Center for Social and Economic Research

CASE Reports

Networks and Competitiveness in Polish Foreign-owned and Domestic Firms

Richard Woodward (ed.)

Katarzyna Binkiewicz
Jacek Cukrowski
Michał Górzyński
Małgorzata Jakubiak
Amelia Kalukiewicz
Piotr Wójcik

No. 61/2005

Warsaw 2005

The views and opinions expressed here reflect the authors' point of view and not necessarily those of CASE.

The work published in this report was with support from the European Commission under the Fifth Framework Programme project entitled "Changes in Industrial Competitiveness as a Factor of Integration: Identifying Challenges of the Enlarged Single European Market" (Contract No. HPSE-CT-2002-00148).

Keywords: **Networks, upgrading, Poland, manufacturing, competitiveness.**

Graphic Design: Agnieszka Natalia Bury

DTP: CeDeWu Sp. z o.o.

ISBN: 83-7178-391-4

Publisher:
CASE – Center for Social and Economic Research
12 Sienkiewicza, 00-010 Warsaw, Poland
tel.: (48 22) 622 66 27, 828 61 33, fax: (48 22) 828 60 69
e-mail: case@case.com.pl
http://www.case.com.pl/

Contents

Authors

Richard Woodward is an economist for CASE – the Center for Social and Economic Rsearch – and a lecturer at the Management School of Edinburgh University in Scotland. He is the author of numerous publications on enterprise privatization, development and innovativeness in Central and East European countries.

Jacek Cukrowski is an advisor for the Regional Bureau for Europe and the CIS of the United Nations Development Programme and formerly worked as an economist for CASE – the Center for Social and Economic Research – and professor at the University of Finance and Management in Bialystok. He is the author of numerous publications on economic transition, international trade, regional development, and other topics.

Michał Górzyński is an economist for CASE – the Center for Social and Economic Research - and vice-president of CASE-Advisors. He has been working with CASE since 1994, taking part in many research and advisory projects in the areas of privatization, restructuring, and small business development. His current research interests are innovation and the Knowledge-Based Economy in the countries of Central and Eastern Europe. Countries in which he has done consulting and advisory work include Poland, Romania, Ukraine and Belarus.

Małgorzata Jakubiak is an economist for CASE – the Center for Social and Economic Research. Her main areas of interest include international economics and macroeconomics. She has published articles on trade flows, exchange rate regimes, saving and investment, knowledge transfer and productivity. She has collaborated with the CASE Foundation since 1997 and is a member of the Council of Directors of the Center for Social and Economic Research-CASE Ukraine.

Amelia Kalukiewicz is an analyst at TNS OBOP and a doctoral student at the Warsaw School of Economics. Her research interests include statistics and data analysis.

Katarzyna Binkiewicz is an expert from the Polish Ministry of Regional Development. She has a degree in regional and spatial development from the University of Warsaw (EUROREG – the European Institute of Regional and Local Development). Her main interest lies in the analysis of the determinants of local and urban development.

Piotr Wójcik is a doctoral student at the Faculty of Economic Sciences of Warsaw University. His research interests include analysis of regional convergence in Poland, financial market modeling, and the practical application of modern statistical and econometric methods.

1. Introduction

Richard Woodward, Michal Górzyński

In contrast to other studies of competitiveness which often focus on the country and industry level, this is a study of competitiveness in Poland at the firm level. In this analysis, we will focus primarily on how cooperation with external actors such as investors, creditors, customers, suppliers, local governments affects changes in Polish firms' competitiveness.

Why the focus on cooperation with external partners? A review of the literature on enterprise upgrading (see Woodward et al., 2005) finds a general consensus that in the process of upgrading, an important role is played not only by activities occurring within the enterprise, but also by its cooperation with other organizations and its ability to learn from such cooperation. The networks of the firm within which it pursues such cooperation and realizes gains therefrom are among its most important assets, and its skills in developing such networks and extracting gains from them are of crucial interest in studying the processes of firms' upgrading and their integration into the European and global economy. Additionally, a large literature exists concerning the special role of enterprise networks in the innovation process. Their importance is due to the fact that they make it possible for the transfer of knowledge to the firm from other firms as well as from research institutions to take place. However, the literature also shows that firms must make some efforts of their own to generate knowledge in order to be able to absorb it from outside as well.

The relevant literature on the post-Communist transition countries shows a severe adverse shock to network activity at the beginning of the transition. The same is true of innovation activity. However, in the near absence of firms' own R&D activity, technological upgrading is occurring through the import of machinery and use of licensing, and the East Asian experience indicates that this may indeed be the beginning of a long-term trajectory leading to world-class technological and innovative capabilities. This is also reflected in a gradual shift of exports to goods with higher levels of skilled labor inputs (see Woodward et al., 2005).

In this study we therefore set out to deepen the available knowledge about the networks of Polish manufacturing firms. Among the questions touched upon in this analysis are: Do foreign-owned companies have less developed networks of Polish suppliers than domestically owned companies? What is the role of the science and technology sector in industrial innovation? What benefits do firms derive from cooperation with various types of partners?

To achieve a mix of mature and emerging industries, we selected four manufacturing industries for analysis:

- electronics
- auto/auto parts
- pharmaceuticals
- food and beverages

We proceed as follows: here in the introduction, we briefly overview of the recent development and performance of the four industries in Poland. In the second section, we present case studies of eight firms – two from each of the four industries studied. These case studies were carried out in 2003. In the third section, we analyze data collected from a sample of 226 companies in 2004. Finally, in the fourth section, we summarize and conclude.

1.1. A brief overview of the four industries in Poland

In this overview of the four industries, we will examine their development in Poland in the years 1998-2001 in terms of employment, the number and size of firms, their performance with respect to sales, productivity, foreign trade, and investment, the role of foreign direct investment (FDI), and productivity. To provide a basis for comparison, we provide some statistics for the entire manufacturing sector in Table 1.1.

Table 1.1. Main economic indicators of Polish manufacturing, 1998-2001

	1998	1999	2000	2001
Sales of domestic producers*	334,887	359,650	412,265	414,630
(Change**)	(-)	(107.4)	(114.6)	(100.6)
Investment*	29,054	28,402	26,523	23,235
(Change**)	(-)	(98)	(93)	(88)
Employment***	3,120.4	2,900.6	2,732.9	2,635.2
(Change**)	(-)	(93)	(94)	(96)
Investment/sales	8.7%	7.9%	6.4%	5.6%

* in millions of PLN, current prices.
** previous year = 100.
*** in thousands.
Source: Central Statistical Office (2001, 2002, 2003), own calculations.

Table 1.2. Share of four industries in total manufacturing, 1998-2001 (%)

	1998	1999	2000	2001
Sales				
Food and beverages	23.4	22.3	21.6	23.4
Pharmaceuticals	1.2	1.2	1.2	1.4
Auto and auto parts	7.0	7.6	7.5	6.4
Electronics	3.2	3.4	3.4	3.6
Employment				
Food and beverages	17.6	18.2	18.0	18.1
Pharmaceuticals	0.8	0.9	0.8	0.9
Auto and auto parts	3.5	3.6	3.6	3.3
Electronics	3.3	3.4	3.4	3.6

Source: Central Statistical Office (2001, 2002, 2003), own calculations.

As we see from Table 1.2, the food and beverages industry is by far the most significant of the four studied here from the point of view of its share in sales and employment for the whole manufacturing sector. The auto and auto parts industry is a distant second in terms of sales and more or less even with electronics in terms of employment. Pharmaceuticals comes in last on both counts. We see that the share of these industries in Polish manufacturing is generally larger, the more traditional they are, and smaller, the more they are based on high value added and the role of intellectual property as a source of competitive advantage. This can be seen as an indicator of Poland's distance from the so-called knowledge-based economy. Furthermore, if we compare the shares of sales to the shares of employment, we see that three of the industries tend to be more productive than the manufacturing average (that is, they have a much higher share in total manufacturing sales than in total manufacturing employment); the exception, ironically, is electronics, generally considered to be a high-technology industry (we will return to the subject of productivity in more detail in Section 1.1.6). The fact that in Poland this "high-tech" industry has such low productivity can also be seen as an indicator of how far Poland still has to go in building a knowledge-based economy.

Finally, it is also worth noting that the shares of the four industries have remained quite stable over the four-year period examined here.

1.1.1. Food and beverages

During the period under analysis we observe the stable growth of sales of the domestic food companies, similar to the average growth of manufacturing as a whole (around 6% annually in current prices). In terms of the volume of sales, this industry is definitely the most important of the four analyzed here. This was around seven times

higher than in the electronics and automobile industries and 16 times higher than in the pharmaceutical industry. However, this industry is also characterized by the lowest export and import intensity. The share of exports in total sales averaged 7% and that of imports 8%. During the last two years for which we have data we observe a significant improvement in the trade balance (caused by an increase in exports and a decrease in imports), although it still remains negative. It should be stressed that although the share of foreign trade in total sales is low in this industry, the value of exports is quite significant in absolute terms when compared to the other analyzed industries. Food industry companies' foreign sales are on a comparable level with the exports and imports of the electronics industry, and they exported almost 10 times more than pharmaceutical companies.

As in case of the pharmaceutical and automobile industries, the food industry saw a decrease in investment activity. However, in contrast to the other three industries, the food industry's investment intensity indicator (i.e., the ratio of investments to sales) is lower than the average for total manufacturing.

Employment fell by 13% in the food industry during the analyzed period. As a result, the labor productivity of the industry was relatively high, at around 200,000 PLN per employee, which made it 25% higher than the average for total manufacturing.

Information on the food industry is shown in Table 1.3.

Table 1.3. Main economic indicators of the food and beverages industry, 1998-2001

	1998	1999	2000	2001
Sales of domestic producers*	78,425	80,241	89,174	97,047
(Change**)	(-)	(102.3)	(111.1%)	(108.8)
Sales of domestic producers***	78,425	75,771	83,264	95,715
(Change**)	(-)	(96.6)	(109.9)	(115.0)
Export*	n.a.	n.a.	6131	6858
Share of export in sales	n.a.	n.a.	6.9%	7.1%
Import*	n.a.	n.a.	7823	7737
Share of import in sales	n.a.	n.a.	8.8%	8.0%
Trade balance (Ex-Im)*	n.a.	n.a.	-1692	-879
Investment*	4617	5310	4374	4455
(Change**)	(-)	(115)	(82)	(102)
Investment/sales	5.9%	6.6	4.9%	4.6%
Employment****	549.7	526.6	492.2	478.0
(Change**)	(-)	(96)	(93)	(97)
Number of companies	-	-	-	21,222

* in millions of PLN, current prices.
** previous year = 100.
*** in millions of PLN, in constant 1998 prices (deflated by PPI).
**** in thousands.
Source: Central Statistical Office (2001, 2002, 2003), own calculations.

1.1.2. Pharmaceuticals

The pharmaceutical industry saw the fastest growth in sales (44%) of the analyzed industries in the years 1998-2001. Imports still play a crucial role on the pharmaceuticals market, which is the most import-dependent of the four markets under consideration here. Imports far exceed the sales of domestic producers (by 30%); as a result, the market share of domestic companies is far below 50%. On the other hand, the competitiveness of domestic pharmaceuticals companies has been steadily increasing. Their market share increased in the last two years (mainly in 2001), as the growth of sales was faster than the growth of the market and of imports. We also observed an increase of exports; currently, domestic companies export 12-13% of their output. The increased competitiveness of the Polish pharmaceutical industry seems to have resulted largely from the successful privatization process carried out in the late 1990s. Due to the participation of foreign strategic investors in the privatization process (see remarks below), the industry experienced very intensive investment activity in the late 1990s. In 1999 the ratio of investment to sales peaked at almost 17%. More recently, investment activity has weakened, but it remains far above the average for manufacturing. The modernization of production capacity and 7% decrease in

Table 1.4. Main economic indicators of the pharmaceutical industry, 1998-2001

	1998	1999	2000	2001
Sales of domestic producers*	4,124	4,339	4,917	5,908
(Change**)	(-)	(105.2)	(113.3)	(120.2)
Sales of domestic producers***	4,124	4,104	4,596	5,834
(Change**)	(-)	(99.5)	(112.0)	(126.9)
Export*	611	532	643	708
(Change**)	(-)	(87)	(121)	(110)
Share of export in sales	14.8%	12.3%	13.1%	12.0%
Import	5081	5725	6,633	7,413
(Change**)	(-)	(113)	(116)	(112)
Share of import in sales	123.2%	131.9%	134.9%	125.5%
Trade balance (Ex-Im)*	-4471	-5193	-5990	-6705
Investment*	553.2	732.9	535.2	438.7
(Change**)	(-)	(132)	(73)	(82)
Investment/sales	13.4%	16.9%	10.9%	7.4%
Employment****	25.4	24.9	23.1	23.6
(Change**)	(-)	(98)	(93)	(102)
Productivity*****	162,343	174,011	212,937	250,148
(Change**)	(-)	(107)	(122)	(117)
Number of companies	-	-	-	96

* in millions of PLN, current prices.
** previous year = 100.
*** in millions of PLN, in constant 1998 prices (deflated by PPI)
**** in thousands.
***** sales (in PLN) per worker.
Source: Central Statistical Office (2001, 2002, 2003), own calculations.

employment helped the industry to achieve the second best productivity ratio among the analyzed industries (only the auto and auto parts industry did better). In 2001 sales per employee in pharmaceuticals amounted to 247,000 PLN, while, the average for total manufacturing was 155,000 PLN. Moreover, the dynamic growth of productivity in pharmaceuticals can be contrasted with the situation in the auto and auto parts industry, where we observed only slight growth.

1.1.3. Auto and auto parts

The auto and auto parts industry recorded the lowest rate of growth of the four analyzed industries in years 1998-2001. Sales in current prices grew by only 13% – only slightly more than half of the average for manufacturing as a whole (24%). This was due to the dramatic decrease of sales on the domestic market in 2001 (a fall of 16.3% in constant prices). On the other hand, exports increased. The auto and auto parts industry is the most export-intensive industry of those analyzed here. The share of exports in total sales of domestic companies amounted to almost 72% in 2001, and the volume of the industry's exports was almost three times higher than that of the food and beverages industry. Imports also play a very significant role on the domestic market: in 2001 the share of imports in the domestic market was 70%. Nevertheless, 2001 saw a significant improvement in the trade balance over the previous year. In 2000 the balance was negative, but turned positive in 2001, due not only to an increase in exports, but also to a significant decrease in imports (by almost 15%).

Table 1.5. Main economic indicators of the auto and auto parts industry, 1998-2001

	1998	1999	2000	2001
Sales of domestic producers*	23,395	27,460	30,944	26,404
(Change**)	(-)	(117.4)	(112.7)	(85.3)
Sales of domestic producers***	23,395	26,126	28,906	25,942
(Change**)	(-)	(111.6)	(110.6)	(89.7)
Export*	n.a.	n.a.	18683	18951
Share of export in sales	n.a.	n.a.	60.4%	71.8%
Import*	n.a.	n.a.	19,572	16,967
Share of import in sales	n.a.	n.a.	63.2%	64.3%
Trade balance (Ex-Im)*	n.a.	n.a.	-889	1984
Investment*	3508	3567	2607	2373
(Change**)	(-)	(102)	(73)	(91)
Investment/sales	15.0%	13.0%	8.4%	9.0%
Employment****	110.7	103.2	99.2	88.2
(Change**)	(-)	(93)	(96)	(89)
Number of companies				1619

* in millions of PLN, current prices.
** previous year = 100.
*** in millions of PLN, in constant 1998 prices (deflated by PPI).
**** in thousands.
Source: Central Statistical Office (2001, 2002, 2003), own calculations.

The industry experienced a significant decrease in investment activity (sharper than in the other three industries), although its investment intensity is far above the average for Polish manufacturing and comparable to that of the pharmaceutical industry. In the years 1998-2001 we also observed a radical employment adjustment (a decrease of over 22%). This gave the industry the highest labor productivity of the four industries analyzed here, with sales per employee of 294,000 PLN – almost twice the average labor productivity for manufacturing as a whole. The industry's high investment intensity resulted primarily from the high level of investment activity of foreign investors (see Section 1.1.5).

1.1.4. Electronics

Sales in this industry grew in the analyzed period faster than in manufacturing as a whole, at a rate of 36.5% in current prices, which was only slightly lower than in pharmaceuticals, the industry with the fastest growth among the four analyzed here. The export and import data show that international trade plays a very important role in the industry. Around 45% of its output is exported, while imports account for about 36% of total sales on the Polish electronics market. As a result the trade balance is positive.

Electronics was the only one of the four industries with positive growth of investment (almost 13% in the years 1998-2001). Nevertheless, this industry has lower investment intensity than the pharmaceutical and automotive industries (though still

Table 1.6. Main economic indicators of the electrical machinery and apparatus industry, 1998-2001

	1998	1999	2000	2001
Sales of domestic producers*	10,782	12,328	14,083	14,720
(Change**)	(-)	(114.3)	(114.2)	(104.5)
Sales of domestic producers***	10,782	11,713	13,169	14,509
(Change**)	(-)	(114.3)	(112.4)	(110.2)
Export*	n.a.	n.a.	6207	6833
Share of export in sales	n.a.	n.a.	44.1%	46.4%
Import*	n.a.	n.a.	5056	5276
Share of import in sales	n.a.	n.a.	35.9%	35.8%
Trade balance (Ex-Im)*	n.a.	n.a.	1151	1557
Investment*	1008	1054	1186	1138
(Change**)	(-)	(105)	(113)	(96)
Investment/sales	9.3%	8.5%	8.4%	7.7%
Employment****	102.1	99.1	93.8	94.0
(Change**)	(-)	(97)	(95)	(100)
Number of companies				4697

* in millions of PLN, current prices.
** previous year = 100.
*** in millions of PLN, in constant 1998 prices (deflated by PPI).
**** in thousands.
Source: Central Statistical Office (2001, 2002, 2003), own calculations.

above the average for manufacturing as a whole). Employment fell by only 7.9%, which is probably the main reason why the industry has the lowest labor productivity indicator of the four discussed here. In fact, labor productivity is lower than the average for manufacturing as a whole.

1.1.5. The role of FDI in the four industries

We will now look at the extent of FDI in the four industries. First we look at the amount of FDI in the four industries, presenting calculations based on cumulative data from the Polish Agency for Foreign Investments (PAIZ) for the end of 2002 as well as an overview of the largest investments and investors (more detail can be found in Tables A1-A4 in the annex to this chapter).

The food processing industry attracted around 4.2 billion USD in FDI, with 113 investors investing more than 1 million USD since the start of the economic transformation in Poland. The largest investor, Coca-Cola, invested 513 million USD. Among the largest investors are also Nestle (365 million USD), PepsiCo (275 million USD), Heineken (221 million USD), Mars (160 million USD), Danone (136 million USD) and Cadbury Schweppes (126 million USD). According to data from the Central Statistical Office (CSO), 46.2% of the core capital in the food industry is foreign-owned.

Around 0.86 billion USD in FDI flowed to the pharmaceutical industry; 26 investors invested more than 1 million USD. UK-based GlaxoSmithKline Pharmaceuticals, the largest investor in the industry, acquired the former Polfa Poznań factory in Poznań for 220 million USD. The second largest investor is the Croatian firm Pliva (which bought Polfa Kraków for 151 million USD), and the third is the US firm ICN Pharmaceuticals (which purchased 80% of Polfa Rzeszów for 51 million USD). According to CSO data, 44.5% of the core capital in the chemical industry is foreign-owned.

Foreigners invested around 5.9 billion USD in the Polish automotive industry (the automotive industry attracted more FDI than any other Polish industry). PAIZ recorded 47 investors who had invested more than 1 million USD since the start of the economic transformation in Poland. The largest foreign investor in the car industry is Italy's Fiat, which invested 1.7 billion USD. Fiat is the second largest foreign investor in Poland. The second largest investor in the industry and the third largest investor in Poland is Daewoo, which invested 1.4 billion USD. Other important foreign players are: General Motors Corp. (801 million USD invested), Volkswagen AG (390 million USD), Delphi Automotive Systems (225 million USD) and Ispol-IMG (Isuzu Motors; 193 million invested). According to CSO data, 72.6% of the core capital in the vehicles, trailers and semi-trailers industry is foreign-owned.

The electronics industry received around 2.2 billion USD in FDI, with 40 investors investing over 1 million USD in Polish electronics. The largest foreign investors are: Thomson (474 million USD invested), Philips (363 million USD), Alstom (317 million USD), Alcatel (150 million USD), Lucent Technologies (139 million USD) and ABB (123 million USD). According to CSO data, 45.2% of the core capital in the electrical machinery and apparatus industry is foreign-owned.

CSO data indicate that 42.6% of the core capital for all Polish manufacturing is foreign-owned. Thus, the four industries examined here (and especially the auto industry) have a larger than average proportion of capital in foreign hands.

1.1.6. Productivity in the four industries

In our look at the four industries as a whole, we conclude with an examination of labor productivity, using two measures: value added per person employed (with the exception of the pharmaceutical industry, for which we did not have access to data on value added) and sales per person employed.

Table 1.7. Gross value added per person employed, in thousands of PLN

	1999	2000	2001
Manufacture of food products	36.8	42.5	43.9
Manufacture of electrical machinery and apparatus	43.6	48.4	49.6
Manufacture of vehicles, trailers and semi-trailers	31.5	45.2	47.8
Total Manufacturing	38.9	45.5	45.0

Source: Central Statistical Office (2001, 2002, 2003), own calculations.

Table 1.8. Sales per person employed, in thousands of PLN

	1998	1999	2000	2001
Food products	142.7	152.4	181.2	203.0
Pharmaceuticals	162.4	174.3	212.9	250.3
Electrical machinery and apparatus	105.6	124.4	150.1	156.6
Auto and auto parts	211.3	266.1	311.9	299.4
Total manufacturing	107.3	124.0	150.9	157.3

Source: Central Statistical Office (2001, 2002, 2003), own calculations.

The pictures in Tables 1.7 and 1.8 are rather different. When measuring productivity by value added, we see two industries (auto and electronics) which are slightly above the manufacturing average, and one (food) that is slightly below it. If we look at sales per person employed, however, we see that electronics – the industry that performs best in terms of value added – is on a par with the manufacturing average, while the other three – including the food industry – are well above it.

