Exports: Orientation Towards Emerging Markets

by Marius Clemens, Florian Mölders and Dieter Schumacher

Nearly 60 percent of globally traded industrial goods are R&D-intensive. Two fifths are goods with very high research intensity (cutting-edge technology), while the remaining three fifths are goods with high research intensity (high-level technology).[1] Up until the 1990s, the USA was the global market leader. However, since then, the situation has changed in favor of Germany and remained so despite the recent economic crisis.[2] In 2009, Germany exported R&D-intensive goods amounting to USD 670 billion. The two main competitors, the USA and Japan, exported goods worth USD 561 and 388 billion respectively. The new Central and Eastern European EU member states, which increasingly focus on the production of R&D-intensive goods, reached a value of USD 189 billion altogether. The situation on the import side is reversed: Here the US market dominates with imports worth USD 756 billion, while Germany comes second with USD 430 Billion (see Table 1).

Germany biggest technology supplier in world trade

Selling R&D-intensive goods on the world market also means selling the know-how implemented in these goods. In this sense, exports tell us to what extent technology is exported to other countries. Similarly, imports indicate a transfer of know-how in the target country. Measured by the difference of exports and imports, and in relation to a country's population, Japan and Germany are net exporters with per capita values of USD 2929 and 1621; to a much lesser extent also the EU-14 group with USD 151 (Table 1). In contrast, the USA is the biggest net importer. In both cases this tendency has already evolved in the 1990s.

During the economic crisis, worldwide trade in R&D-intensive goods decreased from USD 6.7 trillion in 2008 to 5.3 trillion in 2009.[3] The demand for high-level technology goods collapsed significantly. This did not only apply to long-lasting industrial goods, for example in the machine building and vehicle manufacturing industries, but also to second-tier industries like suppliers of vehicle parts as well as plastic and rubber producers.

Countries like Japan and Germany, which specialize in high-level technology, observed a decrease in exports of 31 and 27 percent respectively (USA: -23 percent). The export of cutting-edge technology products has most drastically decreased in the USA (-31 percent), whereas Germany and Japan saw a decline of only 11 and 19 percent respectively. Regarding imports, losses in the high-level technology sector are smallest in Germany (Germany: -23 percent, USA: -27 percent, Japan: -26 percent). For cutting-edge technology products, the decline was similar in all three countries (about 8 percent).

Implications of the crisis on export specialization

The amount of export-import flows is largely influenced by fluctuations in demand and currency exchange ra-

1 See Box 1 in the previous article.

2 Belitz, H., Clemens, M., Gornig, M., Schiersch, A., Schumacher, D. (2010): Wirtschaftsstrukturen, Produktivität und Außenhandel im internationalen Vergleich, Studien zum deutschen Innovationssystem No. 5-2010, Expertenkommission Forschung und Innovation (eds.), Berlin, February 2010.

3 Belitz, H., Clemens, M., Gornig, M., Mölders, F., Schiersch, A., Schumacher, D.(2011): Die deutsche forschungsintensive Industrie in der Finanz- und Wirtschaftskrise im internationalen Vergleich. Studien zum deutschen Innovationssystem No. 4-2011. Eds.: Expertenkommission für Forschung und Innovation, Berlin, February 2011. www.e-fi.de

Table 1

Foreign Trade indicators of selected countries and regions for R&D-intensive Goods 2008 and 2009

