.66	0.54	0.59
Wood, paper, printing and publishing	20-22	0.47	0.81	1.56	0.19	0.65	0.57
Coke, refining of petroleum products	23	7.53	5.87	6.54	6.21	3.44	9.16
Chemicals	24	12.60	16.57	20.83	10.79	17.72	11.81
Rubber and plastic products	25	3.69	3.54	12.06	1.42	1.34	2.33
Non-metallic mineral products	26	2.04	2.10	6.32	0.34	1.50	4.41
Basic metals	27	4.25	1.87	5.56	3.93	2.21	2.20
Fabricated metal products	28	0.57	2.57	2.17	1.60	1.11	1.27
Machinery, nec	29	3.03	5.59	4.51	9.34	4.31	3.50
Office, accounting and computing machinery	30	18.84	8.95	16.28	11.91	16.69	38.18
Electrical machinery	31	4.22	4.56	12.85	34.87	11.82	3.30
Electronic equipment	32	59.53	54.90	26.34	32.45	23.86	46.53
Instruments, watches and clocks	33	3.30	3.80	14.68	21.60	24.66	9.88
Motor vehicles	34	13.55	11.04	17.30	8.88	14.40	15.90
Other transport equipment	35	65.90	28.25	19.03	8.92	34.46	46.12
Furniture, other manufacturing nec	36-37	0.30	0.44	0.95	0.07	1.30	1.44
Total manufacturing	15-37	7.51	7.23	9.50	7.28	8.19	9.83
1997							
Food, beverages and tobacco	15-16	1.15	0.54	4.43	2.02	1.12	1.47
Textiles, fur and leather	17-19	1.62	2.94	2.45	1.66	0.73	0.91
Wood, paper, printing and publishing	20-22	0.34	0.26	1.15	0.24	0.29	1.04
Coke, refining of petroleum products	23	4.05	2.51	1.92	2.33	13.71	5.47
Chemicals	24	14.93	13.15	19.43	10.63	22.99	11.93
Rubber and plastic products	25	4.55	2.36	14.09	2.35	0.74	2.87
Non-metallic mineral products	26	2.00	1.22	4.71	0.46	0.91	1.69
Basic metals	27	4.13	1.78	4.94	3.83	1.44	1.95
Fabricated metal products	28	0.85	1.13	2.84	1.03	0.86	1.88
Machinery, nec	29	4.66	5.38	5.10	5.33	5.42	4.89
Office, accounting and computing machinery	30	17.13	17.56	17.49	7.53	5.97	41.94
Electrical machinery	31	7.02	3.28	12.57	32.73	8.99	9.05
Electronic equipment	32	32.76	47.24	25.11	38.26	21.38	24.41
Instruments, watches and clocks	33	26.14	14.38	23.41	40.49	9.68	18.46
Motor vehicles	34	22.69	20.23	22.95	9.75	23.50	16.22
Other transport equipment	35	28.49	36.71	13.49	7.53	30.02	30.77
Furniture, other manufacturing nec	36-37	1.77	1.46	1.86	0.31	0.78	5.98
Total manufacturing	15-37	7.55	6.83	10.25	5.90	6.55	9.10

Note: R&D expenditure is converted to a common currency using R&D PPPs and gross output is converted using output PPPs.

Source: Nominal R&D intensity from Table B22, R&D PPPs from Tables B8 (1997) and B18 (1987), Output PPPs from Table B23.

Appendix C, Firm interview background

Definition of high-tech industries

For this project we selected four industries that are among the most R&D intensive (and are thus defined as high-tech). These industries are pharmaceuticals, computers, telecommunication equipment and automobiles. Table C1 shows how the ideal industry classification looks like according to the national classification systems. The table shows the definition according to ISIC rev. 3 (International Standard Industrial Classification), NACE (*Français*: Nomenclature generale des Activites economiques dans la Communaute Europeenne) Rev. 1, U.S. SIC (Standard Industrial Classification) 1987, NAICS (North American Industrial Classification System) and JSIC (Japan Standard Industrial Classification). This table presents the ideal internationally comparable set of industries, but in practice we sometimes have to deviate because data is not available at such a detailed level. This is the case in, for example, the computer industry where in many countries, data is only available for NACE industry 30 as a whole, which then includes office machinery like typewriters as well. However, the table as presented here defines the benchmark.