Annex

Table A1. 15 largest investors in the food processing industry

No.	No. on PAIZ list	Investor	Capital Invested (millions of USD)	Origin	Comments
1	26	CC HBC (Coca-Cola Hellenic Bottling Company)	513.0	Greece	Coca Cola Beverages Polska Sp. z o. o. (Warsaw)
2	39	Nestle S.A.	365.0	Switzerland	Nestle Polska S.A (Warsaw, Kalisz, Poznań), 50% stake in Cereal Partners Poland Toruń-Pacific Sp. z o.o. (Toruń), 50% stake in Nałęczowianka Sp. z o.o. (Nałęczów)
3	45	Harbin BV	325.9	Netherlands	Żywiec S.A. – brewery
4	54	PepsiCo	275.0	USA	Bottling plants (Łódź, Białystok, Gdańsk, Kraków, Poznań, Szczecin, Wrocław, Żywiec, Leżajsk and Pniewy), salted snacks factory (Grodzisk Mazowiecki), sale of "Delicja" confectionery to Danone
5	58	Heineken	220.8	Netherlands	Heineken Polska Sp. z o.o. (Warsaw), Grupa Żywiec including breweries: Elbrewery Company Ltd. (Elbląg), Hevelius Brewing Company Ltd, Leżajsk Brewery, and Zakłady Piwowarskie Warka S.A.
6	74	Mars Inc.	160.0	USA	Master Foods Polska Sp. z o.o. (Sochaczew) – pet food and sweets production
7	86	BSN Gervais Danone	135.5	France	Danone Polska Sp. z o.o. (Warsaw), factory in Bieruń, purchase of "Delicja" confectionery from PepsiCo, Bakoma S.A. (Warsaw), Bakoma Nova Sp.z o.o. (Kutno)
8	90	Cadbury's Schweppes	126.5	United Kingdom	Cadbury Wedel Sp. z o.o. (Bielany Wrocławskie), Cadbury Wedel (Warsaw) - chocolate and sweets production
9	92	Wm. Wrigley Jr. Company	126.0	USA	Wrigley Poland Sp. z o.o. – chewing gum factory in Poznań
10	108	Carlsberg	103.5	Denmark	Breweries: Okocimskie Zakłady Piwowarskie S.A. (Brzesko), Browary Dolnośląskie Piast S.A., Browary Kasztelan (Sierpc), Bosman Browar Szczecin S.A. (Szczecin)
11	123	British Sugar Overseas (BSO)	90.0	United Kingdom	BSO Polska Sp. z o.o. (Warsaw), 68% stake in Sugarpol (Toruń), 51% stake in Cukrownia Glinojeck S.A., Cukrownia Pelplin S.A., Cukrownia Guzów S.A., Sugar Tor Sp. z o.o. – sugar production
12	137	Cargill Inc.	81.0	USA	Cargill Polska Sp. z o. o. (Warsaw)
13	138	Pernod Ricard S.A	80.4	France	80% stake in Wyborowa S.A., 97.8% stake in Agros Holding S.A. (Warsaw)
14	140	Schooner Capital Corporation	80.0	USA	78% of shares of Kama Foods S.A. (Brzeg Opolskie Voivodship)
15	147	Brau Union	76.5	Austria	Brau Union Polska Sp.z o.o. (Warsaw), Browary Bydgoskie "Kujawiak" (Bydgoszcz), Browary Warszawskie "Królewskie" S.A. (Warsaw), Browar Van Pur S.A. (Rakszawa)

Source: PAIZ, List of major investors as of December 2002.

Table A2. 15 largest investors in the pharmaceutical industry

No.	No. on PAIZ list	Investor	Capital Invested (millions of USD)	Origin	Comments
1	38	Glaxo SmithKline	376.5	UK	Glaxo SmithKline Pharmaceuticals S.A. is a globally operating pharmaceutical company. In Poland GlaxoSmithKline Pharmaceuticals S.A. produces pharmaceuticals (factory in Poznań) for domestic and international markets.
2	77	Pliva d.d.	154.0	Croatia	Pliva Kraków Zakłady Farmaceutyczne S.A. (formerly Polfa – Kraków S.A.) – manufacture of pharmaceuticals
3	194	ICN Pharmaceuticals Inc.	51.1	USA	80% stake in ICN Polfa – Rzeszów S.A. – manufacture of pharmaceuticals
4	210	Gedeon Richter	47.0	Hungary	51% stake in Grodziskie Zakłady Farmaceutyczne Polfa Sp. z o.o. (Grodzisk Mazowiecki)
5	236	Robert Lewis	40.0	USA	16.5% stake in Laboratorium Funkcjonowania Osocza (EURO-PARK Mielec SEZ)
6	256	Altana Pharma AG	33.3	Germany	Altana Pharma Sp. z o. o. (Warszawa), Zakład Farmaceutyczny Altana Pharma Sp. z o. o. (Łyszkowice)
7	364	Novartis	18.0	Switzerland	Novartis Poland Sp. z o. o. – pharmaceuticals, construction of pesticides warehouse (Warsaw)
8	380	KRKA	17.0	Slovenia	KRKA Polska Sp. z o. o. (Warsaw)
9	392	Sanofi-Synthelabo S.A.	15.3	France	Sanofi-Synthelabo Sp. z o. o. (Warsaw) – pharmaceuticals
10	444	Hexal AG	11.7	Germany	Hexal Polska Sp. z o.o. (Warsaw)
11	475	Lek d.d.	10.0	Slovenia	Lek Polska Sp. z o.o (Pruszków), Zaklad Farmaceutyczny ARGON S.A. (Łódź)
12	485	BASF AG	10.0	Germany	pharmaceuticals plant (Kutno), BASF Polska Sp. z o.o. (Warsaw)
13	503	Recticel International (Eurofoam)	9.0	Belgium	Eurofoam Polska Sp. z o.o. (Zgierz, Poznań, Gdańsk), Kerko Sp. z o.o. (Rzeszów), Caria Sp. z o.o. (Kalwaria Zebrzydowska)
14	506	ICN Switzerland AG	9.0	Switzerland	Przedsiębiorstwo Zagraniczne Solco Basel Polska Sp. z o.o. (Warsaw)
15	527	Baxter Healthcare Corporation	8.3	Netherlands	Baxter Terpol Sp. z o.o. (Sieradz), 34% stake in Lubelskie Zakłady Farmaceutyczne Polfa S.A. (Lublin)

Source: PAIZ, List of major investors as of December 2002.

Table A3. 15 largest investors in the automotive industry

No.	No. on PAIZ list	Investor	Capital Invested (millions of USD)	Origin	Comments
1	2	Fiat	1,749.3	Italy	Fiat Auto Poland S.A., Teksid Poland S.A., Magneti Mareli (Magneti Marelli After Market, Magneti Marelli Suspension System, Magneti Marelli Thermal System), FIAT – GM Powertrain Polska Sp. z o.o., New Holland Bizon, Comau, Fenice
2	3	Daewoo	1,452.3	S. Korea	Daewoo FSO Motor S.A. (Warsaw)
3	17	General Motors Corp.	801.0	USA	Opel Polska (Gliwice) – car production, General Motors Poland Sp. z o.o.
4	35	Volkswagen AG	390.7	Germany	Volkswagen Poznań Sp. z o.o. (Poznań), Volkswagen Elektrosystemy Sp. z o.o. (Gorzów Wielkopolski), Volkswagen Motor-Polska Sp. z o.o. (Polkowice), 51% stake in Sitech Sp. z o.o. (Legnica SEZ)
5	55	Delphi Automotive Systems	255.0	USA	Delphi Automotive Systems Poland Sp. z o.o. (Kraków), Delphi Polska Automotive Systems Sp. z o.o. (Tychy), Delphi Krosno S.A. (Krosno), factories in Jeleśnia, Ostrów, Błonie and Gdańsk
6	63	Ispol-IMG Holdings B.V.	192.7	Netherlands	Isuzu Motors Polska Sp. z o.o. (Tychy)
7	95	Eaton	125.0	USA	98% stake in Eaton Truck Components S.A. (Tczew), Eaton Automotive Sp.zo.o.(Bielsko-Biała)
8	113	Faurecia	100.0	France	Faurecia Fotele Samochodowe Sp. z o.o. (Grójec), Faurecia Wałbrzych Sp. z o.o. (Wałbrzych), Faurecia Systemy Kierownicze Sp. z o.o. (Wałbrzych), Faurecia Automotive Legnica Sp. z o.o. (Legnica)
9	120	Toyota	93.2	Japan	Toyota Motor Poland Co. Ltd. (Warsaw), Toyota Motor Manufacturing Poland Sp. z o.o. (Wałbrzych) – car parts store
10	124	Lear Corp.	89.5	USA	Lear Automotive (EEDS) Poland Sp. z o.o. (Mielec), Lear Corporation Poland Sp. z o.o. (Tychy, Gliwice, Myslowice, Warsaw)
11	139	Volvo AB	80.0	Sweden	Volvo Polska Sp. z o.o. (Wrocław), Volvo Polska Sp. z o.o. (Warsaw), Truck and Bus Service Sp. z o.o. (Długołęka), Volvo Polska Sp. z o.o. (Gdynia)
12	167	Metzeler Automotive Hose Systems	62.9	Germany	Sealing Systems Polska Sp.z o.o., Metzeler Automotive Hose Systems Sp. z o.o. (SEZ Wałbrzych)
13	178	Daimler-Chrysler AG	60.0	International	DaimlerChrysler Automotive Polska Sp. z o.o. (Warsaw, Sosnowiec), DaimlerChrysler Services (Warsaw, Sosnowiec), Bank Polska S.A.(Warsaw), Daimler-Chrysler Leasing Services Sp. z o.o. (Warsaw), DaimlerChrysler Services Fleet Management, DaimlerChrysler Aerospace (Świdnik), EvoBus Polska Sp. z o.o. (Warsaw), Systemy Układu Kierowniczego i Podwozia LSM Sp. z o.o. – assembly and distribution of vehicles, production of steering rods
14	213	Visteon Automotive Systems	46.0	USA	Visteon Poland S.A. (Praszka), Polmot ZEM (Duszniki) – car components production
15	218	Valeo	45.0	France	Valeo Autosystemy Sp. z o. o. (Kraków, Skawina), Valeo Dystrybucja (Warsaw), Valeo Sylea Poland (Czechowice-Dziedzice)

Source: PAIZ, List of major investors as of December 2002.

Table A4. 15 largest investors in the electronics industry

No.	No. on PAIZ list	Investor	Capital Invested (millions of USD)	Origin	Comments
1	32	Thomson Tubes and Displays S.A.	475.0	France	Thomson Multimedia Polska Sp. z o.o. (Piaseczno)
2	40	Philips	363.8	Netherlands	Philips Lighting Poland (Piła), Philips Consumer Electronics Industries Poland (Kwidzyn), Philips DAP Industries Poland Sp. z o.o. (Białystok) Philips Lighting Farel Mazury (Kętrzyn), Philips Lighting Bielsko Sp. z o.o. (Bielsko), Philips Lighting Pabianice Sp. z o.o. (Pabianice), Philips Poland Sp. z o.o. (Warsaw)
3	46	Alstom	316.8	France	Alstom T&D Transformers Mikołów, Alstom T&D S.A. Świebodzice, Alstom Konstal Chorzów, Alstom Polska Sp. z o.o., Alstom Power Generators, Alstom Power FlowSystems
4	80	Alcatel	150.0	France	Alcatel Polska S.A., Alcatel Business Systems Poland Sp. z o.o., Alcatel Setel Sp. z o.o. (Warsaw), Alcatel Teletra S.A., Alcatel CIT Polska Sp. z o.o. (Poznań) – production of equipment for telecommunications
5	83	Lucent Technologies	139.0	Netherlands	Lucent Technologies Poland S.A. (Warsaw and Bydgoszcz) – production of equipment for telecommunications
6	96	ABB Ltd.	123.1	International	Swedish-Swiss capital, ABB Automatyka (Warsaw) – automation and drives production, 94% stake in ABB Elta (Łódź) – transformers, ABB Instal (Wrocław) - MV and LV apparatus, ABB Centrum (Wrocław) – power plant control, ABB Industrial Components (Warsaw) – sales of LV apparatus, 65% stake in ABB Service (Legnica) – industrial services
7	107	Siemens	103.9	Germany	Siemens Sp.z o.o., Siemens iCenter, OSRAM, Bosch-Siemens Huesgerate, Siemens Finance Sp.z o.o., Westinghouse Modelpol Sp.z o.o., Alarmcom Bielski Sp. z o.o., Siemens Fabryka Izolatorow Polska Sp.z o.o., Fujitsu Siemens Computers Sp.z o.o., VW Elektro-Systemy
8	163	Flextronics International	65.0	USA	Flextronics International Sp. z o. o. (SEZ Tczew)
9	169	BSH Bosch und Siemens Hausgerate GmbH	61.9	Germany	BSH Sprzęt Gospodarstwa Domowego Sp. z o.o. (Warsaw), BSH Sp. z o.o.
10	176	Merloni	60.0	Italy	Merloni Indesit Polska Sp. z o.o. (Łódź) – production and distribution of electrical household appliances
11	180	Danfoss A/S	58.7	Denmark	Danfoss Poland Sp. z o. o. (Warsaw), Zakład Hydrauliki Przemysłowej Pilmet (Wrocław) – valve production, (Grodzisk Mazowiecki near Warsaw), Sauer – Danfoss Sp. z o. o.
12	191	Matsushita	52.4	Japan	Matsushita Battery Poland S.A. (Gniezno) – battery manufacturer
13	258	Fagor	32.0	Spain	stake in Wrozamet S.A. (Wrocław)
14	260	Legrand	31.5	France	Legrand SNC (Warsaw), Legrand FAEL (Ząbkowice Śląskie)
15	265	Whirlpool	30.9	Italy	Polar S.A. (Wrocław)

Source: PAIZ, List of major investors as of December 2002.

2. Enterprise case studies

Richard Woodward, Jacek Cukrowski,
Małgorzata Jakubiak, Katarzyna Binkiewicz

The purpose of this chapter is to provide an in-depth picture of the situation in Polish companies with respect to many aspects of their activity, including various forms of network activity. The observations contained here inform the analysis carried out on a sample of over 200 firms which is presented in the third chapter.

2.1. The firms studied: A brief overview

2.1.1. Electronics

Firm A is a domestically-owned manufacturer of power semiconductor devices. The firm is controlled by a single institutional owner – a domestic company from the power semiconductor devices industry. Its manufacture of semiconductor products is based both on a license bought in the mid-1970s from a US company and on own designs. The company cooperates with a US company in the area of power semiconductor design and manufacturing technology, as well as in the distribution of products, and has a dominant share of the Polish market segment in which specializes. Apart from Poland the main markets for company products include the USA, the Far East, Western Europe, countries of the former Yugoslavia, and India. Since March 2001, the company holds an ISO 9002 certificate for its Quality Management System, covering the entire range of the company's activities.

The second firm analyzed (B) was established in 1984. It has seven independent production plants established in the 1960s. Its ownership structure is dispersed, with no single majority investor. The company is one of the leading producers of printed circuit boards in Poland. It holds ISO 9000 and UL certificates.

2.1.2. Auto/auto parts industry

Auto firm A is a domestically-owned auto parts manufacturer with a significant position on the European market. The firm, established in 1978, is a part of a capital group including entities responsible for: production (this is the company under study), logistics, marketing, and cooperation. The company is controlled by a single individual domestic owner. Its main markets are foreign and include Sweden, Belgium, the Netherlands, France, Germany and Portugal. The company holds ISO 9002, VDA 6.1, QS 9000 and ISO 14001 certificates for its Quality Management System, covering the entire range of the company's activities and environmental management system. All entities of the capital group also hold ISO/TS 16949 certificates.

The second company (B) is more a supplier of auto manufacturers than an auto industry producer itself. Established in 1991, it manufactures conveyor systems and is partially foreign-owned since 1994, but its capital structure is not dominated by a single owner. The company exports over half of its production to the EU, but operates also on the world market (e.g., China). The company holds an EN ISO 9001:2000 certificate, a German car industry quality certificate VDA 6.4, QS 9000 TES, and environmental management certificate ISO 14001:2000.

2.1.3. Pharmaceutical industry

Company A is a state-owned pharmaceutical producer with a 180-year tradition (the company was established in 1823). The company exports over 30% of its production. Apart from Poland the main markets for company products include Russia and countries of the Commonwealth of Independent States (CIS) and Western (UK, France, Italy, Benelux, Germany, Holland, Spain) and Southern Europe (altogether the company exports to over 40 countries). The company holds a GMP (Good Manufacturing Practice of Pharmaceutical Products) certificate.

Company B belongs to one of the largest manufacturers of medicine and healthcare products in the world (its operations in Poland date back to 1978). The company exports almost 35% of its production (as of 2002). Apart from Poland the main markets for company products include EU, Russia and countries of the Commonwealth of Independent States (CIS) and Southern Europe. The company meets the quality system standards based on the principles of GMP (Good Manufacturing Practice of Pharmaceutical Products), QMS (Quality Management System). It also holds a number of certificates issued by Polish Ministry of Health.

2.1.4. Food and Beverages

Company A is a leader in the processing, distribution and sales of meat, smoked and canned meat products. The company became predominantly foreign-owned in 1999 and merged with another national market leader in 2000. The majority of its products are sold on the domestic market, although a significant portion is also exported (e.g., to the EU and other Central European countries). All plants of the group apply the HACCP control system. At the time of writing in 2003, some plants already met ISO 9001 requirements and had obtained the AQAP-120 certificate, allowing production of goods for the needs of NATO forces, as well as export licenses to EU countries, the USA, Canada and Korea.

The second company (B) focuses on fruit and vegetable processing (juices) and is a member of a larger food and beverage industry group. A limited liability company with a major domestic financial investor, the company exports over half of its production to the EU and holds ISO 9000:2000 and HACCP certificates.

A summary of the profiles of the firms selected is presented in Table 2.1.

Regarding the legal status of the firms, two of the eight firms analyzed are limited liabilities companies and six are joint stock companies. Most of the firms (5 out of 8) have historical roots extending to the Communist period; similarly, most of them changed their legal and ownership structure during transition, i.e., after 1990.

Table 2.1. Summary of company profiles

	Dominant investor	Main markets	Certificates
Electronic industry			
Firm A	Domestic company	Poland, EU, USA, Far East	ISO 9002
Firm B	None	n.a.	ISO 9000, UL
Auto/auto parts industry			
Firm A	Individual domestic owner	EU, Poland	ISO 9002, VDA 6.1, QS 9000, ISO 14001
Firm B	No single majority investor	Poland, EU	EN ISO 9001:2000, VDA 6.4
Pharmaceutical industry			
Firm A	State Treasury	Russia, CIS, EU, Southern Europe	GMP
Firm B	Foreign company	Poland, Russia, CIS, EU, Southern Europe	GMP, QMS, certificate of Polish Ministry of Health
Food and Beverages			
Firm A	Foreign company	Poland, EU, Central and Eastern Europe	HACCP, ISO 9001, AQAP-120 Export licenses to EU, US, Canada and Korea
Firm B	Domestic financial investor	EU	ISO 9000, HACCP

Regarding the ownership of firms, two of the firms have no majority investor, three firms have a domestic dominant investor (one of them a domestic company, one a domestic individual owner, and one a domestic financial investor), and three have foreign companies as dominant owners.

Most of the firms surveyed were ISO certified or hold similar certificates (two of them hold ISO 9000 certificates, two hold ISO 9001 certificates, and two hold ISO 9002 certificates). Two of them were HACCP certified. One firm in the auto/auto parts industry was ISO 14001 certified (ISO 14001 is an internationally recognized management system which ensures compliance with environmental laws and regulations of the country in which the firm operates). The two firms from the auto/auto parts industry hold German VDA quality certificates and one of them holds a US quality certificate (QS 9000). Moreover, one of the firms in food and beverage has export licenses to the EU, US, Canada and Korea. Both companies in the pharmaceutical industry are GMP certified and one of them holds a QMS certificate. None of the companies surveyed were CE certified, nor were they planning certification.

Regarding the size of the companies surveyed, all firms from the auto/auto part industry, pharmaceutical industry, and food and beverages are rather large: all of them have over 1000 employees (company B in pharmaceutical industry in 2002 reduced employment to 732 employees). In the electronic industry one firm surveyed has about 150 employees, the other 99.

2.2. Quantitative issues and measures in the analyzed companies

2.2.1. Measuring competitiveness

All of the companies surveyed measure productivity; however, the way in which productivity is measured differs across firms. In companies in the electronic industry the key element of productivity improvement was considered to be cost reduction, including direct cost, energy, logistic costs (e.g., inventory management, storage), etc. In the auto/auto parts industry the main way in which productivity was increased was through new technology and automation as well as increased efficiency through improved work practices (e.g., increased specialization). The companies also referred to the use of financial indicators (profit). In one firm in the auto/auto parts industry more advanced systems (balanced scorecards)[1] are used for productivity measurement. In the pharmaceutical industry competitiveness is determined by access to medicines

protected by law (patents) and efficiency of management. Firms from the food and beverage industry referred to a number of productivity measurement activities at the level of specific production lines.

There were no differences among companies regarding who was the source of ideas on both measurement and improving productivity. In all the companies the main source of ideas on measurement of productivity came exclusively from management, while ideas for productivity improvement came from the management and internal departments (economic department, technological department, logistics, etc.).

Regarding financial performance indicators in the companies surveyed, we have to stress that here we face significant problems with reliable data (e.g., incomplete data from the auto/auto parts industry). This is due to two reasons. First, these data are often confidential. Second, because of mergers and acquisitions in the period considered, data related to different years are not comparable.

Profits and sales were generally growing for the electronics and auto industry companies in the sample during the period analyzed, though performance slowed beginning in the year 2000. The performance of the pharmaceutical companies was rather uneven. In the food company from which we received data, profitability was unimpressive but investment spending was high.

We now turn to measures of competitiveness related to products and markets, including market shares, profitability of various markets, development of distribution channels, product specialization and modification and technological improvement.

Regarding market shares, we have to note that in the face of increased competition within the industries, maintaining market shares in domestic and international markets can be interpreted as maintaining competitive position within a particular market segment.

Although data from firms operating in the food and beverages industry do not allow us to discuss changes in market shares, data from other industries allow us to derive some conclusions. In particular, firms operating in the electronic industry and one of the companies from the auto/auto parts industry (company B) did not indicate any significant change in product and geographical market shares in the time period from 1998 until now. Thus, it can be concluded that these firms have neither improved nor seen deterioration of their competitive positions in the period considered. Company A from the auto/auto parts industry indicated a significant increase of its market share in

[1] The balanced scorecard is a management system (not only a measurement system) that enables organizations to clarify their vision and strategy and translate them into action. It provides feedback about both the internal business processes and external outcomes in order to continuously improve strategic performance and results.

the EU market and a change in overall orientation from the domestic to the EU market (i.e., a shift in total sales from the domestic to the EU market). The market share of the firm in the EU market increased from the level of 1-10% to the level of 11-25%. Domestic sales decreased from 11-50% to 1-10% of total sales, while sales to EU markets increased from 51-90% to 91-100% of total sales. Given that the EU market is more competitive, these changes can be interpreted as a significant increase in competitiveness.

In the year 1997 overall export of the pharmaceutical industry declined as the result of the Russian crisis. . In firm B export started to grow only in the years 2001 and 2002. We have to mention, however, that in these years the growth of export was really significant (over 100 percent). This results from the recovery of the eastern markets and the increased role of the EU market (in both cases the role of the international investor is crucial).