	Germany		USA		Japan		EU-14		EU-10	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Exports in billion USD										
R&D-intensive goods	873.5	670.1	765.4	561.2	542.6	388.3	1782.6	1433.6	290.8	188.9
Cutting-edge technology	225.7	200.4	337.8	231.8	117.4	95	617.8	560.8	88.8	57.3
High-level technology	647.9	469.7	427.6	329.4	425.3	293.3	1164.8	872.7	201.9	131.6
Imports in billion USD										
R&D-intensive goods	522	429.6	929.8	755.9	218.7	180.1	1762.4	1386.5	290.7	211.9
Cutting-edge technology	195.4	179.1	401	369.4	105.5	96.1	641.8	573.9	89.3	75.2
High-level technology	326.6	250.5	528.8	386.6	113.2	84	1120.6	812.5	201.4	136.8
Balance of trade per capita in USD										
R&D-intensive goods	4 281	2 929	–541	–641	2 537	1 621	65	151	1	–311
Cutting-edge technology	368	258	–208	–453	93	–9	–77	–42	–6	–241
High-level technology	3 913	2 670	–333	–188	2 443	1 630	142	193	7	–70
Relative share of exports in world trade (RXA)*										
R&D-intensive goods	18	17	22	17	31	26	0	1	1	–5
Cutting-edge technology	–18	–14	39	19	–23	–24	–8	–3	–19	–34
High-level technology	35	34	10	16	54	51	4	3	11	11
Relative share of imports in world trade (RMA)*										
R&D-intensive goods	4	3	2	3	–14	–15	–4	–5	–1	–3
Cutting-edge technology	1	1	14	17	9	8	–8	–7	–23	–21
High-level technology	5	4	–6	–9	–32	–36	–1	–3	10	8
Comparison of export and import share (RCA)**										
R&D-intensive goods	13	11	18	12	44	39	2	3	0	–5
Cutting-edge technology	–24	–22	20	–5	–36	–39	–3	–3	0	–20
High-level technology	30	29	16	25	87	87	4	7	1	3

1 A positive value indicates that the share of R&D-intensive goods in exports/imports of that country is higher than the corresponding share in global trade.
2 A positive value means that the share of R&D-intensive goods in exports is bigger than in imports.
Sources: UN Comtrade 2010; DIW Berlin calculations.

tes. In order to describe the position of German R&D industries without these influences we compare export and import shares of a country with the corresponding international share. We use an indicator[4] that illustrates comparative advantages and disadvantages of the countries of interest in their foreign trade with R&D-intensive goods and analyzes whether the crisis has changed Germany's foreign trade profile (see Box 1).[5]

If we take a look at specific countries' positions regarding R&D-intensive goods for exports (RXA) and imports (RMA), we identify the following grouping for 2009: Regarding cutting-edge technology, the USA was strongly involved on both sides of the international trade flow, surpassing its competitors. In Germany and Japan, only imports were above average. EU-14 countries' trade in cutting-edge technology is below average for both imports and exports. For high-level technology goods, Germany and the EU-10 countries are strongly involved in global trade in both imports and exports, while for Japan, the EU-14 and the USA the same pattern is reflected on the export side.

The RCA indicator combines the two above mentioned indicators to illustrate the current situation of comparative advantages. It can be used to estimate the relative scale of the financial crisis. Table 1 shows that the RCA index has developed negatively from 2008 to 2009 for Germany, the USA and Japan. The lower RCA values for Germany and Japan can be explained by a decline of exports of R&D-intensive goods. However, Germany only had to cope with a moderate decrease compared to Japan, the USA and the EU-10.

4 For the calculation of the indicator, foreign trade data are structured according to the four-digit International Standard Industrial Classification (ISIC Rev.3). Information on the calculation of specialization indicators can be found in Box 1.

5 Dividing the shares provides us with the measure introduced by Balassa (1965), which is used for quantification of specialization patterns of a given country in international trade. See Balassa (1965): Trade Liberalization and 'Revealed' Comparative Advantage. The Manchester School of Economic and Social Studies, 33, 99-123.

Box 1

Indicators Measuring Specialization in International Trade

Specialization patterns of a given country are measured on the basis of whether a country has a significantly bigger or smaller share in world trade regarding imports/exports of specific product groups—compared to its overall share in the manufacturing sector. A country's comparative advantages are calculated based on a comparison of exports and imports. In case the export/import balance of a class of goods—adjusted for the total balance - is positive, the country has a comparative advantage in this class. If it is negative, the country has a disadvantage. Indicators are calculated from relations, making them independent of the size of different classes of goods.[1]

Indices reveal a specialization in exports (imports), if the share of a specific class of goods in total exports (imports) of the manufacturing sector is bigger than in world trade.[2]

$$RXA_{ij} = 100 \ln [(X_{ij}/\sum_i X_{ij})/(\sum_j X_{ij}/\sum_{ij} X_{ij})]$$

and

$$RMA_{ij} = 100 \ln [(M_{ij}/\sum_i M_{ij})/(\sum_j M_{ij}/\sum_{ij} M_{ij})]$$

Therefore, a positive value means that the economy is specialized in the (export) production of goods in a certain class of goods, while a negative value indicates that involvement in world exports is below average.