Table C1, Classification of high-tech industries in the U.S., Europe and

Pharmaceuticals		
ISIC	2423	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
NACE	24.40	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
NAICS	3254	Pharmaceutical and Medicine Manufacturing
USSIC	2834	Pharmaceutical preparations
JSIC	206	Manufacture of drugs and medicines
Computers		
ISIC	3002	Manufacture of computers and other information processing equipment
NACE	30.02	Manufacture of computers and other information processing equipment
NAICS	3341	Computer and Peripheral Equipment Manufacturing
USSIC	357(ex3579)	Computers and computer equipment
JSIC	305	Electronic data processing machines, digital and analog computer equipment and accessories
Telecommunications Equipment		
ISIC	3220	Manufacture of television and radio transmitters and apparatus for line telephony and line telgraphy
NACE	32.20	Manufacture of television and radio transmitters and apparatus for line telephony and line telgraphy
NAICS	3342	Communications Equipment Manufacturing[a)]
USSIC	366	Communication equipment
JSIC	304	Manufacture of communication equipment and related products
Motor Vehicles[b)]		
ISIC	3410	Manufacture of motor vehicles
NACE	34.10	Manufacture of motor vehicles
NAICS	3361	Motor Vehicle Manufacturing
USSIC	3711	Motor vehihicles and car bodies
JSIC	311	Manufacture of motor vehicles, parts and accessories

Notes:

a) This excludes some repair services, which are included in the ISIC and NACE definitions, but are probably relatively small

b) Ideally, we would like to exclude trucks, buses and motor vehicle engines.
For the U.S., this can be easily done by taking industry 33611, but it may not be possible for Europe and Japan.
The fact that Europe and Japan also include some repair services is probably less important.

Comparison of firm and industry R&D expenditure shares

For the four high-tech industries we define, we collect data on the cost structure of the firms we interview. We obtained 10 such cost structures for firms operating in the United States based on seven interviews (for two companies we have separate information on both research and development costs). For Japan we have eight cost structures, based on six companies. We also have information on a German and a French company's cost structures. These data allow us to compare the cost structures of the firm to the corresponding cost structure based on the national R&D surveys for those industries.

The first thing that becomes clear is that the cost structure differs widely by company. For example, in the United States, the labor share varies between 25% and 75%. In Japan this range is 31% to 77%. To some extent, this may be due to the fact that we have figures for research and development separately (for most firms we have only research figures). On average, research has a higher labor share of 60% compared with development, which is only 43%. In interpreting these numbers, it is good to also take

note of the range of observations we currently have. For research, we have 11observations divided nearly equally by the United States and Japan, while for development there are six observations: 3 U.S., 2 Japan, and 1 France. (There are four observations for R&D as a whole). Nevertheless, the finding of higher labor share in research holds up in both Japan and the United States. Also, based on our interviews, the result is plausible since much of development involves large equipment like prototypes in the car industry or semiconductor 'fabs' in other high-tech firms.

Given this observation, we would expect that development would similarly show a higher share of equipment than the overall industry. However, due to restrictions on the capitalization of R&D assets, we first look to see if development has a higher share of material inputs. Given the data we have so far, we cannot establish that the development labs have higher material shares. One observation confirms the conjecture; two deny it, while for the fourth we do not have separate data on material spending. We do tend to see that in research departments, the materials share is lower than for the industry as a whole (based on the R&D surveys). This is the case for 7 of the 11 observations. The average material share in research is also lower than in development.