With respect to product modification and technological change, we have to note that modification of existing products, introduction of new ones or modification of technologies used (typically leading to better product quality) is driven by the interaction between the company and customer, and can be seen as a response to increasing competition (measures aimed at maintaining market share). Companies may be selling products for more than two years while updating the technology used for their production to take advantage of technological advances. Thus, even producing goods for more than two years, firms may increase their market shares and be competitive on their markets.

Data on these issues are presented in Table 2.2. Although not all firms provided details concerning product modification since they considered it a sensitive commercial issue, most of the firms that responded to this question indicated a stable or increasing share of new products (not older than two years) in their total output. In particular, company A in the food industry indicated an increasing share of new products (15 percent in 2000 vs. 20 percent in 2002). Similarly, in the electronic industry firm A indicated that in 1998 the share of new products (introduced to production after 1996) was about 5 percent, while the share of new products (i.e., not older than two years) in 2002 was about 25 percent. In the auto/auto parts industry, company A experienced a surge of innovation in the middle of the analyzed period, with 25-50 percent of the products produced not older than two years in 1998, followed by a new product share of 50-60 percent in 2000, falling back to 25-50 percent by 2002. Company B in the auto/auto parts industry indicated the opposite pattern: while in 1998 about 80 percent of products were considered old, in 2002 this had risen to 100 percent. Thus, one can conclude

that while firms from the electronics and food and beverage industries increased the share of new products, companies from the auto/auto part industry showed the opposite pattern.

Table 2.2. Share of new products and technologies

		Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
		A	B	A	B	A	B	A	B
Share of products introduced in last two years (i.e., not older than two years)	1998	5%	n.a.	25-50%	20%	n.a.	n.a.	n.a.	n.a.
	2000	10%	n.a.	50-60%	10%	n.a.	20%	15%	n.a.
	2002	25%	n.a.	25-50%	0%	n.a.	20%	20%	n.a.
Share of technologies introduced in last two years (i.e., not older than two years)	1998	20%	10%	50-75%	5%	n.a.	50%	n.a.	n.a.
	2000	25%	15%	40-50%	5%	n.a.	80%	n.a.	n.a.
	2002	n.a.	30%	50-75%	5%	n.a.	40%	n.a.	n.a.

With respect to modification of technological processes, both firms operating in the electronic industry report a continuously increasing share of new technologies. In the auto/auto part industry, the share of new technologies remains on a more or less constant level. In pharmaceuticals firm B introduction of a significant share of new technologies in the year 2000 (80 percent) can be considered a post-privatization technological adjustment to the needs of the international investor. In the following years technological updating of the company was much slower. Firms from the food and beverage industry did not provide detailed numbers, claiming that in this industry technologies are very traditional and do not change frequently.

We now turn to the sources of new technologies and new product development ideas, which in turn concerns the role of domestic and foreign R&D in the firms surveyed. Results are presented in Table 2.3. Firms from the electronic industry reported that a significant share of new products was developed domestically (40 percent and 100 percent). On the other hand the share of new technologies developed in the country was much smaller (0 percent and 50 percent, respectively). Similarly, firms operating in the auto/auto parts industry reported a much larger share of domestically developed products (1-10 percent and 80 percent) than domestically developed technologies (1-10 percent and 10 percent, respectively). In pharmaceuticals (firm B) the share of new products developed in the country and introduced in last five years was about 50 percent. The share of domestic technologies was a bit smaller – 40 percent. In the food industry (the most traditional one) all products and technologies introduced were developed domestically. In electronics and the auto/auto parts industry, an interesting pattern can be noticed: domestic R&D focuses rather on

product development than on the development of new technologies. This can be explained by greater complexity and higher costs of process R&D compared to product oriented R&D. On the other hand, one can note that modern foreign technologies are often implemented and used for the production of domestically designed products.

Table 2.3. Share of new products and new technologies developed domestically

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Share of new products introduced in last five years developed in the country	40%	100 %	1-10 %	80%	n.a.	50%	100%	n.a.
Share of new technologies introduced in last five years developed in the country	0%	50%	1-10%	10%	n.a.	40%	100%	n.a.

Summing up, all the firms surveyed appear to be competitive in the sense that they have either increased or at least maintained constant market share on the markets they are selling into (domestic and foreign). In order to increase their competitiveness most of them introduced new products or implemented new technologies in last several years. Import of more advanced foreign technologies allows firms to be competitive on international markets. Moreover, the profitability of firms has not deteriorated over the time period considered, which in face of more intense competition can be interpreted as indicating strong competitive nature of the firms surveyed.

2.2.2. The labor force: employment and human capital

The pattern of changes in employment in the period analyzed (1998-2003) depends on the industry.

In electronics one firm saw a roughly six percent decrease, the other an 18 percent increase. In the firm in which employment decreased, both blue collar and white collar employment were reduced, but the group of white collar employees decreased relatively more (i.e., by 12 percent). In the firm with the overall increase, blue collar employment was reduced, while white collar employment grew substantially, from 35 to 54. In the firm with an employment decrease, changes in the number of managerial staff and the number of engineers and technicians were minor, and the number of employees related to R&D did not change in the period considered, while IT staff slightly increased. Additionally, about 25 percent of employees have university education (all of them belong to the group of white collar employees).

In both firms operating in the auto/auto parts industry employment increased by more than 100 percent in the period analyzed. In this industry the pattern of changes in white and blue collar groups of employees is indeterminate: in one company the group of white collar employees increased relatively more than the group of blue collar employees, while in the other firm the opposite pattern was observed. In the firm with stronger growth of white collar employment, a significant increase of both managerial staff and engineers/technicians was also observed. In one of the companies only three percent of the employees have university education, as opposed to approximately 15 percent in the other company.

In both companies in the pharmaceutical industry, employment decreased in the last few years; however, the employment falls were slower than in domestic manufacturing in general and in the pharmaceutical industry in particular. In company A in the period 1998-2003 employment decreased by 10 percent. All educational groups of workers decreased more or less proportionally. Interestingly, during the period considered the weight of older employees became higher (the size of under 25 and 26-30 age groups was significantly reduced). In company B the employment cuts in years 2000-2002 (by 10.7 percent in 2000, 9.7 percent in 2001) were justified by the modernization of production technology with the installation of modern equipment and facilities.

On the other hand in both firms operating in the food and beverage industry employment in the period considered decreased significantly (by about 45-50 percent). In this industry in both firms analyzed blue collar employment decreased relatively more than white collar employment. In one firm the number of managerial staff

Table 2.4. The importance of training in increasing the skill level of the work force

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Managerial level training in:								
Business management	3	2	3	3	2	3	3	n.a.
Production	2	3	3	3	3	3	3	n.a.
Marketing and advertising	2	2	3	2	3	3	3	n.a.
Quality control	2	3	3	3	3	3	3	n.a.
Finance and accounting	2	2	3	1	2	3	2	n.a.
Foreign languages	2	2	3	3	2	3	3	n.a.
Computer	2	2	3	1	2	3	2	n.a.
Employee level training in:								
New tasks	2	2	2	2	2	3	2	n.a.
New specialization	2	2	2	1	2	3	2	n.a.
Quality control	2	2	3	3	3	3	3	n.a.
Foreign languages	1	2	3	2	1	3	2	n.a.
Computer	2	2	3	1	1	3	2	n.a.
Others							3*	n.a.

* quality management system PN EN ISO 9001:2001.

increased (by 39 percent) while in the other one it decreased (by about 50 percent). In both companies the number of engineers and technicians decreased significantly (by about 80 percent). Similarly, in the period considered, the number of employees engaged in R&D activities and IT staff declined. In one of the companies only eight percent of employees have university education, in the other company about 23 percent (most of them belong to the group of white collar employees).

Firms were asked to rate on a scale of 1 to 3 which types of training have been most important in the last five years. Results are presented in Table 2.4 (1 is of little or no importance, 2 is important, and 3 is very important).

It follows from Table 2.4 that there is no area where firms uniformly agreed across industries. Managerial level training in business management, production and quality control were seen on average as the most important types of training. Employee training in quality control and new tasks and managerial training in foreign languages, although also seen as rather important, received relatively smaller weights. Computer training on both levels was considered as relatively less important. The smallest weight was given to employee training in new specializations. One company (Firm B) from pharmaceutical industry found all kinds of training very important. Only one company (firm A from the food and beverage industry) listed another type of training (training on the management system PN EN ISO 9001:2001).

2.3. Internal factors of competitiveness

2.3.1. Research and development

All the companies surveyed had either an R&D or quality control laboratory. More precisely, all companies surveyed had a quality control laboratory and most of the companies surveyed (all except company B operating in the electronics industry) had an R&D unit. Interestingly, the company without an R&D unit does not subcontract R&D activity either. Yearly R&D expenditures and the specialization of employees engaged in R&D are presented in Table 2.5.

R&D expenditures in the auto/auto parts companies do not exceed 0.5 percent of total revenues. In the pharmaceutical industry R&D expenditures were much higher – 1.5-3.0 percent. Although data concerning professional specialization of R&D staff are not very precise, one can conclude that engineers form the largest professional group in the R&D units of surveyed companies. R&D staffs do not appear to be particularly diversified.

Table 2.5. Yearly R&D expenditure and specialization of R&D staff (%)

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Yearly R&D expenditure (in thousands of PLN)	300	No R&D unit	1000-1500	500	10000	9000	n.a.	n.a.
Yearly R&D expenditure (% of total revenues)	n.a.		0.22-0.35%	0.5%	3.0%	1.5%		n.a.
Employees								
- Physicists					10%			
- Chemists					20%	10%		100%
- Biologists					10%	10%		
- Agronomists								
- Pharmacists					50%	70%		
- Engineers	100%		90%	100%	10%			
- Computer engineers			10%					
- Others						10%		

The purposes of R&D activities performed in firms are presented in Table 2.6.

The purpose of R&D activities was concentrated in at most two areas for all firms, and there were some differences across firms. In particular, all R&D units were engaged in product development and development of technological processes. The focus on product development is confirmed by the relatively large share of new products produced that were developed domestically, but the focus on the development of technological processes seems somewhat inconsistent with the previous results showing the relatively small share of domestically developed technological processes in firms. This might indicate that the average process innovation requires more effort than the introduction of a new product.

One company in each industry focused on R&D related to quality control. Most companies (all except firms A in pharmaceuticals and B in food and beverage industry) reported their interest in business and R&D intelligence. This might indicate firms'

Table 2.6. The purpose of R&D activities performed in firms surveyed

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Product development	X	No R&D unit	X	X	X	X	X	X
Development of technological processes	X		X	X	X	X	X	X
Basic research					X			X
Applied research			X		X			X
Process and product design	X			X		X		X
Quality control	X		X			X	X	
Business and R&D intelligence	X		X	X		X	X	
Development of cooperative links in R&D	X		X			X	X	X
Other								

concerns about their competitive positions in new products and technologies (i.e., their technological advance in comparison with competitors). Three companies (firms A in the auto/auto parts and the pharmaceutical industry and B in the food and beverage industry) indicated some interest in applied research, and only two companies (A in pharmaceuticals and B in the food and beverage industry) indicated their involvement in basic research.

Finally we should note that in the last five years only one company (company A in the auto/auto parts industry) registered a patent. R&D activities performed in all other companies did not result in any patent registration procedure.

2.3.2. The roles of internal actors in improving competitiveness

Our primary concern in this project is with the role of cooperation with external actors in improving competitiveness, but in this section we will examine the roles of internal actors in innovation and other processes related to the improvement of competitiveness.

First we look at corporate strategy. In most of the firms analyzed opportunities for success are perceived in orientation to the market, towards customers' expectations, continuous improvement of organization and technology, cost cutting and quality improvement. While cost reduction is undoubtedly important, quality improvement is the key common strategy factor for all the companies analyzed. Importance of innovations through the constant development of new products in response to consumer needs has also been highlighted as one of the central issues of company's strategies. The weight of other factors depends on the industry. Firms in the electronics and auto/auto part industries indicated the importance of advanced technologies and cooperation with partners recognized on world market. Firms from the pharmaceutical industry stressed the importance of foreign know-how and advanced technologies. Firms in the food and beverages industry indicated the importance of input quality and product specialization.

Respondents were asked to identify assets and barriers to innovation in their companies using a scale from 1 to 3. Results are presented in Table 2.7, where 1 is of little or no importance, 2 is important, and 3 is very important. Since no firms identified any factors as barriers to innovation the table presents only assets.

Almost all factors listed in the table were considered by all firms surveyed as important or very important; however, as in the case of the previous questions, here there were also differences across firms and industries. Firms in the auto/auto parts

and food and beverage industries indicated "understanding of user/market needs" as the most important factor stimulating innovations within companies, while one firm in the electronics industry indicated "qualifications of the personnel" (interestingly, this factor was indicated by company B in the auto/auto parts industry as of little or no importance). These two factors seem to be industry specific: in electronics – an advanced technology industry – qualifications are the most important, whereas in less technologically advanced industries – auto/auto parts and food and beverages – response to consumer needs is the key factor. "Access to financial resources" was also considered by all firms as a very important or important factor. Other factors, including "continuous development of ideas about how to improve the company's competitiveness, and what innovations to introduce", "prototyping techniques and capabilities", "use of cross-functional teams", "incremental (product and process) development capability and strategy", "flexibility in production processes", "dealing with after-sales problems", "use of information and communication technologies" were considered by all firms as at least important for innovation processes. Firm B operating in pharmaceutical industry indicated all factors as very important. Given the large number of factors listed as either important or very important, no single factor can be identified as either helping or hindering innovation across industries.

Table 2.7. Factors acting as an asset to innovation

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Continuous development of ideas about how to improve the company's competitiveness, and what innovations to introduce			3	2		3	2	
Qualifications of personnel	3		2	1		3	2	
Prototyping techniques and capabilities	2		2	2		3	3	
Understanding of user / market needs	2	n.a.	3	3	n.a.	3	3	n.a.
Use of cross-functional teams	2		2	2		3	n.r.*	
Incremental (product and process) development capability and strategy	2		2	2		3	2	
Flexibility in production processes	2		2	3		3		
Dealing with after-sales problems	2		2	2		3	n.r.	
Use of information and communication technologies	2		2	2		3	2	
Access to financial resources	3		3			3	2	

* n.r. – not relevant.

The next few questions deal with the role of top management in innovation processes. The top management of the firms surveyed is characterized in Table 2.8.

Table 2.8. The top management of the firms surveyed

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Number of members of Executive Board	3	n.a.	2	2	4	6	5	3
Number of members of Executive Board with international experience	1		0	1	1	2	2	1
Does CEO have international experience?	Yes		n.a.	Yes	Yes	Yes	Yes	Yes
Does the company have a Supervisory Board?	Yes		Yes	Yes	Yes	Yes	Yes	Yes

The largest Executive Boards are in the companies operating in pharmaceutical industry (6 members in firm B, and 4 in firm A) and a bit smaller in the food and beverage industry (5 and 3, in companies A and B respectively); the smallest Executive Boards are in companies from the auto/auto parts industry (2 members). In almost all companies (except company A from the auto/auto parts industry) members of the Executive Board have international experience (as do Chief Executive Officers). Moreover, all firms surveyed have Supervisory Boards. The role of the Supervisory Board differs across firms. A firm from the auto/auto parts industry indicated that the role of Supervisory Board members described as consultants was very important for finance and important for investment and restructuring; board members who were scientists working in research institutes were said to have an important role in R&D, distribution strategy and innovations; and company management representatives were important for financial decisions. Firm B from the food and beverage industry indicated the very important role of members representing foreign banks and financial institutions in decision processes concerning general strategy, product strategy, investment, finance, price policy, distribution strategy and marketing. The role of Supervisory Board members representing domestic enterprises, owners, customers or suppliers of the company was deemed very important in decision making concerning general strategy, product strategy, investment and restructuring, their role in decision processes regarding R&D, finance, labor issues, price policy, distribution strategy and marketing as important and their role in decision making processes concerning innovations as negligible. Firm A from the pharmaceutical industry indicated that the role of Supervisory Board members representing the State Treasury was very important for restructuring and labor issues and important for general strategy, investment and innovations. The role of the members of the Supervisory Board representing domestic enterprises which are not company shareholders and linked to other

industries was much smaller; only the impact on decisions regarding general firm strategy, finance, and restructuring was considered important by the respondents. The firms' responses regarding the contributions of outsiders on the supervisory board show their importance in decision making processes concerning strategy, finance, investment and restructuring, and indicate that outsiders had little or no impact on innovations and labor issues.

The last question in this group was related to the role of employees in innovation processes. Although answers to this question differ across industries and firms, one can find a few patterns observed in different industries. First, in firms in the auto/auto parts industry the role of top management in innovating processes was estimated as very important, especially in such areas as development of the innovation idea, acceptance, implementation, supervision of the implementation, and evaluation of the results. The role of the technical manager and technical staff in the development of the idea and design of prototypes was considered very important. In company B the technical manager was also seen as a key person in the processes of acceptance, implementation, supervision of implementation, and evaluation of the results. In firm A in the pharmaceutical industry, the role of top management was estimated as very important in development of innovation idea, acceptance and evaluation of the results, and as important in development of prototypes, implementation, and control of implementation. This firm also indicated the important role of middle level management in collecting materials and knowledge needed for the development of the idea, development of prototypes, implementation and evaluation of the results. In firm A in the food and beverage industry, a centre for product development is being developed which will be responsible for overseeing all product innovation processes, and Firm B indicated the important role of top management in acceptance and supervision of the implementation. In contrast to the companies from auto/auto parts industry, this firm indicated the important role of middle level management in the development of the innovation idea, collecting of materials and knowledge needed for the development of the idea, and development of prototypes. Consequently, all firms analyzed are similar regarding the role of top management in innovation processes (a key role in acceptance and supervision of the implementation), but there are significant differences across industries concerning the role of middle level management: in pharmaceuticals and food and beverages its role is considered important, while in the auto/auto part industry, middle management (excepting the technical manager) does not play an important role in innovation processes.

2.4. Networking in the analyzed companies

2.4.1. Source countries for technologies and supplies

Returning to the question of the countries of origin of production technologies, we note that only companies from the auto/auto parts industry reported increases of revenues from sales of goods produced based on domestic know-how and domestic technologies in the last five years. In particular, the share of sales of firm A owing to technologies originating in EU countries increased from 10-50% in 1998 to 91-100% in 2003 (the shares of other groups of source countries, including Poland, remained relatively unchanged over the period considered); the share of sales of firm B owing to domestic technologies increased from 1-10% in 1998 to 51-90% in 2003, while the share of sales owing to Central and Eastern European and EU technologies increased from 0% in 1998 to 1-10% in 2003.

The next group of questions deals with the importance of domestic and foreign markets as sources of supplies. Regarding this issue we have to note that in most of the companies the relative importance of domestic and foreign sources of supply had not changed since 1998. In particular, no change was reported by both companies operating in the food and beverage industry, by company B from the electronics industry, and by company B from the auto/auto parts industry. In a few companies, however, a relative increase of suppliers from the EU has been reported. Company A in the electronics industry reported an increase of EU sources from 1-10% in 1998 to 11-50% in 2003, and company A in the auto/auto parts industry reported a decrease of the importance of domestic sources (from 11-50% in 1998 to 1-10% in 2003) and an increase in the importance of EU sources (from 11-50% in 1998 to 91-100% in 2003). (We remind the reader that both of these companies are domestically owned.) Consequently, EU markets appear important for companies operating in electronic and auto/auto parts industry, while domestic suppliers remain important in more traditional industries as food and beverages. Finally, we note that pharmaceuticals company A began cooperating to a limited extent with suppliers from the Far East during the period examined (though this source still accounts for under 10% of the company's total supplies).

Responses of the firms regarding decisions concerning selection/changes of suppliers indicated that they come from different sources. A firm in the electronics industry reported quite complex procedures involving periodic listing and evaluation of all current suppliers, with propositions for changes coming from managers of various divisions and final acceptance by the general manager. In the auto/auto parts industry,

in company A suppliers are selected based on the list of product characteristics and potential suppliers indicated by the client. Selection of suppliers is done in cooperation with a specialized company (a member of the industrial group). In company B decisions are made by the purchasing and cooperation manager based on quarterly evaluation of suppliers. In firms in the food and beverage industry, suppliers are selected either by the purchasing department or by the member of the board responsible for purchasing for the whole industrial group. The most important factor in the decision to change suppliers is periodical evaluations concerning the quality, timing, reliability, etc. of each supplier. In pharmaceuticals company A, decisions on suppliers are made by the executive board on the basis of price and reputation.

2.4.2. External cooperation

The common pattern of cooperation with other companies is primarily connected with the current production of the firms in the sample. The enterprises act as subcontractors, supplying foreign or domestic clients. When their own capacities are insufficient, some of the inputs for their final products are also subcontracted. With respect to innovation, cooperation with various external partners is mostly visible at the early stages, such as formulating an innovative idea and collecting the necessary information for developing this idea (e.g., market research). Cooperation with external organizations at later stages, such as implementation, is seen as less important.

Only one firm (company B of the food and beverages industry) has recently bought shares in another company. Nearly all firms reported acting as subcontractors, predominantly to foreign firms. OEM arrangements are similarly widespread. Both firms in the electronics industry, firm B of the auto parts industry, and firm B of the food and beverages branch subcontracted part of their work.

Table 2.9. Inter-firm relations with other companies

Type of cooperation	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Acquisitions								D
Joint venture				F				
OEM	F	F D	F	F D				F D
Subcontracting	F D	F		F D				F D
Licensing	F				F			D
Research consortia	D							
Strategic alliances				F				
Cooperation with competitors				D	F D			
Secondments	F			F D				

Note: F – relations with foreign firms,
D – relations with domestic firms.

One electronics manufacturer and one pharmaceuticals company were using foreign licenses, and one food producer was using a domestic license. In 2003 the same electronics producer began working on the establishment of a research consortium, involving three other firms and one university. The firms and the university want to work together on one specific technology.

Company B of the auto parts industry formed strategic alliances with its minority (foreign) shareholder in order to get contracts. There has also been cooperation with domestic entities in the past.

Firm A of the electronics industry and firm B of the auto parts industry were sending their personnel (engineers and technicians) to the global leaders in their industries, with which they closely cooperate, for training. They also have had foreign specialists training their personnel in Poland. The firm producing machines for auto manufacturers was sending its personnel to work in the plants of its clients for some time, after the delivery of its equipment.

Company A of the food and beverages industry is not involved in any of the forms of cooperation listed in Table 2.9. However, there were such relations in the past. For example, in 1997 this firm created a new company with its competitors. The new enterprise specialized in the trade of spices and other products used for the production in this branch. Pharmaceutical company B itself is not involved in any such cooperation; such cooperative relationships occur only in the case of its mother company (outside Poland).

In Table 2.10, we look at the question of R&D cooperation with other organizations.