A comparison of comparative advantages for imports and exports can be achieved with the help of the RCA (Revealed Comparative Advantage) index:

$$RCA_{ij} = 100 \ln [(X_{ij}/\sum_i X_{ij})/(M_{ij}/\sum_i M_{ij})]$$

If the world import value equals the world export value, the RCA index can be calculated as the difference between RXA and RMA. RCA values characterize the pattern of comparative advantages/disadvantages of a given country in world trade, taking into account import competition on the domestic market. In this respect it is important to note to what extent a country's import structure deviates from the global trade structure.

Measuring relative geographic orientation

The Revealed Geographic Advantage Index (RGA, following the RCA index) measures geographic advantages/disadvantages of a specific country regarding its trade in certain sectors. To this end, the share of an export market in total exports of a specific sector is calculated (in our case R&D-intensive industries) and put in relation to the corresponding weight of the other OECD member states. This creates a relative index that mirrors a country's geographical orientation in correspondence to the orientation of the potential competitors, the other OECD countries. Formally, this index is calculated as follows:

$$RGA_{jk} = 100 \ln [(X_{jk}/\sum_j x_k)/(X_{OECDjk}/\sum_j x_{OECDk})]^3$$

A positive RGA value indicates that the respective country exports more goods of sector k to country j than other OECD member states do. In case the index echoes a null value, this means e.g. that Germany and the other OECD member states have identical shares in exports to country j in sector k.

1 The analysis of comparative advantages and disadvantages based on foreign trade data (RCA: Revealed Comparative Advantage) was developed by Balassa (1965) and is often used in his mathematical formulation.

2 X = exports, M = imports, i = product group index, j = country index.

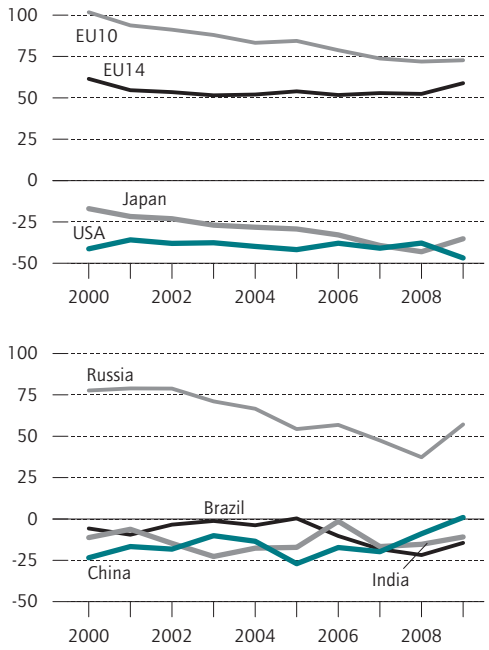
3 Definition of variables: X = exports, j = country index, k= product group index, OECD = OECD member states.

An analysis of specific industry sectors reveals a more detailed picture: RCA values show that after the crisis Germany holds comparative advantages in a number of R&D-intensive products. This is the case, not only in the traditionally export-strong industries like vehicle manufacturing and machine building, but also in many smaller product groups like medical technology, chemistry and electrical engineering.[6] Overall, the USA (like Germany) possesses comparative advantages in 20 out of 31 R&D-intensive classes of goods in 2009. Japan and EU-14 countries are nearly as strong with 19 and 18 classes

6 See also Schrooten, M., Teichmann, I. (2010): Export wieder auf Touren—Binnennachfrage muss nachziehen. Wochenbericht des DIW Berlin No. 35, 2-7.

Figure 1

Geographic orientation of German exports of R&D-intensive goods in international comparison



Sources: UN Comtrade 2010, DIW Berlin calculations.

German exports of R&D-intensive goods to BRIC states grow faster than those of the other OECD countries.

respectively, while the EU-10 falls behind with advantages in only eight product classes.

In summary, the following can be recorded about a shift of the sectoral patterns in the year of crisis: Though absolute numbers have gone down, Germany has not experienced severe losses compared to its competitors. While medical technology, chemical industry and machine building show moderately positive or no changes at all in their relative positions the loss of comparative advantages in the high-level technology sector can be mainly attributed to the automobile industry.