One other way to corroborate this would be to look at the cost shares for foreign affiliates. Our interviews with these types of firms suggest that they usually do not have or buy the same type of equipment as is available in the home country. The alternative for these affiliates is sometimes to let headquarters do that part of the development. This course of action would lead to a higher labor cost share. We do find some evidence of this, although it is not the case for all foreign affiliates that they have a higher labor cost share than other firms do.

We also ask the companies to report the cost share of capital depreciation. This should be comparable to the question in the RD-1 survey on R&D depreciation. However, the U.S. firms invariably report a much higher figure for capital depreciation than the industry average for "R&D Depreciation". While R&D depreciation from the RD-1 survey varies between 0.4% and 2.9%, capital depreciation from the U.S. firm data varies between 1.2% and 9.9%, with most observations near the high side of this range. We might even be underestimating depreciation for R&D as a whole because we are mainly looking at the costs for the research departments. As mentioned above, the development

side is usually more equipment intensive although for capital depreciation, the findings are not unambiguous either. In general, however, the NSF R&D Survey responses are generally too low, which might indicate that firms are misinterpreting the question as asking for things like own-account software depreciation.

What we can observe is that the figures from individual firms are generally very different from the survey average. In the United States, firm responses indicate that both the labor and the capital share are higher than in the surveys, with either the materials or the other current expenditure share being lower. We noted before that the labor share in the United States varies between 25% and 75% for the firm data. The survey data vary between 32.6% and 53.3% across industries. In the United States, 8 of the 10 labor shares observed are larger than the surveys indicate as average for their respective industries. In Japan the firm data indicate a range for the labor share between 31% to 77%, while this range is 37.3% to 44.6% based on the survey. Also, 6 out of 8 observations are larger than the corresponding survey figure. Since our data are primarily for research laboratories, these observations confirm our prior that research departments is more labor-intensive than R&D in general. In the case of the United States, the higher capital share would argue against such a conclusion, but we argued above that this information may be misreported in the RD-1 Survey.

Representativeness of interviewed firms

In order to evaluate the representativeness of the firms we interviewed, we compared each company's R&D intensity to that of the other companies in the same industry, using the weighted average and median R&D intensity based on *Compustat* and the overall R&D intensity based on national R&D surveys ("target intensities"). The weighted average Compustat intensities should be relatively close to the survey intensities, but they do not match completely because of differences in coverage, scope, and definition. First, Compustat only covers publicly traded companies while the R&D surveys also cover private firms. Second, Compustat includes R&D by foreign affiliates in the data for the home country, while the R&D surveys only cover R&D performed within the country. Third, the NSF definition of R&D differs from that of the SEC in a number of respects. For example, the Compustat data do not include spending on social sciences research. For

more information on these differences and their impact see Hall and Long (1999) and NSF (1999).

All of the selected companies we interviewed perform a large amount of R&D, ranging from 3.5% to 21% of sales. The R&D intensity of the companies we interviewed is generally in a similar range to the target industry-wide intensities, although the spread between these target intensities can be quite large. For example, in the telecom industry, (publicly traded) U.S. firms in Compustat show nearly twice as large of an R&D intensity compared with the NSF R&D Survey. Since our selected firms are also (primarily) publicly traded corporations, in the telecom industry, we appear to be sampling from the higher end of the R&D intensity distribution. On the other hand, in the computer industry, we may be sampling from the lower half of the distribution. Still, the firms are rarely outside the range of the three target industry-wide intensities. Especially in the pharmaceutical and motor vehicle industries, our selected firms appear to have R&D intensity very close to the target levels. These results hold across the U.S. and Japan (and in the European countries we covered). Moreover, our coverage of total R&D performed in an industry is often substantial and in some cases overwhelming. These results suggest that conclusions we draw based on the firm interviews and cost structures directly reflect a sizable part of each industry and should also be broadly representative of the firms in each industry.