Regarding cooperation in R&D, all firms indicated cooperation with public domestic research organizations. All but one (company A in pharmaceuticals) indicated cooperation with suppliers of raw materials, machinery and equipment. We have to

Table 2.10. Organizations with which firms cooperate in R&D

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Private domestic research organizations					X		X	
Public domestic research organizations	X			X	X	X	X	X
Domestic universities	X			X	X	X		X
Foreign universities						X		
Raw material suppliers	X		X	X			X	X
Machinery and equipment suppliers	X	No R&D unit	X	X			X	X
Independent researchers			X					
Other firms owned by the owner of the company						X	X	

note, however, that the typical range of institutions with which firms cooperate varies across industries. In particular, all companies surveyed but two indicated cooperation with domestic universities, whereas the exceptions – firms A in pharmaceuticals and in the food and beverages industry – reported cooperation with private domestic research organizations. Firm B in pharmaceuticals and firm A in the food and beverage industry reported cooperation with other firms of the industrial group (i.e., with other firms owned by the owner of the company). Company A in the auto/auto part industry reported cooperation with independent researchers. Only company B in the pharmaceutical industry reported R&D cooperation with foreign universities.

Firms reported two main external sources of innovative ideas. Firm A in the electronics industry indicated the very important role of a foreign university in formulating innovative concepts. The essential role of customers and suppliers in formulating ideas for innovation was reported by both auto industry firms and firm A in electronics, while company B in the electronics industry indicated a "small role" of customers and suppliers in this area.

The lack of answers concerning external sources of innovative ideas suggests that both food industry firms are relying on their own personnel at the first stage of product innovation.

The firms indicated various external partners helping them in collecting the necessary information for developing innovative ideas. The companies from the electronics industry cooperated with foreign and domestic universities, research labs, as well as with their customers and suppliers. Similar patterns were observed for pharmaceutical company B, except that it does not cooperate with foreign universities. Auto industry company B used the resources of foreign universities and foreign research labs at this stage of the innovation process. This firm also cooperated with its customers in developing innovative ideas. The other firm in the car parts industry also perceived the cooperation with its customers as very important at this stage. It should be noted that the latter firm (A) cooperates with external players at the initial stages of innovation only. It greatly values the inputs of the company's suppliers in formulating the idea, then cooperates with its customers for the purpose of gathering the necessary information, after which cooperation with external organizations ends. This may be related to the relatively low level of research activity of this enterprise.

Firm B of the food and beverages industry cooperates with universities and research labs, domestic consulting firms and raw material suppliers for the purpose of "making physical and chemical analyses".

Table 2.11. Role of various organizations with which companies cooperate in innovation processes

	Formulating idea		Collecting information		Developing the idea (prototyping)		Approval		Implementation		Control over implementation		Evaluation of results	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Foreign universities	**El**		El	**Au Fo**										
Domestic universities	El Ph	El **Ph**	**El**	El **Fo Ph**		El		El						El
Foreign research institutes/labs	El	**Ph**	El	**Au Fo Ph**		**Ph**		**Ph**						
Domestic research institutes/labs	**El** Fo **Ph**	**Ph**	**El** Fo Ph	**Fo Ph**	**El Fo** Ph	**Ph**	Fo Ph		**Fo** Ph		Fo Ph		Fo Ph	
Foreign consulting firms in the host country	El		El			**Au**		**Au**		**Au**		**Au**		**Au**
Domestic consulting firms/individuals	El		El	**Fo**										
Market research agencies														
Industrial customers (foreign/domestic)	**El**	El **Au**	**El Au**	El **Au**	**El**	El **Au**		**Au**		**Au**		**Au**		**El**
End-product customers (foreign/domestic)	**El**	**Ph**	**El Au**	**Ph**	**El**	**Ph**		**Ph**		**Ph**		**Ph**		**Ph**
Raw material suppliers (foreign/domestic)	**Au**	El		El **Fo**		El								El
Technology suppliers (foreign/domestic)	**El Au**	El **Ph**	**El**	El **Ph**	**El**	El **Ph**	**El**	**Ph**	**El**	**Ph**	**El**	**Ph**	**El**	El **Ph**

Note: El - electronics, Au – auto parts, Ph – pharmaceuticals, Fo – food and beverages. Boldface symbols indicate a "very important" or "important" role, regular print corresponds to "relations of little importance".

Cooperation with external partners during later stages of the innovation process is very important only for firm B of the auto parts industry and firm B of the pharmaceuticals industry. The auto firm cooperates closely with its industrial customers through all the stages from the construction of a prototype to the control over the implementation, and uses the services of foreign consulting firms through all these steps, as well as for the evaluation of the results. The underlying reason is that the company exports almost all its production, and in world markets has the position of a "follower". Trying to compete with both prices and quality, it has to cooperate closely with its customers and construct new products according to their changing needs.

Firm A of the electronics industry perceived cooperation with technology suppliers as "important" in preparing plans for an innovation, its implementation, and evaluation.

2.4.3. Foreign contacts

Each firm underlined the importance of contacts with a foreign partner in relation to different types of activities (Table 2.12).

The wide scope of cooperation with foreign partners of firm A in the electronics industry resulted in a joint venture (1996), a licensing agreement (1996), trade and subcontracting agreements (1996-2003), and technical assistance (1996-2003). This is probably the reason why this firm values greatly the cooperation with foreign partners in every sphere of its activities, from personnel training to the broadening of access to new markets.

The other electronics producer regards cooperation with foreign partners as the most crucial for product specifications and design. However, the firm has not engaged with any foreign partner in technical assistance or common research. Contacts with its

Table 2.12. Types of cooperation with foreign partners

Type of cooperation	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Setting up joint venture	1996			1993		n.a.	n.a.	n.a.
Signing licensing agreement	1996	2000	yes		yes	n.a.	n.a.	n.a.
Signing trade agreement or subcontract	1996-2003			1992		n.a.	n.a.	n.a.
Technical assistance	1996-2003					n.a.	n.a.	n.a.
Common R&D						n.a.	n.a.	n.a.
Distribution					1998	n.a.	n.a.	n.a.

Table 2.13. Importance of having a foreign partner/investor

Type of contact	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Employee training	**3**	2	**3**	**3**	1	n.a.	Foreign partners are not important for these types of activities	n.a.
Improvements in inventory management	**3**	1	**3**	1	1	n.a.		n.a.
Improved product quality	**3**	2	**3**	**3**	2	n.a.		n.a.
Product specifications	**3**	**3**	2	**3**	2	n.a.		n.a.
Product design	**3**	**3**	2	**3**	1	n.a.		n.a.
Research and product development	**3**	2	2	**3**	1	n.a.		n.a.
Improved marketing	**3**	1	**3**	2	**3**	n.a.		n.a.
Timeliness of delivery	**3**	1	**3**	**3**	2	n.a.		n.a.
Terms of delivery	**3**	1	**3**	**3**	2	n.a.		n.a.
Improved access to finance	**3**	1	**3**	1	1	n.a.		n.a.
Improved access to modern technologies	**3**	2	2	2	1	n.a.		n.a.
Improvements in the production process	**3**	1	**3**	2	1	n.a.		n.a.
Modernization of production equipment	2	2	2	2	1	n.a.		n.a.
Increasing production opportunities	2	1	2	1	**3**	n.a.		n.a.
Access to new markets	**3**	2	**3**	**3**	2	n.a.		n.a.
Access to new distribution channels	**3**	2	2	1	**3**	n.a.		n.a.

Note: 1 = little or no importance, 2 = important, 3 = very important.

foreign trade partners have led only to the conclusion of a subcontracting agreement in 2000. Probably the firm plans to cooperate with foreign partners in designing products on a long-term basis.

Both auto industry firms pointed to the importance of cooperation with foreign partners in employee training, product and process innovations, delivery planning, and getting access to new markets. For firm A, having a foreign partner with stable financial standing and good ratings improves the perception of Polish firms and improves their access to finance. This firm has signed a licensing agreement with its foreign trade partners. Firm B has cooperated on a long-term basis with its foreign trade partners since the early 1990s, and among the results of this cooperation was the signing of a licensing agreement in 1992 and the establishment of a joint venture in 1993.

Pharmaceuticals company B has no foreign contacts except with its mother company. Food producer A replied that its foreign partners do not have any influence on it in any of the specified areas (and this in spite of the fact that it has a foreign strategic investor). This enterprise declares that the only long-term contact that recently resulted in a common project was established with a foreign-owed retail chain for the supply of products served in the shop restaurants.

2.4.4. Sister companies

Assessing relations with other firms held by the same owner turned out to be difficult for the firms. Two firms even gave information which contradicted what they said in describing their companies. Some respondents also indicated no links with sister companies when such links existed but their firms had no dominant owner. Only three firms of the eight surveyed had no problems answering this question. The majority of the information here comes from interviews and information about the ownership structure of the firms available on the internet rather than answers provided in filling out the questionnaire.

Company A in the electronics industry belongs to a capital group with two other electronics producers held by the same domestic institutional investor. Electronics company B has no single dominant owner, so this question does not apply to it.

The domestic individual who owns firm A in the auto industry owns two other smaller Polish companies. One of these companies is involved in the transport and distribution of company A's products. The other one was created for promotional and marketing purposes. The owner of the firm also established a subsidiary in Ukraine, which in 2004 should start the production of a subset of company A's products. The firms cooperate on an equal basis.

Table 2.14. Links with other firms of the same owner

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B*	A	B*	A	B	A	B
The owner of this firm does not own any other firms				D				
The owner owns other firms, but we have no links with them					D	F	F	
The owner owns other firms which distribute our products			D					
The owner owns other firms, and we produce inputs for their production				F				
The owner owns other firms which design the products we produce								D
The owner owns other firms which are our suppliers				F				D
The owner owns other firms and we cooperate with them on equal terms	D		D F	F				

Note: D – in Poland, F – abroad, * – no single dominant shareholder.

The German minority investor in auto industry firm B manufactures products similar to those of the Polish company. From time to time it subcontracts part of its work in Poland. The firms also cooperate on an equal basis on some contracts, dividing parts of the assignments between themselves. In 1993 the Polish firm created a subsidiary in Ukraine, mainly for the purpose of serving Ukraine and neighboring markets. However, the production has not expanded on a big scale yet. Both firms cooperate, and if the Polish plant is working at full capacity, some of the easier assignments are performed in Ukraine.

Firm A in the food and beverages industry is in itself a capital group of vertically and horizontally linked enterprises in Poland. However, if we ignore the relationships within this structure and look at company A as a single unit, we observe a Swedish strategic investor. Company A does not report any cooperation with dependent units belonging to this investor, either in the area of current operational activities or long-term planning. Likewise, pharmaceuticals firm B does not report any cooperation with sister companies.

Firm B of the food and beverages industry is currently in the process of merging with another firm of the same owner (domestic financial investor). It reports close links with other sister companies, both of a vertical and horizontal nature.

2.4.5. Role of environment in which companies operate

Only one firm, electronics company A, used public funds to support its R&D activity. The project was financed by the Polish State Scientific Committee. Another

firm, food and beverages company A, applied for EU SAPARD money to modernize its facilities and to invest in new production lines, thus indirectly supporting the development of the company. However, its applications were rejected for formal reasons. The firm was planning to apply again in 2004.

Table 2.15. Contacts with universities or research institutes

	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Contacts with universities or research institutes	yes	yes	yes	yes	yes	yes	yes	no

Company A of the electronics industry has had contacts with engineering schools in two large cities, and with four industrial research institutes in Warsaw.

Auto parts firm A cooperates with an economics university in the nearest large city. Depending on its needs, the firm contracts analyses or research with the staff of that university. Its board members, moreover, take part in open lectures for students and encouraging the latter to apply for internships at their firm. Firm B cooperates with a polytechnic institute in a nearby city, subcontracting material tests. The same firm also has regular contacts with one professor from a university in the European Union and with some Polish industrial institutes in the field of project management.

Company A in the food and beverages industry cooperates with agricultural colleges and with research institutes dealing with meat products. This cooperation focuses on development of new goods and improvement of production techniques and recipes, as well as quality testing. Company B in the same industry does not cooperate with any research institution.

Both pharmaceutical companies cooperate with domestic universities. Firm B's cooperation includes the most renowned universities and medical academies in the country.

None of the surveyed firms operates in a special economic zone, industrial park or special customs zone. Three of them were granted local tax privileges. One (firm A of the auto parts industry) has some tax exemptions related to its status as a firm employing disabled personnel. Around half of this firm's workforce is disabled. The other firms that benefit from local tax exemptions are company A of the electronics industry and pharmaceuticals company A.

Electronics firm A lobbied with success within an industrial association for lower tariffs on imported inputs. Firm B declares membership in the National Chamber of Commerce for Electronics and Telecommunications.

Table 2.16. Improved competitiveness following contacts with non-profit organizations

Type of organization	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Industrial associations	X				X		Did not cooperate	X
Employers' associations			X		X			
Local or regional business associations								
Local or regional development agencies								X
Enterprise incubator								
Loan guarantee fund								
Chambers of Commerce		X	X	X	X	X		
Embassies			X			X		
Other				X				X

The cooperation with chambers of commerce and Polish embassies of the two auto parts producers is connected with establishing subsidiaries in Ukraine. The company that employs the disabled also cooperates with the National Chamber of Commerce and Rehabilitation in Warsaw and with the local division of the National Fund for Rehabilitation of the Disabled. This enterprise lists three types of advantages of its cooperation with non-profit organizations, including exchanges of experience, getting knowledge about the difficulties connected with a given market, and common lobbying. Company B, introducing *project management* as its dominant operational practice, is a member of the International Project Management Association and actively promotes the idea of *project management* in Poland.

Food and beverages producer B cooperates with industrial associations, local development agencies, the Consumers' Federation and charities. This last kind of cooperation was undertaken in order to promote the firm's image.

Pharmaceuticals firm B said that it does *not* cooperate with industrial and employers' associations because foreign-owned companies are not treated on equal terms with other members by such organizations. For this reason, its contacts with the embassy and chamber of commerce of its mother company's country of origin are more important.

2.4.6. Cooperation with customers, suppliers and other companies in the industry

The four firms of the electronics and auto parts industry cooperate quite closely with their customers, suppliers and other companies in these industries. What is special about these relations is that nearly all customers and most suppliers are located abroad. Thus, some of the information presented in Tables 2.17 and 2.18 refers to the data already presented in Table 2.12.

Table 2.17. Types of cooperation with customers, suppliers, and other companies in the industry

Type of cooperation	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Setting up joint venture	1996			1993		Did not cooperate	Did not cooperate	n.a.
Signing licensing agreement	1996		yes		yes			n.a.
Signing trade agreement or subcontract	1996-2003	yes	yes	1992	yes			n.a.
Technical assistance	1996			1992				n.a.
Common R&D			yes					n.a.

It is difficult to track any common pattern of cooperation with other firms across the analyzed enterprises. Four of them worked with their clients or suppliers (or both) on improving the quality of their products, modernization and improvements of production processes, and on personnel training.

Table 2.18. Types of cooperation with customers, suppliers, and other companies in the industry

Area of cooperation	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Employee training	C	C S	C S	C	C	C S O	C	n.a.
Improvements in inventory management			C S	S	C	C S		n.a.
Improved product quality	C S	C S	C S	C S	C			n.a.
Product specifications						C O	C	n.a.
Product design								n.a.
Research and product development	C		O			C S O		n.a.
Improved marketing			C	O	C	C S O	C	n.a.
Timeliness of delivery	C		C S	C	C	C S O	S	n.a.
Terms of delivery	C			C S		C S O	S	n.a.
Improved access to finance	O							n.a.
Improved access to modern technologies	C O	S		C		S O		n.a.
Improvements in the production process	C	C S	C	S		C S O		n.a.
Modernization of production equipment	C O	S	S	C		S		n.a.
Increasing production opportunities	C O		S			C S O		n.a.
Access to new markets		S		C		C S O		n.a.
Access to new distribution channels			C		C	C S O		n.a.
Joint lobbying			O		C	C S O		n.a.
Joint participation in trade fairs	C		C			C S O		n.a.
Assistance with filling orders when own production capacity is fully utilised				S				n.a.

Note: C – cooperation with clients, S – with suppliers, O – with other firms of the same industry.

Firm A in the electronics industry values cooperation with its foreign partners highly, predominantly because this cooperation has resulted in better access to the markets of NAFTA members. The firm established a joint venture with a Japanese enterprise and bought a license from a firm which currently distributes its products in the USA, and has additionally signed trade and technical assistance contracts.

Judging by the structure of the sales of electronics firm B, some of the relations with its customers listed in Table 2.17 refer to domestic firms and some to enterprises located in the EU countries.

Company A of the auto parts industry, which concluded some formal agreements regarding cooperation with other enterprises of the same branch, stresses that cooperation with domestic firms predominantly takes the form of joint lobbying. Nearly all its production is exported and the firm is dependent on a few key foreign customers. These customers, in turn, influence the choice of firm A's own subcontractors. As a result, the firm concludes subcontracts mainly with foreign producers. This means that nearly all the symbols referring to cooperation with customers and suppliers in Table 30 show cooperation with foreign firms.

The majority of customers of auto parts company B are also located abroad. The personnel of this firm appreciate cooperation with them as an opportunity to acquire new skills and technological knowledge. Personal contacts with foreign clients have helped many times in establishing formal relations (signing contracts). Geographically close Polish and Slovak suppliers usually cooperate with firm B on a long-term basis, and this cooperation helps in planning and making deliveries, managing inventories, and the like.

Firm A in the food and beverages industry did not cooperate in any formal way with other firms in this branch. However, informal contacts with customers helped in personnel training and in obtaining information about consumer demand. The firm cooperates with its suppliers in planning deliveries.

Program for suppliers of food industry company A

Company A in the food industry has launched a program integrating production processes. This program offers farmers cooperating with the firm on a long-term basis access to high-quality fodder and carefully selected breeding cows and hogs. The breeders have access to free advisory services related to feeding and veterinary services and are able to buy veterinary medicines at preferential prices (participating veterinarians agree to assure that the pharmaceutical companies with which they cooperate under this program limit the margin on sales to a specified rate). Within the program, the farmers can also use services of the firm in designing new breeding facilities, helping to achieve high environmental standards.

Two commercial banks are offering the cooperating farmers preferential credit lines for the purchase of young sows, breeding boars, piglets and fodder, as well as the modernization of farmers' production facilities. The program is open for any new farmers who wish to cooperate on a long-term basis and are able to assure quality standards.

The program also involves cooperation with scientists from an agricultural academy in a nearby large city, who monitor the genetic material of the pigs, thus

ensuring that the optimum economic and breeding conditions for production are being fulfilled.

The program aims at improving the quality of supplies for company A. For the breeders, it guarantees demand for their products, and provides them with development opportunities. It also offers access to a stable market segment for producers of fodder.

Source: company web site and interviews

2.4.7. Contacts with banks

Two firms declared that since 1998 they have not taken any long-term bank loan (i.e., a loan scheduled for repayment after more than one year). The other companies were using this type of financing, under different terms of bank monitoring.

Table 2.19. Monitoring investment projects by banks

Type of monitoring	Electronics		Auto/auto parts		Pharmaceuticals		Food and beverages	
	A	B	A	B	A	B	A	B
Transferring the loan money to the company in tranches	Has not taken	n.a.	X		X	n.a.		
Monitoring of debt covenants		n.a.	X		X	n.a.		
Bank sends auditors to the firm on a regular basis	long term loan	n.a.	X		X	n.a.		X
Does not monitor		n.a.		X		n.a.	X	

Firm A in the food industry has a loan conditional on the progress of its investment. The bank monitors debt covenants (i.e., requirements to keep within certain accounting ratios, levels of cash flow, etc.) and requires regular audits. Regular audits are performed also for the bank of firm B in the food and beverages industry.

Firm B of the auto parts industry has a short-term loan, hence the bank does not monitor its financial standing. The bank does not monitor the long-term credit of food company either, because of the good credit history and its overall good standing.

2.4.8. Respondent companies' roles in improving the competitiveness of other companies

Cooperation with dependent companies could be tracked in the companies from the auto parts and pharmaceuticals industries. Both auto industry firms established new,

fully dependent companies. Auto industry firm A invested in Ukraine in 2002, while firm B did this nine years earlier. Firm A also bought one domestic company during the last five years. Pharmaceuticals company A has 100% ownership of a wholesale distributor, and pharmaceuticals company B also has a 97.5% share in a distributor.

The two auto industry firms indicated more areas in which the dependent firms' competitiveness has been improved than was the case for the pharmaceuticals company. These include personnel training, quality improvements, progress in delivery planning, access to new technologies, new markets and distribution channels, modernization and upgrading of equipment and production processes.

The firms in the electronics and auto parts industries listed various areas beneficial for foreign and domestic trade partners, such as training, delivery planning, market research, improvement in production processes and access to new markets. The firms export the majority of their output, so the benefits arising for their customers are mainly attributed to the foreign firms. On the contrary, the four companies see their role in enhancing the performance of domestic suppliers primarily on domestic markets. Company B in the auto parts industry sees mutual benefits in cooperation with its suppliers in the area of personnel training, since by engaging its own personnel in training the subcontractors, it thus assures the quality of supplies it receives from those subcontractors. This firm emphasizes its positive role in improving timeliness of deliveries and promoting quality certification.

Table 2.20. Improvement of competitiveness of dependent companies

Area of cooperation	Auto A	Auto B	Pharmaceuticals A
Employee training	X	X	
Improvements in inventory management	X		X
Improved product quality	X	X	
Product specifications			
Product design			
Research and product development			
Improved marketing	X		X
Timeliness of delivery	X	X	
Terms of delivery	X		X
Improved access to finance	X		
Improved access to modern technologies	X		
Improvements in the production process		X	
Modernization of production equipment		X	
Increasing production opportunities		X	
Access to new markets	X	X	
Access to new distribution channels		X	X
Joint lobbying			
Joint participation in trade fairs			X
Assistance with filling orders when own production capacity is fully utilized		X	

Firm A in the food industry indicated that the only benefits for its customers are in the area of training in quality control. Pharmaceuticals company B, by contrast, indicated extensive benefits for both customers and suppliers, declaring that it is a policy of its mother company to encourage such types of cooperation.

Table 2.21. Benefits for clients and suppliers arising from cooperation

Area of cooperation	Electronics				Auto/auto parts				Pharmaceuticals				Food and beverages		
	A		B		A		B		A		B		A		B
	C	S	C	S	C	S	C	S	C	S	C	S	C	S	n.a.
Employee training	F	D	F		D	D	B	D			D	B	B		n.a.
Improvements in inventory management					D	D					D	B			n.a.
Improved product quality		D	F		B	B	B	D			D	B			n.a.
Product specifications		D	F		F	F					D	B			n.a.
Product design															n.a.
Research and product development											D	B			n.a.
Improved marketing					B	B					D	B			n.a.
Timeliness of delivery		D			D	B	B	D			D	B			n.a.
Terms of delivery		D			D	D	B				D	B			n.a.
Improved access to finance											D	B			n.a.
Improved access to modern technologies					B	D					D	B			n.a.
Improvements in the production process		D				F	B	D			D	B			n.a.
Modernization of production equipment		D				F					D	B			n.a.
Increasing production opportunities					n										.a.
Access to new markets		D			D	D	F					B			n.a.
Access to new distribution channels															n.a.
Joint lobbying											D	B			n.a.
Joint participation in trade fairs	D										D	B			n.a.
Assistance with filling orders when own production capacity is fully utilized															n.a.