Geographical diversification

The demand of the emerging countries in Asia and Latin America has reduced the market concentration of the traditional sales markets for the USA, Europe and Japan. The world economy is currently driven by these emerging countries, putting the geographical competitive position on new emerging markets into the foreground. Although the European and North American markets still dominate as destinations for German exports of R&D -intensive goods, a regional shift can be identified. The BRIC[7] states' share used to be below five percent in the beginning of the last decade –it has now risen to nearly eleven percent in 2009. Emerging countries are likely to play an increasing role: The share of R&D -intensive goods in total Chinese imports has increased by 12 percentage points in the past decade.

To obtain a relative index, a subsequent analysis should include the corresponding values of countries that are potential competitors in a specific market, (see Box 1). This index describes the geographical orientation of R&D -intensive industries, in relation to the orientation of other OECD countries. The Revealed Geographic Advantage Index (RGA) allows us to draw conclusions on the relative geographical orientation of exports based on observations from 2000 till 2009. Figure 1 illustrates the development of the RGA index between 2000 and 2009 for German exports in selected traditional and emerging markets.

The biggest part of Germany's foreign trade is conducted within Europe. Especially the EU-10 countries import a significant, and above average, percentage of R&D -intensive goods from Germany. Starting in 2008, the figure shows a decline in the relative concentration of R&D -intensive goods on the US market. This shift is accompanied by a reorientation of German trade towards the BRIC states; however, because of its geographical proximity, exports above-average can only be observed for Russia.

The value of the RGA index is influenced by the geographical proximity to the sales market. This allows Germany, the United Kingdom and France to gain significant geographical advantages on the European market, as it is the case for the USA on American and Japan on Asian markets (see Table 2).

Compared to other OECD countries, the USA has lost some of its presence both on traditional and emerging markets over the past years. Regarding the Chinese market, Japan holds a clear advantage because of its geographical proximity. Furthermore, a slightly negative tendency can be observed concerning the markets of industrialized economies. The BRIC states do not play a significant role for Japan with regard to the development during the financial crisis.

In UK's regional orientation, its cultural proximity to the American market is mirrored, whereas France pos-

7 BRIC states are Brazil, Russia, India and China.

Table 2

Relative geographical orientation of selected export countries and destination markets
RGA Index 2009, values for 2007 in brackets

Destination	Germany	USA	Japan	France	United Kingdom	China	India	Russia	Brazil
Exportländer									
Germany	0	–47 (–41)	–35 (–39)	66 (59)	46 (42)	1 (–20)	–11 (–17)	57 (47)	–14 (–18)
USA	–48 (–45)	0	56 (69)	–91 (–57)	–20 (–18)	2 (13)	–3 (41)	–108 (–103)	79 (94)
Japan	–95 (–92)	34 (46)	0	–151 (–141)	–90 (–69)	116 (109)	–19 (–28)	–76 (–2)	–42 (–58)
France	68 (58)	–64 (–70)	–68 (–62)	0	46 (48)	–64 (–38)	–33 (13)	31 (–18)	–15 (10)
United Kingdom	36 (36)	16 (2)	–27 (–38)	27 (37)	0	–78 (–95)	–18 (–34)	–9 (–17)	–30 (–50)

Sources: UN Comtrade 2010, DIW Berlin calculations.

sesses geographical advantages in Russia. Regarding the emerging economies, both states have developed quite differently over the past years. France has increased its exports to Russia, whereas British exporters have become more present in all BRIC states, although still below OECD average.

Outlook

Following the economic crisis, German R&D-intensive exports have decreased. However, the share of R&D-intensive goods in total exports has nearly remained unchanged in Germany—in contrast to Japan and the USA. Taking into account indicators of relative specialization, we see that Germany's loss of comparative advantages regarding R&D-intensive goods was less dramatic than that of Japan or the USA. Comparative advantages of Germany's exports have not shifted, but there are signs that exporters have begun a reorientation towards emerging markets in 2007. With respect to expected future growth, a stronger focus on the Chinese, Indian, Russian and Brazilian markets is important. Their weight in the demand for R&D-intensive goods is expected to increase with their economic development, making a geographical reorientation probable. Large emerging countries like China are increasingly focusing their export specialization on R&D-intensive industries, possibly leading to an increasing demand for German technology.

Based on these findings, European foreign trade policy should focus on improving trading conditions with these fast growing and emerging economies. Free trade agreements with the EU are currently being negotiated with India as well as with a number of Latin American and East Asian states. Since the market diversification in R&D-intensive exports may guarantee a more consistent growth, and as the import of know-how can improve the countries' capacity for innovation, barrier-free trade is in the interest of both European and emerging countries.

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