Note: C – clients, S – suppliers, D – domestic firm benefits, F – foreign firm benefits, B – both foreign and domestic firms benefit.

Outward foreign direct investment

One of the companies examined here is an example of growing Polish outward foreign direct investment, much of it directed to former Soviet countries such as Russia and Ukraine. Much of the company's production is now carried out in Ukraine, in a factory with 2,000 employees recently built in response to the announcement by the Polish finance minister that a planned reduction of the corporate income tax was being canceled. The company was attracted to the western Ukraine by low wages, low energy costs and tax breaks granted by the national authorities. Such investments are an illustration of the upgrading process of Polish firms, whereby they acquire the ability to develop and manage international production networks, sometimes relocating lower value added activity to low-cost countries and focusing on higher value added activities in the home country.

Source: *Polityka*, *Rzeczpospolita*

3. Actors and factors in the process of competitiveness development: The Polish case[2]

Amelia Kalukiewicz, Piotr Wójcik, Richard Woodward

This chapter contains the analysis of a survey of 226 firms in four industries in Poland. The sample consisted of 125 firms from the food and beverages industry, 43 from the automotive industry, 38 from the electronics industry, and 21 pharmaceutical firms. The analysis covers:

- measures of competitiveness (e.g., market share and financial indicators) and innovation (e.g., percentage of products introduced within the last two years), as well as internal factors affecting competitiveness and innovation (e.g., education of the work force, research and development activity);
- networking, or cooperative relationships with external actors (e.g., other firms in the supply chain, universities and research institutes, consultants, etc.) to improve competitiveness, and
- relationships between networking and competitiveness.

We will begin with a characterization of the firms in the sample with respect to size (measured by employment) and type of ownership (that is, the identity of the dominant shareholder, if there is one single dominant shareholder). We then move on to an analysis of competitiveness and its determinants, followed by an analysis of relationships with external actors. We conclude with an analysis of the relationships between these variables and some observations concerning the role of local authorities and various types of non-profit organizations in the improvement of enterprise competitiveness.

[2] The authors would like to thank Tomasz Tokarski and Deniz Eylem Yoruk for their advice concerning the methodology used in constructing competitiveness and network indicators and analyzing the relationships between them.

3.1. Overview of the sample

Our first observation is that in terms of numbers of companies in each industry, the sample reflects the picture for the Polish manufacturing sector as a whole, with the food and beverage industry being by far the most numerous and pharmaceuticals the least numerous. As we see in Table 3.1, medium-sized enterprises dominate in all industries except the automotive industry, which has a slight advantage of rather large enterprises (employing over 250 persons) over medium-sized firms (but also has the largest number of small firms). Table 3.2 shows that ownership by a Polish individual is the most common form of ownership in the sample as a whole, reflecting the situation in the food and beverage industry. Foreign ownership is important in pharmaceuticals and the automotive industry, where around a third of the companies are foreign-owned, less important in food and beverages and least important in electronics. Industrial corporate investors own almost a quarter of the pharmaceutical companies, and are least important in the food and beverages industry. State ownership is observed in every industry except pharmaceuticals. In a significant number of companies in each industry, no single owner has a controlling share.

Table 3.1. Size (employment)

Employment	Industry								TOTAL	
	Food & beverages		Automotive		Electronics		Pharmaceuticals			
	n	%	n	%	n	%	n	%	**n**	%
1-50	9	7.2%	5	11.9%	0	0.0%	1	4.8%	15	6.6%
51-250	90	72.0%	18	42.9%	27	71.1%	12	57.1%	147	65.0%
Over 251	26	20.8%	19	45.2%	11	28.9%	8	38.1%	64	28.3%
Total	**125**	**100.0%**	**42**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**226**	**100.0%**

Table 3.2. Type of ownership

Type of owner	Industry								TOTAL	
	Food & beverages		Automotive		Electronics		Pharmaceuticals			
	n	%	n	%	n	%	n	%	**n**	%
State	11	8.9%	3	7.0%	4	10.8%	0	0.0%	**18**	**8.0%**
Domestic individual	66	53.7%	10	23.3%	13	35.1%	5	23.8%	**94**	**42.0%**
Domestic industrial company	4	3.3%	6	14.0%	6	16.2%	5	23.8%	**21**	**9.4%**
Financial investor	1	0.8%	0	0.0%	1	2.7%	0	0.0%	**2**	**0.9%**
Foreign individual	3	2.4%	3	7.0%	1	2.7%	1	4.8%	**8**	**3.6%**
Foreign industrial company	13	10.6%	12	27.9%	3	8.1%	5	23.8%	**33**	**14.7%**
No controlling owner	17	13.8%	7	16.3%	9	24.3%	2	9.5%	**35**	**15.6%**
Other	8	6.5%	2	4.7%	0	0.0%	3	14.3%	**13**	**5.8%**
Total	**123**	**100.0%**	**43**	**100.0%**	**37**	**100.0%**	**21**	**100.0%**	**224**	**100.0%**

3.2. Competitiveness

3.2.1. Indicators of competitiveness

Looking at Table 3.3, we observe only a handful of monopolists in this sample, none of which are in pharmaceuticals. The food and beverage producers are, by and large, operating in very competitive environments, whereas the majority of companies in the electronics and automotive industries can be said to have significant market share (pharmaceutical companies are somewhere in between).

Table 3.3. Domestic market share (by industry)

Share	Industry								TOTAL	
	Food & beverages		Automotive		Electronics		Pharmaceuticals			
	n	%	n	%	n	%	n	%	**n**	%
0%	15	12.0%	5	11.6%	3	7.9%	4	19.0%	**27**	**11.9%**
1-10%	82	65.6%	12	27.9%	6	15.8%	7	33.3%	**107**	**47.1%**
11-90%	21	16.8%	25	58.1%	27	71.1%	10	47.6%	**83**	**36.6%**
91-100%	7	5.6%	1	2.3%	2	5.3%	0	0.0%	**10**	**4.4%**
Total	**125**	**100.0%**	**43**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**227**	**100.0%**

If we consider domestic market share by ownership (Table 3.4), we see that the only monopolists are owned by domestic individuals or by owners not belonging to one of our categories. In the ownership categories represented by more than a handful of companies[3], firms owned by individuals (whether domestic of foreign) seem to operate in very competitive environments, while firms with corporate owners (domestic or foreign) likely enjoy at least some market power.

Table 3.4. Domestic market share (by ownership)

Share	Type of owner																**Total**	
	State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
	n	%	N	%	n	%	n	%	n	%	n	%	n	%	n	%	**n**	%
0%	1	5.6%	9	9.6%	2	9.5%	0	0.0%	2	25.0%	4	12.1%	5	14.3%	4	30.8%	**27**	**12.1%**
1-10%	9	50.0%	55	58.5%	7	33.3%	0	0.0%	5	62.5%	11	33.3%	14	40.0%	6	46.2%	**107**	**47.8%**
11-90%	8	44.4%	22	23.4%	12	57.1%	2	100.0%	1	12.5%	18	54.5%	16	45.7%	1	7.7%	**80**	**35.7%**
91-100%	0	0.0%	8	8.5%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	2	15.4%	**10**	**4.5%**
Total	**18**	**100.0%**	**94**	**100.0%**	**21**	**100.0%**	**2**	**100.0%**	**8**	**100.0%**	**33**	**100.0%**	**35**	**100.0%**	**13**	**100.0%**	**224**	**100.0%**

Tables 3.5 and 3.6 illustrate how the firms' sales are divided among various markets: domestic sales, export to the 15 countries which were members of the European Union prior to 1 May, 2004, and other export markets. With respect to

[3] We will generally avoid remarks on the companies owned by financial investors, as there are only two of them. We will simply note here that they tend to be distinctive.

ownership, foreign-owned companies seem to have the most intense exporting activity. The two consumer goods industries seem to focus quite strongly on the domestic market, while the two industries with a higher share of production of intermediate goods have more export activity.

Table 3.5. Share of domestic sales and exports in total sales (by industry)

Market	Share	Industry								TOTAL	
		Food & beverages		Automotive		Electronics		Pharmaceuticals			
		n	%	n	%	n	%	n	%	**n**	**%**
Domestic market	None	5	4.0%	1	2.3%	2	5.3%	1	4.8%	**9**	**4.0%**
	1-10%	23	18.4%	7	16.3%	2	5.3%	4	19.0%	**36**	**15.9%**
	11-90%	27	21.6%	24	55.8%	19	50.0%	6	28.6%	**76**	**33.5%**
	91-100%	70	56.0%	11	25.6%	15	39.5%	10	47.6%	**106**	**46.7%**
	Total	**125**	**100.0%**	**43**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**227**	**100.0%**
Export to European Union	none	83	66.4%	11	25.6%	15	39.5%	11	52.4%	**120**	**52.9%**
	1-10%	27	21.6%	12	27.9%	14	36.8%	10	47.6%	**63**	**27.8%**
	11-90%	15	12.0%	17	39.5%	8	21.1%	0	0.0%	**40**	**17.6%**
	91-100%	0	0.0%	3	7.0%	1	2.6%	0	0.0%	**4**	**1.8%**
	Total	**125**	**100.0%**	**43**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**227**	**100.0%**
Other export	none	87	69.6%	17	39.5%	15	39.5%	6	28.6%	**125**	**55.1%**
	1-10%	28	22.4%	15	34.9%	12	31.6%	11	52.4%	**66**	**29.1%**
	11-90%	10	8.0%	11	25.6%	10	26.3%	4	19.0%	**35**	**15.4%**
	91-100%	0	0.0%	0	0.0%	1	2.6%	0	0.0%	**1**	**0.4%**
	Total	**125**	**100.0%**	**43**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**227**	**100.0%**

A review of financial indicators, not presented here, shows the following:

- *Growth in total revenues and sales revenues:* There is very strong differentiation within the industries, with pharmaceuticals having the least variance. Automotive and pharmaceutical companies seem on the whole to have the best performance here, with food and electronics firms on the whole having rather negative performance (but with spectacular exceptions). State-owned companies have performed quite poorly, while foreign-owned companies have had by far the best performance, followed by domestically owned private companies.
- *Export revenues and export intensity:* These seem to be growing robustly in all industries except food and beverages. However, with the exception of pharmaceuticals, exports to the EU-15 countries have been growing at much lower rates. The automotive industry is by far the most export intensive, whereas the two consumer goods industries – pharmaceuticals and food – are the least export intensive. For export revenues, the sample is less strongly differentiated by ownership, with largely positive values across various ownership groups. Export intensity, however, is again strongly differentiated – not surprisingly, the foreign-owned companies have the highest indicators here (though it is perhaps worth noting that the state-owned sector does not do badly here, comparing favorably

Table 3.6. Share of domestic sales and exports in total sales (by ownership)

Market	Share	Type of owner																Total	
		State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	**n**	%
Domestic market	none	0	0.0%	3	3.2%	1	4.8%	0	0.0%	1	12.5%	2	6.1%	2	5.7%	0	0.0%	**9**	**4.0%**
	1-10%	3	16.7%	19	20.2%	2	9.5%	0	0.0%	4	50.0%	5	15.2%	2	5.7%	1	7.7%	**36**	**16.1%**
	11-90%	5	27.8%	18	19.1%	13	61.9%	2	100.0%	2	25.0%	20	60.6%	11	31.4%	3	23.1%	**74**	**33.0%**
	91-100%	10	55.6%	54	57.4%	5	23.8%	0	0.0%	1	12.5%	6	18.2%	20	57.1%	9	69.2%	**105**	**46.9%**
	Total	**18**	**100.0%**	**94**	**100.0%**	**21**	**100.0%**	**2**	**100.0%**	**8**	**100.0%**	**33**	**100.0%**	**35**	**100.0%**	**13**	**100.0%**	**224**	**100.0%**
Export to European Union	none	7	38.9%	64	68.1%	8	38.1%	0	0.0%	2	25.0%	10	30.3%	21	60.0%	7	53.8%	**119**	**53.1%**
	1-10%	7	38.9%	19	20.2%	11	52.4%	0	0.0%	2	25.0%	12	36.4%	7	20.0%	5	38.5%	**63**	**28.1%**
	11-90%	4	22.2%	11	11.7%	2	9.5%	2	100.0%	1	12.5%	10	30.3%	7	20.0%	1	7.7%	**38**	**17.0%**
	91-100%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	37.5%	1	3.0%	0	0.0%	0	0.0%	**4**	**1.8%**
	Total	**18**	**100.0%**	**94**	**100.0%**	**21**	**100.0%**	**2**	**100.0%**	**8**	**100.0%**	**33**	**100.0%**	**35**	**100.0%**	**13**	**100.0%**	**224**	**100.0%**
Other export	none	7	38.9%	65	69.1%	7	33.3%	0	0.0%	3	37.5%	12	36.4%	19	54.3%	10	76.9%	**123**	**54.9%**
	1-10%	7	38.9%	20	21.3%	8	38.1%	0	0.0%	4	50.0%	13	39.4%	10	28.6%	3	23.1%	**65**	**29.0%**
	11-90%	4	22.2%	9	9.6%	6	28.6%	2	100.0%	1	12.5%	8	24.2%	5	14.3%	0	0.0%	**35**	**15.6%**
	91-100%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	2.9%	0	0.0%	**1**	**0.4%**
	Total	**18**	**100.0%**	**94**	**100.0%**	**21**	**100.0%**	**2**	**100.0%**	**8**	**100.0%**	**33**	**100.0%**	**35**	**100.0%**	**13**	**100.0%**	**224**	**100.0%**

with domestic private companies). The situation with regard to export in general is mirrored almost exactly with respect to export to the EU.

- *Ratio of revenues to costs; gross profitability:* The highest is observed in pharmaceuticals; in the other industries, it does not seem to be strongly differentiated. It is therefore not surprising that pharmaceuticals companies have the best gross profitability (which is, of course, characteristic of this industry world-wide). In general, gross profitability is low and falling (only in electronics is it stable). With respect to ownership, the ratio of revenues to costs is strongest among companies in the "other" category, followed by foreign-owned companies, and worst in state-owned companies; this situation is very similar with respect to gross profitability. Gross profitability is generally in decline in the period examined (which was one of decline for most of Polish manufacturing), most strongly among state-owned enterprises.
- *Labor costs:* Wages represent a small portion of total costs, with the lowest proportion in the food and beverages industry; however, this proportion is growing in all industries. Contrary to what one might expect, state-owned companies do not have the highest share of labor costs in total costs; rather, the companies with dispersed ownership and foreign individual ownership do.

Tables 3.7 and 3.8 show how companies evaluated their own competitiveness. First, they evaluated the competitiveness of their products on the domestic and international markets, and then the competitiveness of their production technologies, again on the domestic and international markets. Typically, a quarter to a third of the sample in all industries sees itself as weak on international markets, with respect to both products and to technology. The same pattern is found in the breakdown by ownership. However, there is also a small group of leaders in each industry which consider themselves to be

Table 3.7. Self-evaluation of competitiveness (by industry)

	Response*	Industry								TOTAL	
		Food & beverages		Automotive		Electronics		Pharmaceuticals			
		n	%	n	%	n	%	n	%	**n**	**%**
Level of products in domestic market	1	40	32.3%	14	33.3%	20	55.6%	10	50.0%	**84**	**37.8%**
	2	73	58.9%	25	59.5%	16	44.4%	10	50.0%	**124**	**55.9%**
	3	11	8.9%	3	7.1%	0	0.0%	0	0.0%	**14**	**6.3%**
Level of products in international market	1	15	13.3%	7	16.7%	12	33.3%	2	11.1%	**36**	**17.2%**
	2	70	61.9%	29	69.0%	16	44.4%	12	66.7%	**127**	**60.8%**
	3	28	24.8%	6	14.3%	8	22.2%	4	22.2%	**46**	**22.0%**
Level of technology in domestic market	1	35	28.7%	13	32.5%	14	42.4%	8	42.1%	**70**	**32.7%**
	2	73	59.8%	24	60.0%	18	54.5%	9	47.4%	**124**	**57.9%**
	3	14	11.5%	3	7.5%	1	3.0%	2	10.5%	**20**	**9.3%**
Level of technology in international market	1	14	12.5%	5	12.5%	8	23.5%	5	31.3%	**32**	**15.8%**
	2	59	52.7%	29	72.5%	18	52.9%	6	37.5%	**112**	**55.4%**
	3	39	34.8%	6	15.0%	8	23.5%	5	31.3%	**58**	**28.7%**

* 1 = strongly competitive; 2 = moderately competitive; 3 = weak

Table 3.8. Self-evaluation of competitiveness (by ownership)

	Response*	Type of owner																TOTAL	
		State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	*n*	%
Level of products in domestic market	1	9	50.0%	32	34.4%	8	40.0%	2	100.0%	4	50.0%	12	37.5%	11	33.3%	3	23.1%	**81**	**37.0%**
	2	7	38.9%	58	62.4%	12	60.0%	0	0.0%	4	50.0%	16	50.0%	18	54.5%	9	69.2%	**124**	**56.6%**
	3	2	11.1%	3	3.2%	0	0.0%	0	0.0%	0	0.0%	4	12.5%	4	12.1%	1	7.7%	**14**	**6.4%**
Level of products in international market	1	2	11.8%	13	15.9%	5	26.3%	2	100.0%	3	37.5%	6	18.8%	4	12.1%	0	0.0%	**35**	**17.0%**
	2	11	64.7%	49	59.8%	12	63.2%	0	0.0%	5	62.5%	21	65.6%	18	54.5%	9	69.2%	**125**	**60.7%**
	3	4	23.5%	20	24.4%	2	10.5%	0	0.0%	0	0.0%	5	15.6%	11	33.3%	4	30.8%	**46**	**22.3%**
Level of technology in domestic market	1	7	38.9%	24	27.6%	5	25.0%	1	100.0%	5	62.5%	13	41.9%	11	33.3%	3	23.1%	**69**	**32.7%**
	2	7	38.9%	57	65.5%	15	75.0%	0	0.0%	3	37.5%	14	45.2%	17	51.5%	9	69.2%	**122**	**57.8%**
	3	4	22.2%	6	6.9%	0	0.0%	0	0.0%	0	0.0%	4	12.9%	5	15.2%	1	7.7%	**20**	**9.5%**
Level of technology in international market	1	2	11.8%	7	9.0%	4	21.1%	1	100.0%	2	25.0%	8	25.8%	6	18.2%	1	8.3%	**31**	**15.6%**
	2	10	58.8%	43	55.1%	12	63.2%	0	0.0%	6	75.0%	15	48.4%	17	51.5%	7	58.3%	**110**	**55.3%**
	3	5	29.4%	28	35.9%	3	15.8%	0	0.0%	0	0.0%	8	25.8%	10	30.3%	4	33.3%	**58**	**29.1%**

* 1 = strongly competitive; 2 = moderately competitive; 3 = weak

very competitive internationally; this group is largest for products in electronics and for production technologies in pharmaceuticals. Self-evaluations for the domestic market are also strongest in electronics and pharmaceuticals.

With respect to ownership, excepting the two companies owned by financial investors, the self-proclaimed leaders in international product competitiveness are firms owned by foreign individuals, and the leaders in international production technology competitiveness are firms owned by both foreign individuals and foreign corporate investors. We find exactly the same pattern for both product and production technology competitiveness in the domestic markets (Table 3.8).

In tables 3.9a, 3.9b, 3.10a, and 3.10b we have information about innovation. Firms were asked to estimate the percentage of sales due to new products (that is, products being sold for less than two years) and to new manufacturing technologies (i.e., technologies that were less than two years old). With respect to new products, they were also asked to indicate whether these were new for the firm, for the domestic market, or for the international market. In this sample, there appears to be no trade-off between product and process innovation: the patterns are the same for both. The automotive industry is the leader, followed by electronics and pharmaceuticals (again, the relatively poor showing of this industry is surprising, especially given the high self-rated level of competitiveness in this industry), with food and beverages in last place. The automotive and electronics companies are well ahead of the pharmaceuticals firms (not to mention food and beverages) in innovations on international markets. Strangely, the strong performance of the automotive firms is not reflected in their ratings of their

Table 3.9a. Percentage of new products and technologies (by industry)

		Industry				TOTAL
		Food & beverages	Automotive	Electronics	Pharmaceuticals	
New products	Mean	18.9	44.4	32.0	15.1	*26.0*
	Median	7.0	30.0	17.5	8.0	*10.0*
	Maximum	100.0	100.0	100.0	50.0	*100.0*
	Minimum	0.0	0.0	0.0	0.0	*0.0*
New technologies	Mean	20.7	35.3	33.5	28.8	*26.5*
	Median	7.6	30.0	25.0	11.0	*14.0*
	Maximum	100.0	100.0	100.0	100.0	*100.0*
	Minimum	0.0	0.0	0.0	0.0	*0.0*

Table 3.9b. On which markets new products were innovations (by industry)

Products are new for:	Industry								TOTAL	
	Food & beverages		Automotive		Electronics		Pharmaceuticals			
	n	%	n	%	n	%	n	%	**n**	%
The firm	71	56.8%	32	74.4%	31	81.6%	14	66.7%	**148**	**65.2%**
The domestic market	47	37.6%	20	46.5%	20	52.6%	10	47.6%	**97**	**42.7%**
The international market	4	3.2%	8	18.6%	7	18.4%	1	4.8%	**20**	**8.8%**

Table 3.10a. Percentage of new products and technologies (by ownership)

		Type of Owner								TOTAL
		State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other	
New products	Mean	20.0	25.7	20.8	14.0	57.9	27.4	25.8	22.0	*25.8*
	Median	10.0	10.5	7.5	14.0	60.0	20.0	15.0	8.0	*10.0*
	Maximum	100.0	100.0	100.0	14.0	100.0	100.0	100.0	100.0	*100.0*
	Minimum	0.0	0.0	0.0	14.0	10.0	0.0	0.0	0.0	*0.0*
New technologies	Mean	13.5	27.0	30.4	70.0	39.3	25.5	23.7	26.0	*26.2*
	Median	30.0	20.0	10.0	70.0	45.0	10.0	12.0	10.0	*12.5*
	Maximum	45.0	100.0	100.0	70.0	70.0	100.0	100.0	90.0	*10.0*
	Minimum	0.0	0.0	0.0	70.0	0.0	0.0	0.0	0.0	*0.0*

Table 3.10b. On which markets new products were innovations (by ownership)

	Type of Owner														TOTAL	
	State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	*n*	%
The firm	12	66.7%	61	64.9%	14	66.7%	1	50.0%	5	62.5%	20	60.6%	25	71.4%	8	61.5%	**146**	**65.2%**
The domestic market	7	38.9%	34	36.2%	11	52.4%	2	100.0%	4	50.0%	19	57.6%	15	42.9%	5	38.5%	**97**	**43.3%**
The international market	0	0.0%	6	6.4%	3	14.3%	0	0.0%	2	25.0%	6	18.2%	3	8.6%	0	0.0%	**20**	**8.9%**

own competitiveness. The differences tend to be less pronounced across ownership groups, suggesting that innovation is more strongly determined by industry than by ownership. Firms owned by foreign individuals have the best performance, followed by those owned by domestic individuals and foreign companies. This reflects the competitiveness self-rating patterns with respect to ownership.

3.2.2. Determinants of competitiveness

Having looked at various measures of competitiveness, we now consider a number of factors considered to be important determinants of competitiveness.

In Tables 3.11 and 3.12 we have information about investment spending: the increase over the period reported by the company and the ratio of investment spending to gross profit. With respect to the latter, there is an extraordinarily high level of variance in all industries except pharmaceuticals, and the median seems to reflect the situation of the industry better than the mean. Strangely, pharmaceuticals is clearly the poorest performer. It is difficult to identify a best performer, given the high level of variance in food and beverages and electronics: clearly there is a great deal of heterogeneity here. Looking at dynamics, the situation seems clearer (again, the median seems a much better measure than the mean). Both electronics and

Table 3.11. Investment spending (by industry)

		Industry				TOTAL
		Food & beverages	Automotive	Electronics	Pharmaceuticals	
Increase in investment spending (%)	Mean	356.8	57.2	949.4	1.0	*352.1*
	Median	25.7	11.3	-38.9	-8.1	*10.5*
	Maximum	12003.4	618.6	18452.9	161.7	*18452.9*
	Minimum	-100.0	-85.3	-94.7	-81.4	*-100.0*
Ratio of investment to gross profit (current)	Mean	8.9	1.2	24.2	0.4	*9.0*
	Median	0.7	0.4	0.5	0.1	*0.5*
	Maximum	606.7	19.4	600.0	2.2	*606.7*
	Minimum	-25.8	-5.9	-11.1	-0.4	*-25.8*

Table 3.12. Investment spending (by ownership)

		Type of owner								TOTAL
		State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other	
Increase in investment spending (%)	Mean	-31.0	172.5	2088.9	-83.6	2058.0	48.8	108.1	-7.2	*355.2*
	Median	-41.2	31.9	25.8	-83.6	54.2	-37.5	17.2	-41.4	*8.1*
	Maximum	244.1	4521.2	18452.9	-83.6	12003.4	690.5	1484.3	119.0	*18452.9*
	Minimum	-94.7	-100.0	-38.9	-83.6	-79.0	-100.0	-88.2	-74.0	*-100.0*
Ratio of investment to gross profit (current)	Mean	35.7	0.8	45.5	1.4	0.2	0.6	3.2	1.7	*9.2*
	Median	0.0	0.8	0.7	1.4	0.2	0.1	0.6	0.3	*0.5*
	Maximum	606.7	9.2	600.0	1.4	1.2	11.1	38.7	10.1	*606.7*
	Minimum	-2.8	-25.8	-1.7	1.4	-0.8	-7.5	-5.9	0.0	*-25.8*

pharmaceuticals have seen declines in investment spending, whereas the food and automotive industries are seeing growth in investment. Considering both the current situation and the dynamics, it appears pharmaceutical companies may be in the weakest situation, whereas the food industry may be in the best. With respect to ownership, there appears to be no pattern at all.

In Tables 3.13 and 3.14 we have information about the structure and growth of employment. First, we consider the share of white-collar employees and technical staff in total employment as a measure (admittedly a very imperfect one) of the skill level of the work force. As we would expect, electronics and pharmaceuticals have the highest measures here.

Total employment growth could be an indirect indicator of competitiveness; comparing industries, we see that pharmaceuticals is the least differentiated and seems to have the strongest performance, while the other three industries seem to be extremely heterogeneous. There is strong heterogeneity within ownership groups as well, though the performance of the state-owned sector and companies without controlling owners seems to have been fairly consistently poor, while companies owned by foreign individuals saw strong employment growth. Thus, there may be grounds to believe that this measure is more sensitive to corporate governance factors than to industry specifics.

Table 3.13. Structure and growth of employment since 1998; % (by industry)

		Industry				**TOTAL**
		Food & beverages	Automotive	Electronics	Pharmaceuticals	
Share of white-collar employees in total employment	Mean	23.0	19.0	42.7	48.3	*27.6*
	Median	20.6	16.7	34.0	49.1	*23.1*
	Maximum	87.3	42.9	100.0	68.8	*100.0*
	Minimum	2.0	6.9	13.5	17.0	*2.0*
Share of technical staff* in work force	Mean	8.5	9.0	38.8	13.9	*14.1*
	Median	6.2	7.9	29.8	10.2	*8.6*
	Maximum	33.3	19.5	112.6	39.2	*112.6*
	Minimum	0.0	0.0	4.9	0.0	*0.0*
Growth of total employment	Mean	4.9	175.6	7.2	11.0	*37.2*
	Median	-15.4	-9.1	-22.5	1.6	*-12.3*
	Maximum	358.9	4920.0**	375.0	124.3	*4920.0*
	Minimum	-79.2	-82.4	-74.9	-58.3	*-82.4*
Growth of white-collar employment	Mean	10.1	55.6	19.3	37.3	*22.5*
	Median	-9.1	-11.2	0.0	6.0	*0.0*
	Maximum	585.7	1240.0	418.8	237.7	*1240.0*
	Minimum	-92.5	-86.2	-72.4	-33.3	*-92.5*
Growth of technical staff	Mean	18.8	79.3	38.1	27.0	*33.0*
	Median	0.0	0.0	4.0	9.1	*0.0*
	Maximum	366.7	600.0	335.7	160.0	*600.0*
	Minimum	-90.6	-45.5	-73.0	-100.0	*-100.0*

* Technical staff consists of technicians, engineers, and R&D and IT staff.
** 1998 startup.

Table 3.14. Structure and growth of employment since 1998; % (by ownership)

		Type of owner								TOTAL
		State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other	
Share of white-collar employees in total employment	Mean	30.4	24.6	35.9	35.9	21.3	28.9	30.4	27.2	*27.7*
	Median	33.7	19.3	30.4	35.9	16.7	25.5	25.7	23.3	*23.2*
	Maximum	51.9	100.0	68.8	38.4	51.0	66.7	100.0	47.4	*100.0*
	Minimum	13.3	2.0	15.7	33.5	7.6	9.8	8.8	7.1	*2.0*
Share of technical staff* in work force	Mean	14.9	12.8	13.2	16.5	6.5	9.9	22.0	14.4	*14.1*
	Median	11.0	7.7	10.7	16.5	6.2	6.2	10.0	13.0	*8.6*
	Maximum	35.2	96.6	29.8	30.6	8.7	39.2	112.6	39.1	*112.6*
	Minimum	4.8	0.0	0.0	2.3	5.1	0.0	0.9	3.2	*0.0*
Growth of total employment	Mean	-43.5	26.7	-5.0	-37.8	142.2	207.2	-20.8	-4.8	*36.6*
	Median	-47.2	3.0	-12.3	-37.8	70.3	-18.1	-22.7	-14.3	*-12.4*
	Maximum	-2.3	375.0	124.3	-1.6	358.9	4920.0	55.6	80.0	*4920.0*
	Minimum	-77.4	-64.0	-55.8	-74.0	-9.1	-82.4	-74.0	-62.5	*-82.4*
Growth of white-collar employment	Mean	-44.0	38.0	-1.5	-35.1	57.9	76.9	-13.0	-4.3	*21.6*
	Median	-50.4	4.3	-8.3	-35.1	44.1	2.4	-14.4	-11.1	*-1.5*
	Maximum	11.2	585.7	101.1	-1.0	150.0	1240.0	70.6	62.2	*1240.0*
	Minimum	-75.9	-80.0	-49.1	-69.1	-16.7	-86.2	-92.5	-71.7	*-92.5*
Growth of technical staff	Mean	-35.6	49.6	53.6	-30.2	91.5	38.2	20.0	-5.7	*32.5*
	Median	-34.1	22.2	66.7	-30.2	95.6	-9.6	-19.5	0.0	*0.0*
	Maximum	-3.7	366.7	160.0	-0.6	150.0	400.0	600.0	75.0	*600.0*
	Minimum	-70.5	-73.0	-100.0	-59.8	25.0	-80.0	-90.6	-76.8	*-100.0*

* Technical staff consists of technicians, engineers, and R&D and IT staff.

If we look at the growth of those groups of employees considered to be most highly skilled, we once again see extreme diversity within industries, although employment in these groups seems generally to be growing at a higher rate than total employment. Differences in the share of skilled employees in total employment across ownership groups seem to be much less striking than the cross-industry differences, with the exception that foreign-owned companies seem to have much smaller technical staffs. (This may reflect foreign-owned companies' reliance on home country resources for innovation, design, and the like.) Similarly, if we look at growth in employment of those groups considered to be most highly skilled, all ownership groups except the foreign-owned companies seem to perform poorly. However, growth in the skilled work force was slower for the foreign-owned companies than total employment growth, reflecting the aforementioned low share of such employees in the work forces of those companies.

Next, we look at certification. As one would expect, ISO certification is most prevalent in industries dominated by companies producing intermediate goods, with only about a third of the companies in the industries producing consumer goods – food and beverages and pharmaceuticals – being certified. The low level of CE certification gives cause for concern, indicating that EU export markets may not be very important for the firms in the sample (at least in the case of consumer goods producers) – and indeed, over half of the firms in the two consumer goods industries report no export to the EU, as we saw in Table 3.5. With respect to industry-specific certificates, such as HACCP and GMP, the food and beverage industry seems most advanced. There

appears to be little significant differentiation across ownership groups, except for the fact that firms owned by domestic individuals seem to obtain ISO certification less than other ownership groups (the ownership category "other" also seems to be exceptional for some reason).

Table 3.15. Certification (by industry)

	Industry							
	Food & beverages		Automotive		Electronics		Pharmaceuticals	
	n	%	n	%	n	%	n	%
ISO	48	38%	29	67%	34	89%	7	33%
CE	0	0%	4	9%	11	29%	1	5%
HACCP	74	59%	2	5%	1	3%	4	19%
GMP	17	14%	0	0%	0	0%	8	38%
Other	8	6%	17	40%	7	18%	4	19%

Table 3.16. Certification (by ownership)

	Type of Owner															
	State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other	
	n	%	N	%	n	%	n	%	n	%	n	%	n	%	n	%
ISO	12	66.7%	37	39.4%	13	61.9%	2	100.0%	4	50.0%	21	63.6%	24	68.6%	3	23.1%
HACCP	10	55.6%	34	36.2%	3	14.3%	1	50.0%	3	37.5%	8	24.2%	12	34.3%	8	61.5%
CE	1	5.6%	3	3.2%	2	9.5%	0	0.0%	0	0.0%	5	15.2%	4	11.4%	0	0.0%
GMP	0	0.0%	9	9.6%	3	14.3%	0	0.0%	0	0.0%	2	6.1%	5	14.3%	5	38.5%
Other	4	22.2%	9	9.6%	7	33.3%	1	50.0%	1	12.5%	7	21.2%	3	8.6%	4	30.8%

As we see in Tables 3.17 and 3.18, differences across industry and ownership groups with respect to whether a company has a quality control lab or not (almost all firms do) are much smaller than differences with respect to whether it has an R&D or design unit or not. Less than one in five food and beverage companies have such a unit; almost half of the automotive industry companies do, and a majority of pharmaceuticals and electronics companies have such a unit (interestingly, a significantly higher proportion of electronics companies have such units than is the case in pharmaceuticals). In this context, it is not surprising that the performance of the electronics companies is best in the area of patent applications (Table 3.19), followed by pharmaceuticals with respect to domestic applications and automotive companies with respect to international applications (note that pharmaceutical companies are in third place with respect to international patent applications!). There is virtually no difference between companies owned by foreign and domestic companies with respect to whether they have R&D or design units.

Table 3.17. R&D, design, and quality control (by industry)

	Industry							
	Food & beverages		Automotive		Electronics		Pharmaceuticals	
	n	%	n	%	n	%	n	%
R&D or design unit	22	18%	20	47%	27	71%	12	57%
Quality control lab	93	74%	34	79%	32	84%	19	90%

Table 3.18. R&D, design, and quality control (by ownership)

	Type of owner															
	State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
R&D or design unit	5	27.8%	24	25.5%	10	47.6%	2	100.0%	3	37.5%	15	45.5%	18	51.4%	3	23.1%
Quality control lab	16	88.9%	60	63.8%	18	85.7%	2	100.0%	6	75.0%	31	93.9%	32	91.4%	11	84.6%

Table 3.19. Patent applications (by industry)

		Industry			
		Food & beverages	Automotive	Electronics	Pharmaceuticals
Patent applications (domestic)	Mean	0.5	1.2	4.8	3.7
	Median	0.0	0.0	0.0	0.0
	Maximum	25.0	20.0	65.0	50.0
	Minimum	0.0	0.0	0.0	0.0
Patent applications (international)	Mean	0.0	0.3	1.7	0.2
	Median	0.0	0.0	0.0	0.0
	Maximum	0.0	6.0	32.0	2.0
	Minimum	0.0	0.0	0.0	0.0

Table 3.20, which illustrates patent application performance by ownership, shows a result which may appear counterintuitive. The relatively strong performance of the state sector and of firms with dispersed ownership (i.e., the firms with presumably the weakest corporate governance) contrasts with the performance of foreign-owned firms, whose level of patent activity is not distinguished. However, the performance of the latter is very likely due to concentration of intellectual property related activity in the home country.

Table 3.20. Patent applications (by ownership)

		Type Of Owner							
		State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
Patent applications (domestic)	Mean	4.4	1.2	1.5	0.0	0.0	1.1	3.0	0.0
	Median	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	25.0	50.0	20.0	0.0	0.0	14.0	65.0	0.0
	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Patent applications (international)	Mean	1.3	0.0	0.1	0.0	0.0	0.3	1.6	0.0
	Median	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	20.0	2.0	1.0	0.0	0.0	6.0	32.0	0.0
	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tables 3.21 and 3.22 show how the importance of training was rated in developing the work force (both with respect to managerial and employee training). It comes as no surprise that the industries with high R&D and patent intensity also seem to value training the highest, and it is also not surprising that the importance of employee training is rated well below that of management training, especially in food and beverages, the least knowledge-intensive industry. With respect to ownership, once again state-owned companies rate the importance of training particularly highly; so do companies owned by foreign individuals (managerial training is also very important in widely-held firms, which is hardly surprising, given that these are the companies with the most managerial latitude due to lack of a controlling owner). Again, managerial training is seen as more important than employee training.

Table 3.21. Training (by industry)

	Response*	Industry								TOTAL	
		Food & beverages		Automotive		Electronics		Pharmaceuticals			
		n	%	n	%	n	%	n	%	**n**	**%**
Importance of training (managerial)	1	5	4.1%	2	4.7%	0	0.0%	1	5.0%	**8**	**3.6%**
	2	53	43.1%	17	39.5%	12	32.4%	7	35.0%	**89**	**39.9%**
	3	65	52.8%	24	55.8%	25	67.6%	12	60.0%	**126**	**56.5%**
Importance of training (employee)	1	14	11.3%	2	4.7%	0	0.0%	0	0.0%	**16**	**7.1%**
	2	67	54.0%	20	46.5%	15	40.5%	8	40.0%	**110**	**49.1%**
	3	43	34.7%	21	48.8%	22	59.5%	12	60.0%	**98**	**43.8%**

* 1 = little or no importance, 2 = important, 3 = very important

Table 3.22. Training (by ownership)

	Response*	Type of owner																TOTAL	
		State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	*n*	*%*
Importance of training (managerial)	1	0	0.0%	6	6.6%	1	4.8%	0	0.0%	0	0.0%	0	0.0%	1	2.9%	0	0.0%	**8**	**3.6%**
	2	3	16.7%	43	47.3%	9	42.9%	1	50.0%	2	25.0%	14	42.4%	11	32.4%	6	46.2%	**89**	**40.5%**
	3	15	83.3%	42	46.2%	11	52.4%	1	50.0%	6	75.0%	19	57.6%	22	64.7%	7	53.8%	**123**	**55.9%**
Importance of training (employee)	1	0	0.0%	8	8.7%	1	4.8%	0	0.0%	0	0.0%	5	15.2%	1	2.9%	1	7.7%	**16**	**7.2%**
	2	7	38.9%	49	53.3%	11	52.4%	1	50.0%	3	37.5%	11	33.3%	21	61.8%	5	38.5%	**108**	**48.9%**
	3	11	61.1%	35	38.0%	9	42.9%	1	50.0%	5	62.5%	17	51.5%	12	35.3%	7	53.8%	**97**	**43.9%**

* 1 = little or no importance, 2 = important, 3 = very important

3.2.3. Competitiveness: Factor analysis and competitiveness indicators

Using factor analysis, we extracted the following competitiveness components, which account for different aspects of competitiveness (for this analysis, the values have been normalized between 0 and 1; the higher the value of each factor, the higher degree of competitiveness):

Component 1 – company's evaluation of its product and process competitiveness, and its efficiency as measured by the share of materials and energy costs in total costs (the lower value – the more competitive);

Component 2 – share of sales of new products (due to new manufacturing technology) (the higher value – the more competitive);

Component 3 – sales and market share on EU markets (the higher value – the more competitive);

Component 4 – innovative products (the higher value – the more competitive);

Component 5 – domestic market share and non-EU exports (the higher value – the more competitive);

We would like to note that while there were alternative results which included more financial variables (such as profitability and total revenues), they were based on significantly fewer observations.

Using these components, two indicators of overall competitiveness have been constructed:

$$CED_j = \sqrt{\sum_i \left(1 - x_{ij}\right)^2} \qquad (1a)$$

$$CCD_j = \sum_i \left|1 - x_{ij}\right| \qquad (1b)$$

where x_{ij} stands for the i-th competitiveness component in the j-th firm. The indicator CED_j measures competitiveness in Euclidean space and CCD_j in city block space.

The lower the value of indicator, the more competitive the company is. As five factors are taken into account, CED ranges from 0 (perfect competitiveness) to the square root of 5 (around 2.24 – worst case) and CCD from 0 (perfect) to 5.

Table 3.23. Average competitiveness indicators, by industry (variant 2)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
Average CED	1.517	1.348	1.325	1.400
Average CCD	3.248	2.796	2.765	3.044
Number of firms	64	23	20	9

In Table 3.23 one can see that according to both overall competitiveness indicators the electronics firms are the most competitive; the automotive industry is second, followed by pharmaceuticals, with the food industry in last place.

Table 3.24. Average competitiveness components values, by industry

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
Component 1	0.453	0.424	0.574	0.520
Component 2	0.403	0.505	0.451	0.382
Component 3	0.217	0.370	0.273	0.224
Component 4	0.423	0.507	0.493	0.486
Component 5	0.257	0.395	0.448	0.356
Number of firms	64	23	20	9

Table 3.24 shows how the four industries compare with respect to the individual components of competitiveness. The electronic industry has the highest values of two competitiveness components: self-evaluation of competitiveness and domestic market share and non-EU exports, whereas the automotive industry is the most competitive sector with respect to the three factors involving new products and EU sales.

The following competitiveness determinants not related to networking have been extracted (the higher the value, the higher the competitiveness):

Component 1 – work force growth;

Component 2 – quality management certification;

Component 3 – domestic and foreign patent applications;

Component 4 – certification in areas other than quality management;

Component 5 – share of highly-skilled employees in total employment, and

Component 6 – importance assigned by the firm to training.

Four of the above components take the highest values for the electronics firms (quality management certification, domestic and foreign patent applications, share of highly-skilled employees in total employment and importance assigned by the firm to training). Work force growth seems to be the highest in the pharmaceutical industry, and certification in areas other than quality management is highest in the food and beverages industry.

3.3. Networks – relationships with external actors

3.3.1. Networks: Overview

In this section we will look at the interrelationships between firms and other external actors. We begin with a brief examination of supply relationships.

Supply relationships

As we see in Table 3.25, the food and beverage industry relies much more heavily on the domestic market for its supplies than do the other three industries. The European Union decidedly dominates as the source of supplies outside Poland. The pharmaceuticals industry seems to be the only one with significant foreign supply relationships outside the EU. Table 3.26 shows no significant differences with respect to different ownership groups, apart from the fact that the foreign-owned firms seemed to use EU supply markets somewhat more intensively than others (though the difference is far smaller than one might expect).

Table 3.25. Supply relationships: sources of supplies (by industry)

		Industry								TOTAL	
		Food & beverages		Automotive		Electronics		Pharmaceuticals			
		n	%	n	%	n	%	n	%	**n**	%
Domestic market	None	1	0.8%	2	4.7%	3	7.9%	2	9.5%	**8**	**3.5%**
	1-10%	2	1.6%	1	2.3%	0	0.0%	1	4.8%	**4**	**1.8%**
	11-90%	34	27.2%	30	69.8%	26	68.4%	14	66.7%	**104**	**45.8%**
	91-100%	88	70.4%	10	23.3%	9	23.7%	4	19.0%	**111**	**48.9%**
	Total	**125**	**100.0%**	**43**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**227**	**100.0%**
European Union	None	77	61.6%	9	20.9%	7	18.4%	2	9.5%	**95**	**41.9%**
	1-10%	24	19.2%	10	23.3%	7	18.4%	6	28.6%	**47**	**20.7%**
	11-90%	24	19.2%	23	53.5%	22	57.9%	12	57.1%	**81**	**35.7%**
	91-100%	0	0.0%	1	2.3%	2	5.3%	1	4.8%	**4**	**1.8%**
	Total	**125**	**100.0%**	**43**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**227**	**100.0%**
Other	None	106	84.8%	25	58.1%	17	44.7%	12	57.1%	**160**	**70.5%**
	1-10%	11	8.8%	12	27.9%	14	36.8%	2	9.5%	**39**	**17.2%**
	11-90%	8	6.4%	6	14.0%	7	18.4%	7	33.3%	**28**	**12.3%**
	91-100%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	**0**	**0.0%**
	Total	**125**	**100.0%**	**43**	**100.0%**	**38**	**100.0%**	**21**	**100.0%**	**227**	**100.0%**

Cooperation with other firms and benefits from such cooperation

We begin by looking at the following types of contractual relationships:

- Acquisitions
- Joint venture
- OEM
- Subcontracting
- Licensing
- Strategic alliances
- Secondments
- Technical assistance

Table 3.26. Supply relationships: sources of supplies (by ownership)

		Type of Owner																**Total**	
		State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	***n***	***%***
Domestic market	none	0	0.0%	2	2.1%	1	4.8%	0	0.0%	1	12.5%	2	6.1%	2	5.7%	0	0.0%	*8*	*3.6%*
	1-10%	0	0.0%	1	1.1%	0	0.0%	0	0.0%	0	0.0%	1	3.0%	1	2.9%	1	7.7%	*4*	*1.8%*
	11-90%	11	61.1%	33	35.1%	13	61.9%	2	100.0%	5	62.5%	20	60.6%	14	40.0%	5	38.5%	*103*	*46.0%*
	91-100%	7	38.9%	58	61.7%	7	33.3%	0	0.0%	2	25.0%	10	30.3%	18	51.4%	7	53.8%	*109*	*48.7%*
	Total	**18**	**100.0%**	**94**	**100.0%**	**21**	**100.0%**	**2**	**100.0%**	**8**	**100.0%**	**33**	**100.0%**	**35**	**100.0%**	**13**	**100.0%**	***224***	***100.0%***
European Union	none	5	27.8%	51	54.3%	6	28.6%	0	0.0%	0	0.0%	9	27.3%	17	48.6%	5	38.5%	*93*	*41.5%*
	1-10%	7	38.9%	15	16.0%	7	33.3%	1	50.0%	3	37.5%	4	12.1%	5	14.3%	5	38.5%	*47*	*21.0%*
	11-90%	6	33.3%	27	28.7%	7	33.3%	1	50.0%	4	50.0%	19	57.6%	13	37.1%	3	23.1%	*80*	*35.7%*
	91-100%	0	0.0%	1	1.1%	1	4.8%	0	0.0%	1	12.5%	1	3.0%	0	0.0%	0	0.0%	*4*	*1.8%*
	Total	**18**	**100.0%**	**94**	**100.0%**	**21**	**100.0%**	**2**	**100.0%**	**8**	**100.0%**	**33**	**100.0%**	**35**	**100.0%**	**13**	**100.0%**	***224***	***100.0%***
Other	none	8	44.4%	82	87.2%	10	47.6%	0	0.0%	5	62.5%	15	45.5%	28	80.0%	9	69.2%	*157*	*70.1%*
	1-10%	7	38.9%	6	6.4%	7	33.3%	0	0.0%	2	25.0%	10	30.3%	4	11.4%	3	23.1%	*39*	*17.4%*
	11-90%	3	16.7%	6	6.4%	4	19.0%	2	100.0%	1	12.5%	8	24.2%	3	8.6%	1	7.7%	*28*	*12.5%*
	91-100%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	*0*	*0.0%*
	Total	**18**	**100.0%**	**94**	**100.0%**	**21**	**100.0%**	**2**	**100.0%**	**8**	**100.0%**	**33**	**100.0%**	**35**	**100.0%**	**13**	**100.0%**	***224***	***100.0%***

Here, we ask how frequently each of these types of relationships are engaged in with customers, suppliers and competitors – both foreign and domestic. We find a clear dominance of arm's-length relationships like OEM and subcontracting over equity-based relationships (acquisitions, joint ventures) and strategic alliances; surprisingly, however, licensing does not appear to be particularly popular. Technical assistance is also a widespread form of cooperation. Most of these forms of cooperation (except for subcontracting and technical assistance) seem to be more frequent with customers than with suppliers (and among customers, more frequent with domestic ones than with foreign ones). There is less industry differentiation in the area of cooperation with suppliers. Electronics firms engage in these types of cooperation most frequently, food and beverage firms least frequently. There is little cooperation with competitors, but somewhat more with domestic competitors than with foreign ones.

As one would expect, foreign-owned companies cooperate more frequently with foreign partners than do domestically owned companies. Interestingly, cooperation with domestic competitors is most frequently engaged in by foreign-owned companies. State-owned companies and foreign-owned companies are notable for OEM and technical assistance relationships.

We also asked in which areas the respondent firms benefited from cooperation with which types of partners. With respect to cooperation with customers, benefits are perceived most frequently in product quality improvement, timeliness and terms of delivery, and access to new markets (in order of frequency with which they were named by respondents). Cooperation with suppliers yields benefits most frequently in the areas of timeliness and terms of delivery and product quality improvement. Given that firms generally have a good deal fewer investors than customers and suppliers, benefits from cooperation with investors are noted much less frequently than benefits from cooperation with customers and suppliers; however, those benefits come most frequently in the areas of access to finance, modernization of production equipment, and product quality improvement. Benefits from cooperation with other firms in the industry are found most frequently in employee and management training, product quality improvement, modernization of equipment and improved access to modern technologies. Firms benefit most frequently from cooperation with suppliers, then customers, and then other firms in the industry, with investors being listed very infrequently. Benefits from cooperation with domestic partners are cited more often than benefits from cooperation with foreign partners (hardly surprising, given the greater frequency of cooperation with domestic partners which we have seen in the foregoing analysis). Again, not surprisingly, electronics firms most frequently note benefits from cooperation with all types of partners, except investors (since they most

frequently engage in it); food and beverage firms note them least frequently. Electronics firms frequently note the benefits of cooperation with foreign suppliers. Benefits from cooperation with investors are most frequently noted by pharmaceutical companies.

We also looked at the same question by the type of dominant owner. With respect to benefits from cooperation with customers, foreign-owned companies note benefits more frequently than other companies in the areas of improved product quality and improvements in production process (as one might expect, there is a high frequency of benefits from cooperation with foreign customers). Companies with foreign corporate owners also noted improved access to modern technologies as a benefit more frequently than other companies. State-owned companies are notable for benefiting from cooperation with customers in the area of product specification and design. Improved marketing is an area of benefits noted particularly frequently by companies owned by the state and other domestic companies, which also mention cooperation with foreign customers relatively frequently. Companies owned by the state and by other domestic companies note benefits from foreign cooperation as frequently as foreign-owned companies in the area of access to new markets.

With respect to cooperation with suppliers, state-owned companies and companies owned by foreign individuals noted benefits more frequently than other types of companies. The latter benefit chiefly in the areas of employee training, product quality, and modernization of production equipment. State-owned companies also note product quality, timeliness and terms of delivery, and modernization of production equipment (especially in teh case of cooperation with foreign partners). It is interesting that companies owned by foreign individuals almost never cite cooperation with their investors as a source of benefits; by contrast, companies owned by foreign corporate investors note cooperation with investors as a source of benefit more frequently than any other companies (interestingly, they frequently mention cooperation with *domestic* investors). We observe the opposite situation among domestically owned companies: companies owned by domestic individuals cite cooperation with investors much more frequently than companies held by domestic companies. Finally, with respect to cooperation with other companies in the industry, there appears to be virtually no significant differentiation by type of ownership.

We asked surveyed firms about their links with "sister companies"; i.e., companies owned by the same owner as the respondent company. This type of linkage is most frequent in the automotive industry. It is much more important for foreign-owned firms than for domestically owned firms.

In general, there has been very little acquisition of subsidiaries by the respondent companies. The domestically-owned companies are somewhat more active than foreign-owned ones, implying that foreign owners prefer to acquire other companies directly rather than through their Polish subsidiaries. It is, however, interesting to note that the most frequent acquirers of foreign firms are companies in which the state has a dominant share. Acquisitions are relatively more frequent among food and electronics manufacturers than in the other two industries.

Finally, we look at areas in which respondent companies believe their customers and suppliers have improved operations due to cooperation with respondent firms. Respondents seem to believe that their partners have benefited from co-operation with them more often than they have benefited from co-operation with their partners. However, the areas in which they believe benefits have most frequently accrued to their partners are largely the same as the areas in which they believe themselves to have benefited most frequently. Generally, they believe that customers have benefited more frequently than suppliers. The most frequently named areas of benefits for customers are product quality, timeliness and terms of delivery, employee training and marketing. The most frequently named areas of benefits for suppliers are timeliness and terms of delivery, product quality, and inventory management.

Cooperation in R&D and innovation

Next, we look at R&D activity to see in what areas firms cooperate and with whom, and in what areas they prefer to keep all their R&D activity in-house.

Table 3.27. With whom do firms cooperate in R&D (by industry)

	Industry								**TOTAL**	
	Food & beverages		Automotive		Electronics		Pharmaceuticals			
	n	%	n	%	n	%	n	%	*n*	%
Private domestic research institutes	18	14.4%	7	16.3%	15	39.5%	8	38.1%	**48**	**21.1%**
Public domestic research institutes	34	27.2%	15	34.9%	19	50.0%	11	52.4%	**79**	**34.8%**
Domestic universities	22	17.6%	11	25.6%	20	52.6%	12	57.1%	**65**	**28.6%**
Private foreign research institutes	5	4.0%	2	4.7%	6	15.8%	2	9.5%	**15**	**6.6%**
Public foreign research institutes	0	0.0%	2	4.7%	6	15.8%	5	23.8%	**13**	**5.7%**
Foreign universities	1	0.8%	1	2.3%	5	13.2%	1	4.8%	**8**	**3.5%**
Raw materials suppliers	53	42.4%	22	51.2%	22	57.9%	11	52.4%	**108**	**47.6%**
Machinery and equipment suppliers	37	29.6%	17	39.5%	19	50.0%	7	33.3%	**80**	**35.2%**
Independent researchers	8	6.4%	5	11.6%	14	36.8%	9	42.9%	**36**	**15.9%**
Other firms with which there are capital ties	9	7.2%	6	14.0%	10	26.3%	3	14.3%	**28**	**12.3%**
Other	8	6.4%	2	4.7%	4	10.5%	0	0.0%	**14**	**6.2%**

As we see in Table 3.27, the group most often cooperated with is clearly suppliers of raw materials; a majority of firms in all industries except food and beverages cooperate with them. Only pharmaceuticals companies cooperate with another group more frequently (domestic universities). The next two groups most frequently cooperated with are public domestic research institutes and machinery and equipment suppliers. Domestic universities are also important for the electronics and pharmaceuticals firms; these two industries are also the ones most intensively involved in R&D cooperation. The food and beverage firms seem to cooperate least frequently, probably reflecting their low level of R&D activity. Looking at Table 3.28, there is little of interest to say about the breakdown with respect to ownership; what seems noteworthy is the relatively high propensity of the state-owned companies to work with universities, both domestic and foreign (with the latter even more frequently than foreign-owned companies), and, as one might expect, the propensity of foreign-owned companies to work with foreign private research institutes.

Subcontracting relationships in R&D are rather rare (much rarer than cooperation) and are strongly concentrated in domestic research institutes and universities. These patterns are generally the same across industries; as in the case of R&D cooperation, subcontracting is rarest in the food and beverage industry and most intensive in electronics and pharmaceuticals. Again, there is little of note in the breakdown by ownership, aside from the fact that state-owned and foreign-owned firms tend to use R&D subcontractors outside the aforementioned most popular groups more frequently (e.g., machinery and equipment suppliers or independent researchers). Pharmaceutical and automotive companies subcontract both product and process development significantly more often than firms in the other two industries, whereas subcontracting of scientific and applied research is the domain of pharmaceutical and electronics companies. Quality control is the most popular area for subcontracting, and is particularly favored by the two consumer goods industries – pharmaceuticals and food and beverages. With respect to ownership, we note that companies owned by corporate investors (both domestic and foreign) engage in scientific research more often than others, and subcontracting of design work is favored by state-owned companies and companies owned by domestic industrial companies.

In Tables 3.29 and 3.30, we look at which kinds of R&D work are done in-house. Quality control is named most frequently (as noted above, it is also the most frequently subcontracted). Product and process development are also named very frequently. Electronics firms, which cooperate and subcontract most frequently in the R&D area, also do in-house work in this area most frequently. Likewise, food and beverage companies, which cooperate and subcontract least frequently in the R&D area, also

Table 3.28. With whom do firms cooperate in R&D (by ownership)

	Type of Owner																TOTAL	
	State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	**n**	%
Private domestic research institutes	2	11.1%	18	19.1%	5	23.8%	1	50.0%	3	37.5%	8	24.2%	9	25.7%	2	15.4%	**48**	**21.4%**
Public domestic research institutes	7	38.9%	29	30.9%	8	38.1%	2	100.0%	3	37.5%	13	39.4%	14	40.0%	3	23.1%	**79**	**35.3%**
Domestic universities	9	50.0%	20	21.3%	6	28.6%	2	100.0%	2	25.0%	11	33.3%	14	40.0%	1	7.7%	**65**	**29.0%**
Private foreign research institutes	1	5.6%	3	3.2%	0	0.0%	1	50.0%	3	37.5%	4	12.1%	3	8.6%	0	0.0%	**15**	**6.7%**
Public foreign research institutes	0	0.0%	4	4.3%	2	9.5%	1	50.0%	0	0.0%	3	9.1%	3	8.6%	0	0.0%	**13**	**5.8%**
Foreign universities	3	16.7%	1	1.1%	0	0.0%	0	0.0%	0	0.0%	3	9.1%	1	2.9%	0	0.0%	**8**	**3.6%**
Raw materials suppliers	9	50.0%	40	42.6%	9	42.9%	2	100.0%	4	50.0%	17	51.5%	22	62.9%	5	38.5%	**108**	**48.2%**
Machinery and equipment suppliers	8	44.4%	27	28.7%	5	23.8%	2	100.0%	3	37.5%	15	45.5%	16	45.7%	3	23.1%	**79**	**35.3%**
Independent researchers	3	16.7%	12	12.8%	5	23.8%	0	0.0%	1	12.5%	6	18.2%	7	20.0%	2	15.4%	**36**	**16.1%**
Other firms with which there are capital ties	2	11.1%	6	6.4%	1	4.8%	0	0.0%	1	12.5%	14	42.4%	4	11.4%	0	0.0%	**28**	**12.5%**
Other	1	5.6%	7	7.4%	0	0.0%	0	0.0%	0	0.0%	1	3.0%	3	8.6%	2	15.4%	**14**	**6.3%**

have the lowest propensity to do in-house work in this area. Differentiation across ownership groups is not as strong as differentiation across industry, except in the case of design work, with firms owned by domestic industrial companies and in the "other" category clearly leading.

Table 3.29. What R&D work do firms do in-house (by industry)

	Industry								TOTAL	
	Food & beverages		Automotive		Electronics		Pharmaceuticals			
	n	%	n	%	n	%	n	%	*n*	%
Product development and improvements	72	57.6%	26	60.5%	35	92.1%	16	76.2%	**149**	**65.6%**
Process developments and improvements	66	52.8%	32	74.4%	29	76.3%	13	61.9%	**140**	**61.7%**
Scientific research	2	1.6%	5	11.6%	9	23.7%	2	9.5%	**18**	**7.9%**
Applied research	14	11.2%	10	23.3%	22	57.9%	10	47.6%	**56**	**24.7%**
Design	32	25.6%	24	55.8%	33	86.8%	11	52.4%	**100**	**44.1%**
Quality control	94	75.2%	37	86.0%	34	89.5%	18	85.7%	**183**	**80.6%**
Gathering commercial and technical information from outside sources	36	28.8%	16	37.2%	23	60.5%	16	76.2%	**91**	**40.1%**
Establishing R&D contacts with other organizations	19	15.2%	12	27.9%	20	52.6%	8	38.1%	**59**	**26.0%**
Other	1	0.8%	1	2.3%	2	5.3%	0	0.0%	**4**	**1.8%**

This analysis shows that, in spite of criticism (see, for example, Gorzelak et al., 1995; Radosevic, 1999; Kraslawski, Gajewski, 2000; Radosevic, 2004), the (almost entirely public) science and technology sector in Poland is playing a role of some importance for industry. We have attempted to define that role and identify, if possible, both the areas of strength in the Polish S&T sector's cooperation with industry and the opportunities that are being missed – results which would be important in informing innovation and S&T policy in Poland.

One step in this direction is our analysis of the role played by various partners of the company in various stages of its innovation process. To do so, we separated the following stages of the process:

- Formulating the idea of innovation;
- Collecting necessary information for developing this idea (e.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.);
- Developing the idea; preparing plans (prototyping);
- Implementation;
- Control over implementation, and
- Evaluation of results.

Table 3.30. What R&D work do firms do in-house (by ownership)

	Type of Owner																TOTAL	
	State		Domestic individual		Domestic industrial company		Financial investor		Foreign individual		Foreign industrial company		No controlling owner		Other			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	**n**	**%**
Product development and improvements	13	72.2%	56	59.6%	13	61.9%	2	100.0%	5	62.5%	21	63.6%	28	80.0%	8	61.5%	**146**	**65.2%**
Process developments and improvements	12	66.7%	51	54.3%	15	71.4%	2	100.0%	6	75.0%	21	63.6%	26	74.3%	5	38.5%	**138**	**61.6%**
Scientific research	2	11.1%	9	9.6%	2	9.5%	0	0.0%	1	12.5%	2	6.1%	2	5.7%	0	0.0%	**18**	**8.0%**
Applied research	4	22.2%	18	19.1%	9	42.9%	1	50.0%	1	12.5%	10	30.3%	9	25.7%	3	23.1%	**55**	**24.6%**
Design	8	44.4%	34	36.2%	13	61.9%	2	100.0%	2	25.0%	15	45.5%	17	48.6%	8	61.5%	**99**	**44.2%**
Quality control	14	77.8%	69	73.4%	18	85.7%	2	100.0%	7	87.5%	29	87.9%	32	91.4%	10	76.9%	**181**	**80.8%**
Gathering commercial and technical information from outside sources	8	44.4%	33	35.1%	8	38.1%	1	50.0%	2	25.0%	16	48.5%	15	42.9%	6	46.2%	**89**	**39.7%**
Establishing R&D contacts with other organizations	6	33.3%	15	16.0%	9	42.9%	2	100.0%	2	25.0%	9	27.3%	13	37.1%	3	23.1%	**59**	**26.3%**
Other	0	0.0%	2	2.1%	0	0.0%	0	0.0%	0	0.0%	2	6.1%	0	0.0%	0	0.0%	**4**	**1.8%**

In tables 3.31 and 3.32, we look at which companies carry out all of their innovation activity in-house at each of these stages of the innovation process. From Table 3.31 we see that generally electronics firms cooperate more often than companies in other industries in all stages of the innovation process, whereas the food companies engage in the least cooperation. There is a trend to cooperate most in the early stages of innovation and less in later stages, with an increase in cooperation at the end of the process, when results are evaluated. This is the same across all industries. With respect to ownership, state-owned enterprises are clearly the least cooperative in innovation, but other ownership groups are not strongly differentiated (table 3.32).

Table 3.31. All innovation activity carried out in-house (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	69.6%	64.3%	44.7%	57.1%
2. Collecting necessary information for developing this idea*	60.8%	66.7%	47.4%	52.4%
3. Developing the idea; preparing plans (prototyping)	61.6%	54.8%	52.6%	66.7%
4. Implementation	64.8%	66.7%	60.5%	90.5%
5. Control over implementation	69.6%	71.4%	57.9%	85.7%
6. Evaluation of results	64.0%	66.7%	42.1%	71.4%
7. Other	4.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.32. All innovation activity carried out in-house (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	88.9%	60.6%	57.1%	50.0%	50.0%	54.5%	65.7%	76.9%
2. Collecting necessary information for developing this idea*	77.8%	57.4%	42.9%	50.0%	50.0%	60.6%	57.1%	76.9%
3. Developing the idea; preparing plans (prototyping)	77.8%	57.4%	57.1%	50.0%	62.5%	48.5%	57.1%	84.6%
4. Implementation	88.9%	64.9%	52.4%	50.0%	75.0%	60.6%	68.6%	84.6%
5. Control over implementation	94.4%	69.1%	66.7%	50.0%	75.0%	60.6%	65.7%	76.9%
6. Evaluation of results	88.9%	57.4%	61.9%	50.0%	62.5%	54.5%	60.0%	76.9%
7. Other	0.0%	3.2%	0.0%	0.0%	0.0%	3.0%	2.9%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Next we look at those firms which do cooperate in the innovation process, asking what kinds of partners they cooperate with at which stages of the process. We asked about the following types of partners:

- Universities (domestic and foreign)
- Research institutes / labs (domestic and foreign)
- Consulting firms/ individuals (domestic and foreign)
- Market research agencies
- Industrial customers (domestic and foreign)
- End-product customers (domestic and foreign)
- Raw material suppliers (domestic and foreign)
- Technology suppliers (domestic and foreign)

The role of foreign universities in any stage of the innovation process was minimal. Only two electronics companies and one automotive company cited foreign universities as playing a role in any stage at all. With respect to ownership, it was mentioned by one state-owned enterprise and two companies owned by foreign industrial investors. The role of foreign research labs and institutes was similarly minimal, though – interestingly – their cooperation was sought somewhat more frequently by domestic companies than by foreign-owned companies.

The role of foreign consultants is minimal in the innovation process, though we can say that there seems to be a somewhat higher propensity of foreign-owned companies to use their services. Domestic consultants are also used quite seldom, but most frequently by automotive and food firms. Companies owned by foreign corporate investors and domestic individual investors seem to have a higher propensity to use their services.

Market research agencies tend to be used, if at all, in the very earliest stages (formulation of ideas and collection of information) and at the end, in the evaluation phase. Food and pharmaceutical companies cooperate most frequently with these agencies. With respect to ownership, state-owned enterprises use this form of cooperation least frequently.

The most important partners in the innovation process are domestic research institutes and labs and domestic industrial and end-product customers. As one would expect, electronics firms engage most frequently in cooperation with domestic research institutes and labs, followed by pharmaceuticals and then automotive companies, with food and beverage producers cooperating least (Table 3.33). Ownership is not a strong differentiating factor here (Table 3.34).

The importance of domestic industrial customers is much greater for producers of intermediate goods (automotive and electronics industries) than for producers of consumer goods (Table 3.35). Companies owned by foreign individuals cooperate with this group very seldom; state-owned companies are also relatively weak in this form of

Table 3.33. Role of domestic research institutes / labs in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	6.4%	9.5%	26.3%	23.8%
2. Collecting necessary information for developing this idea*	10.4%	14.3%	18.4%	14.3%
3. Developing the idea; preparing plans (prototyping)	3.2%	9.5%	21.1%	33.3%
4. Implementation	1.6%	9.5%	13.2%	14.3%
5. Control over implementation	3.2%	11.9%	15.8%	14.3%
6. Evaluation of results	3.2%	16.7%	18.4%	9.5%
7. Other	0.8%	0.0%	2.6%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.34. Role of domestic research institutes / labs in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	11.1%	16.0%	19.0%	0.0%	0.0%	9.1%	8.6%	0.0%
2. Collecting necessary information for developing this idea*	11.1%	12.8%	14.3%	50.0%	12.5%	12.1%	14.3%	0.0%
3. Developing the idea; preparing plans (prototyping)	5.6%	11.7%	19.0%	0.0%	0.0%	6.1%	14.3%	0.0%
4. Implementation	0.0%	6.4%	9.5%	0.0%	0.0%	6.1%	8.6%	7.7%
5. Control over implementation	0.0%	8.5%	19.0%	0.0%	0.0%	3.0%	14.3%	0.0%
6. Evaluation of results	5.6%	8.5%	19.0%	0.0%	0.0%	6.1%	14.3%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%	2.9%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

cooperation (Table 3.36). Cooperation with foreign industrial customers is much less frequent, and is named significantly more often by electronics companies than by companies in other industries. Again, companies owned by foreign individuals very seldom cooperate with this type of partner; interestingly, however, state-owned companies do so relatively frequently.

Cooperation with domestic end-product consumers is also very important. It is relatively undifferentiated across industry, except that in the case of pharmaceuticals companies it is limited more strongly than in other industries to the first (formulation of idea) and final (evaluation) stages of the innovation process (Table 3.37). With respect to ownership, again we observe very weak cooperation among companies owned by foreign individuals (Table 3.38). Cooperation with foreign end-product

Table 3.35. Role of domestic industrial customers in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	6.4%	14.3%	34.2%	9.5%
2. Collecting necessary information for developing this idea*	7.2%	14.3%	26.3%	0.0%
3. Developing the idea; preparing plans (prototyping)	3.2%	14.3%	21.1%	4.8%
4. Implementation	1.6%	14.3%	31.6%	0.0%
5. Control over implementation	1.6%	9.5%	21.1%	0.0%
6. Evaluation of results	5.6%	11.9%	28.9%	4.8%
7. Other	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.36. Role of domestic industrial customers in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	11.1%	13.8%	4.8%	50.0%	0.0%	15.2%	20.0%	0.0%
2. Collecting necessary information for developing this idea*	16.7%	9.6%	19.0%	50.0%	0.0%	9.1%	11.4%	7.7%
3. Developing the idea; preparing plans (prototyping)	5.6%	9.6%	14.3%	0.0%	0.0%	9.1%	8.6%	0.0%
4. Implementation	5.6%	6.4%	19.0%	50.0%	0.0%	9.1%	14.3%	0.0%
5. Control over implementation	0.0%	5.3%	14.3%	0.0%	0.0%	6.1%	11.4%	0.0%
6. Evaluation of results	5.6%	13.8%	23.8%	0.0%	12.5%	9.1%	2.9%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

consumers is named with any frequency only by electronics companies (Table 3.39), though there is also some propensity for pharmaceuticals companies to such cooperation in the first phase of innovation. With respect to ownership, we found that

Table 3.37. Role of domestic end-product customers in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	12.8%	11.9%	18.4%	23.8%
2. Collecting necessary information for developing this idea*	11.2%	11.9%	13.2%	4.8%
3. Developing the idea; preparing plans (prototyping)	4.8%	7.1%	13.2%	4.8%
4. Implementation	4.8%	4.8%	7.9%	0.0%
5. Control over implementation	2.4%	4.8%	7.9%	0.0%
6. Evaluation of results	14.4%	9.5%	15.8%	19.0%
7. Other	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.38. Role of domestic end-product customers in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	11.1%	16.0%	14.3%	50.0%	0.0%	15.2%	14.3%	15.4%
2. Collecting necessary information for developing this idea*	16.7%	11.7%	9.5%	50.0%	12.5%	15.2%	5.7%	0.0%
3. Developing the idea; preparing plans (prototyping)	5.6%	9.6%	0.0%	50.0%	0.0%	12.1%	0.0%	0.0%
4. Implementation	0.0%	8.5%	4.8%	50.0%	0.0%	3.0%	0.0%	0.0%
5. Control over implementation	0.0%	6.4%	4.8%	0.0%	0.0%	3.0%	0.0%	0.0%
6. Evaluation of results	16.7%	20.2%	14.3%	0.0%	0.0%	9.1%	11.4%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.39. Role of foreign end-product customers in various stages of innovation process in electronics industry

1. Formulating the idea of innovation	18.4%
2. Collecting necessary information for developing this idea*	15.8%
3. Developing the idea; preparing plans (prototyping)	10.5%
4. Implementation	7.9%
5. Control over implementation	5.3%
6. Evaluation of results	13.2%
7. Other	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

domestic companies (especially state-owned ones) cooperate with foreign end-product consumers much more frequently than among foreign-owned companies.

As we see in Table 3.40, electronics firms most frequently name domestic universities as partners in the innovation process, followed by pharmaceuticals firms in a distant second place. In both cases, most of the cooperation is in early stages of the innovation process. Ownership does not appear to be a differentiating factor here (Table 3.41).

Table 3.40. Role of domestic universities in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	3.2%	4.8%	26.3%	4.8%
2. Collecting necessary information for developing this idea*	9.6%	4.8%	21.1%	14.3%
3. Developing the idea; preparing plans (prototyping)	4.8%	4.8%	23.7%	14.3%
4. Implementation	4.8%	4.8%	7.9%	0.0%
5. Control over implementation	1.6%	2.4%	5.3%	0.0%
6. Evaluation of results	3.2%	2.4%	7.9%	9.5%
7. Other	0.0%	0.0%	2.6%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

As we see in Tables 3.42 and 3.44, both domestic and foreign raw material suppliers are fairly important partners in the innovation process for electronics companies (and

Table 3.41. Role of domestic universities in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	11.1%	11.7%	9.5%	0.0%	0.0%	3.0%	2.9%	0.0%
2. Collecting necessary information for developing this idea*	11.1%	11.7%	19.0%	0.0%	12.5%	12.1%	5.7%	0.0%
3. Developing the idea; preparing plans (prototyping)	5.6%	9.6%	9.5%	50.0%	0.0%	6.1%	11.4%	0.0%
4. Implementation	0.0%	5.3%	9.5%	0.0%	0.0%	3.0%	8.6%	0.0%
5. Control over implementation	0.0%	2.1%	4.8%	0.0%	0.0%	3.0%	2.9%	0.0%
6. Evaluation of results	0.0%	4.3%	9.5%	0.0%	0.0%	9.1%	2.9%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.42. Role of domestic raw material suppliers in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	6.4%	7.1%	13.2%	9.5%
2. Collecting necessary information for developing this idea*	9.6%	7.1%	23.7%	14.3%
3. Developing the idea; preparing plans (prototyping)	4.0%	7.1%	15.8%	9.5%
4. Implementation	4.0%	4.8%	13.2%	4.8%
5. Control over implementation	2.4%	4.8%	2.6%	9.5%
6. Evaluation of results	1.6%	4.8%	0.0%	0.0%
7. Other	0.0%	2.4%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.43. Role of domestic raw material suppliers in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	11.1%	6.4%	4.8%	50.0%	0.0%	9.1%	14.3%	0.0%
2. Collecting necessary information for developing this idea*	16.7%	10.6%	14.3%	50.0%	0.0%	9.1%	14.3%	0.0%
3. Developing the idea; preparing plans (prototyping)	16.7%	4.3%	19.0%	50.0%	0.0%	6.1%	2.9%	0.0%
4. Implementation	11.1%	3.2%	14.3%	0.0%	0.0%	9.1%	5.7%	0.0%
5. Control over implementation	5.6%	3.2%	4.8%	0.0%	0.0%	3.0%	2.9%	0.0%
6. Evaluation of results	0.0%	3.2%	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%
7. Other	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

are also named by some pharmaceutical companies for the information collection phase). With respect to ownership, we again observe the weakness of companies owned by foreign individuals in this type of cooperation. In particular, state-owned companies cooperate relatively frequently with domestic suppliers (Tables 3.43, 3.45).

Table 3.44. Role of foreign raw material suppliers in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	3.2%	2.4%	15.8%	9.5%
2. Collecting necessary information for developing this idea*	4.0%	7.1%	26.3%	14.3%
3. Developing the idea; preparing plans (prototyping)	2.4%	7.1%	15.8%	4.8%
4. Implementation	1.6%	4.8%	10.5%	4.8%
5. Control over implementation	0.8%	2.4%	2.6%	4.8%
6. Evaluation of results	0.8%	2.4%	0.0%	4.8%
7. Other	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.45. Role of foreign raw material suppliers in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	11.1%	3.2%	4.8%	50.0%	0.0%	6.1%	11.4%	0.0%
2. Collecting necessary information for developing this idea*	11.1%	6.4%	9.5%	50.0%	12.5%	12.1%	14.3%	0.0%
3. Developing the idea; preparing plans (prototyping)	5.6%	3.2%	14.3%	50.0%	0.0%	9.1%	5.7%	0.0%
4. Implementation	0.0%	2.1%	14.3%	0.0%	0.0%	6.1%	5.7%	0.0%
5. Control over implementation	0.0%	1.1%	0.0%	0.0%	0.0%	6.1%	2.9%	0.0%
6. Evaluation of results	0.0%	1.1%	0.0%	0.0%	0.0%	6.1%	0.0%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Domestic technology suppliers are relatively more important for electronics and food manufacturers than for companies in other industries (Table 3.46). Foreign technology suppliers are also relatively important for electronics producers (Table 3.48). Looking at the breakdown by ownership, we see relatively little differentiation with respect to domestic technology suppliers, except that companies owned by foreign individuals never cooperate with this type of partner (Table 3.47). Foreign technology suppliers appear to be relatively more important for foreign-owned companies than for other companies (Table 3.49).

Table 3.46. Role of domestic technology suppliers in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	11.2%	4.8%	21.1%	4.8%
2. Collecting necessary information for developing this idea*	10.4%	7.1%	10.5%	4.8%
3. Developing the idea; preparing plans (prototyping)	10.4%	4.8%	15.8%	4.8%
4. Implementation	10.4%	2.4%	10.5%	4.8%
5. Control over implementation	8.8%	2.4%	0.0%	0.0%
6. Evaluation of results	4.0%	2.4%	0.0%	4.8%
7. Other	0.0%	0.0%	0.0%	0.0%

** E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.47. Role of domestic technology suppliers in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	16.7%	11.7%	0.0%	50.0%	0.0%	12.1%	14.3%	7.7%
2. Collecting necessary information for developing this idea*	11.1%	9.6%	9.5%	50.0%	0.0%	12.1%	5.7%	7.7%
3. Developing the idea preparing plans (prototyping)	16.7%	11.7%	4.8%	50.0%	0.0%	12.1%	2.9%	7.7%
4. Implementation	16.7%	12.8%	4.8%	0.0%	0.0%	6.1%	2.9%	0.0%
5. Control over implementation	5.6%	8.5%	4.8%	0.0%	0.0%	3.0%	2.9%	0.0%
6. Evaluation of results	5.6%	3.2%	0.0%	0.0%	0.0%	6.1%	2.9%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

** E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.48. Role of foreign technology suppliers in various stages of innovation process (by industry)

	Industry			
	Food & beverages	Automotive	Electronics	Pharmaceuticals
1. Formulating the idea of innovation	6.4%	4.8%	23.7%	9.5%
2. Collecting necessary information for developing this idea*	5.6%	2.4%	10.5%	14.3%
3. Developing the idea; preparing plans (prototyping)	5.6%	2.4%	13.2%	4.8%
4. Implementation	4.0%	2.4%	7.9%	4.8%
5. Control over implementation	1.6%	0.0%	2.6%	0.0%
6. Evaluation of results	0.8%	2.4%	5.3%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%

** E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

Table 3.49. Role of foreign technology suppliers in various stages of innovation process (by ownership)

	Type of Owner							
	State	Domestic individual	Domestic industrial company	Financial investor	Foreign individual	Foreign industrial company	No controlling owner	Other
1. Formulating the idea of innovation	5.6%	7.4%	0.0%	0.0%	0.0%	21.2%	14.3%	7.7%
2. Collecting necessary information for developing this idea*	5.6%	5.3%	4.8%	0.0%	12.5%	12.1%	8.6%	0.0%
3. Developing the idea; preparing plans (prototyping)	5.6%	6.4%	0.0%	0.0%	12.5%	12.1%	5.7%	0.0%
4. Implementation	0.0%	4.3%	0.0%	0.0%	0.0%	9.1%	8.6%	0.0%
5. Control over implementation	0.0%	1.1%	0.0%	0.0%	0.0%	0.0%	5.7%	0.0%
6. Evaluation of results	0.0%	2.1%	0.0%	0.0%	0.0%	3.0%	2.9%	0.0%
7. Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

* E.g., market research on need for innovation, scientific knowledge, technological knowledge, experience of others, etc.

3.3.2. Networks: Factor analysis

Using the same technique as in section 2.3, we have identified the most important network variables using factor analysis. The following factors have been extracted:

Group 1. R&D cooperation

Component 1 – doing all kinds of research & development in-house

Component 2 – R&D cooperation with domestic universities and independent researchers

Component 3 – R&D cooperation with suppliers of raw materials and machinery and equipment and with private domestic research institutes

Component 4 – R&D cooperation and subcontracting with firms owned by the same owner and R&D subcontracting to machinery and equipment suppliers

Component 5 – R&D cooperation with foreign research organizations

Component 6 – subcontracting of design projects and subcontracting of R&D work to domestic research institutes

Component 7 – subcontracting product and process developments and improvements

Component 8 – subcontracting establishment of R&D contracts and information gathering

Component 9 – subcontracting quality control

Group 2. Sister companies and subsidiaries

(For the purpose of this analysis the variables related to subsidiaries have been re-coded as dummy variables to take into account only the presence – or lack thereof – of improvements in the competitiveness of subsidiaries.)

Component 1 – the firm has improved product quality, production process and management in its subsidiaries
Component 2 – the firm has improved sales and marketing of its subsidiaries
Component 3 – the firm has links with other firms belonging to the same owner

Group 3. Cooperation with suppliers

Component 1 – benefits from cooperation with suppliers (including acquisition of foreign suppliers) in the areas of product design, access to modern production technologies and increasing production opportunities
Component 2 – secondments with suppliers (domestic or foreign)
Component 3 – improvements in inventory and delivery management thanks to cooperation with suppliers
Component 4 – improved marketing, new markets and distribution channels thanks to cooperation with suppliers
Component 5 – joint participation in trade fairs and improved access to finance thanks to suppliers from outside EU
Component 6 – increase in outside services costs linked with obtaining new EU suppliers
Component 7 – obtaining technical assistance from domestic suppliers

Group 4. Cooperation with customers and competitors

Component 1 – producing licensed subcomponents for foreign competitors
Component 2 – obtaining domestic or foreign customers and competitors
Component 3 – obtaining technical assistance from domestic or foreign customers
Component 4 – strategic alliances with domestic competitors
Component 5 – OEM cooperation with domestic or foreign customers
Component 6 – strategic alliances with domestic or foreign customers

Group 5. Benefits for customers & suppliers

Component 1 – access to modern technologies, production improvements and better distribution possibilities for customers
Component 2 – access to modern technologies and production improvements for suppliers
Component 3 – improved marketing and distribution possibilities for suppliers
Component 4 – improved product quality & design and better inventory management for suppliers
Component 5 – improved product quality and delivery conditions for customers
Component 6 – joint participation in trade fairs with customers and suppliers
Component 7 – better delivery conditions for suppliers
Component 8 – joint lobbying with customers

Group 6. Areas of benefits from cooperation

Component 1 – modernization and new market opportunities thanks to cooperation with domestic investors

Component 2 – improvement in production quality, delivery and marketing thanks to cooperation with domestic and foreign customers

Component 3 – new markets and distribution channels thanks to foreign investors

Component 4 – technology modernization thanks to cooperation with domestic customers

Component 5 – contacts with domestic and foreign customers, investors and other firms in the industry thanks to participation in trade fairs

Component 6 – improvement in marketing and sales opportunities because of domestic customers

Component 7 – improved inventory management because of cooperation with other firms in the industry (domestic and foreign)

Component 8 – access to modern technologies because of cooperation with other firms in the industry (domestic and foreign)

Component 9 – new markets and distribution channels thanks to cooperation with customers (domestic and foreign)

Component 10 – new distribution channels thanks to participation in international trade fairs

Group 7. Role of outside organizations in innovation

Component 1 – formulating and developing innovations through cooperation with market research agencies and end-product customers

Component 2 – formulating, developing and implementing innovations in cooperation with domestic research institutes/labs

Component 3 – formulating, developing and implementing innovations in cooperation with domestic universities

Component 4 – developing and implementing innovations in cooperation with domestic end-product customers

Component 5 – developing and implementing innovations in cooperation with domestic consulting firms

Component 6 – implementing innovations in cooperation with industrial customers (domestic or foreign)

Component 7 – formulating innovation ideas in cooperation with industrial customers (domestic or foreign)

Component 8 – preparing innovation plans in cooperation with raw material suppliers (domestic or foreign)

Component 9 – formulating, developing and implementing innovations in cooperation with domestic technology suppliers
Component 10 – formulating innovations in cooperation with foreign end-product customers
Component 11 – developing innovations in cooperation with foreign technology suppliers
Component 12 – formulating innovations in cooperation with foreign universities

These factors are employed in the analysis contained in the next section, which examines the relationships between networks and competitiveness.

3.4. Effects of networking on competitiveness

For this analysis, we have used the ordered logit technique and the competitiveness indicators constructed in Section 3.2.3. The models are significant at the 1% level, unless stated otherwise. For all regressions in this paper, interpretation is as follows:

The threshold values indicate the cumulative logits when the independent values equal zero. The negative values for e.g. [CED = 1.4000] mean that the predicted probability of values of 1.4 or less on the dependent variable is smaller than for values greater than 1.4. The positive value for e.g. [CED = 1.5000] means that P(CED <=1.5)>P(CED >1.5) when all independent variables equal zero. The thresholds are necessary for calculating predicted values but are relatively uninteresting in themselves.

Negative coefficients for different variables indicate the positive influence of a given variable on the degree of competitiveness (the higher the value of the variable, the lower the probability of having higher rather than lower values of CED or CCD – which in turn, by construction of the indicators, means higher competitiveness) and vice versa.

We first present the results of partial regressions of CED and CCD on the type of ownership (domestic vs. foreign) and significant network activity components (Tables 3.50, 3.51).

The regression summarized in Table 3.50 shows that there are 8 factors statistically significant in explaining changes in the probability of having a higher or lower degree of competitiveness. All of the factors appearing in the regression influence the probability of having a higher degree of competitiveness positively (negative coefficients indicate a positive influence).

Table 3.50. Regression of CED on type of ownership and significant networking components (102 observations)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	own_foreign	-.726	.454	2.554	1	.110	-1.616	.164
	fac1_3	-4.477	1.634	7.504	1	.006	-7.680	-1.274
	fac3_3	-2.836	1.256	5.094	1	.024	-5.298	-.373
	fac6_3	-5.317	1.450	13.455	1	.000	-8.159	-2.476
	fac3_4	-3.837	1.306	8.626	1	.003	-6.397	-1.276
	fac5_4	-4.428	1.500	8.709	1	.003	-7.369	-1.487
	fac6_4	-11.838	5.597	4.474	1	.034	-22.808	-.868
	fac6_5	-3.751	.990	14.344	1	.000	-5.693	-1.810

Link function: Logit.

These results indicate that competitiveness is higher among foreign-owned firms, and that it can be improved by: cooperation with suppliers (including acquisition of foreign suppliers) in the areas of product design, access to modern production technologies and increasing production opportunities; cooperating with suppliers to improve inventory and delivery management; outsourcing related to obtaining new EU suppliers; obtaining technical assistance from customers; engaging in OEM cooperation and strategic alliances, and participating in trade fairs with customers and suppliers. What is conspicuously missing are factors related to R&D cooperation and cooperation with sister companies and subsidiaries, which did not turn out to have significant effects on the competitiveness of the Polish firms we studied.

A similar regression has been run for the second competitiveness factor, CCD (Table 3.51). The results are practically identical to those for CED.

Table 3.51. Regression of CCD on type of ownership and significant networking components (102 observations)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	own_foreign	-.915	.441	4.305	1	.038	-1.779	-.051
	fac1_3	-4.459	1.599	7.779	1	.005	-7.592	-1.325
	fac3_3	-2.034	1.209	2.830	1	.093	-4.404	.336
	fac6_3	-3.834	1.371	7.822	1	.005	-6.521	-1.147
	fac3_4	-3.350	1.263	7.038	1	.008	-5.825	-.875
	fac5_4	-3.571	1.442	6.135	1	.013	-6.397	-.745
	fac6_4	-10.788	5.463	3.899	1	.048	-21.496	-.080
	fac6_5	-3.730	.960	15.089	1	.000	-5.612	-1.848

Link function: Logit.

Next, we add non-network competitiveness determinants (NNCD) to the analysis and regress CED and CCD on ownership type, significant network components and significant NNCDs. The results are shown in Tables 3.52 and 3.53.

Table 3.52. Regression of CED on type of ownership, significant networking components and significant NNCD (71 observations)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	own_foreign	-.912	.599	2.317	1	.128	-2.086	.262
	fac1_3	-4.039	1.965	4.223	1	.040	-7.891	-.187
	fac3_3	-2.815	1.804	2.436	1	.119	-6.351	.720
	fac6_3	-3.707	2.091	3.141	1	.076	-7.806	.392
	fac3_4	-3.653	1.638	4.974	1	.026	-6.864	-.443
	fac5_4	-4.070	1.905	4.563	1	.033	-7.805	-.336
	fac6_4	-9.152	6.221	2.164	1	.141	-21.345	3.041
	fac6_5	-3.256	1.309	6.191	1	.013	-5.821	-.691
	fac1_nncd	9.567	3.460	7.645	1	.006	2.786	16.349
	fac6_nncd	-2.377	1.047	5.152	1	.023	-4.429	-.324

Link function: Logit.

The results of the previous two regressions are once again duplicated, and two additional factors are brought to light. These are the negative influence of work force growth and the positive role of training. The same regression was carried out on CCD (Table 3.53). The result is practically identical to that obtained for CED, with the exception that the role of training drops out.

Table 3.53. Regression of CCD on type of ownership, significant networking components and significant NNCD (71 observations)

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	own_foreign	-.562	.554	1.027	1	.311	-1.648	.525
	fac1_3	-4.737	1.921	6.082	1	.014	-8.502	-.972
	fac3_3	-1.544	1.726	.800	1	.371	-4.926	1.839
	fac6_3	-2.363	1.976	1.430	1	.232	-6.236	1.510
	fac3_4	-4.321	1.545	7.823	1	.005	-7.349	-1.293
	fac5_4	-3.316	1.792	3.423	1	.064	-6.829	.197
	fac6_4	-7.656	6.010	1.623	1	.203	-19.436	4.124
	fac6_5	-3.610	1.256	8.256	1	.004	-6.073	-1.148
	fac1_nncd	9.302	3.317	7.863	1	.005	2.800	15.804

Link function: Logit.

3.5. The role of local government and the non-profit sector

Another subject of our analysis concerns the role of local authorities and non-profit organizations in supporting enterprise-level competitiveness improvements. 61 companies, or 27% of the sample, reported having benefited from some sort of support from local government; 111, or 49% of the sample, reported benefits for their competitiveness resulting from contacts with non-profit organizations.

First, we look at various forms of support from local authorities (table 3.54). This most frequently takes the simplest form, that of tax incentives. Only three firms receiving such treatment were foreign-owned. 19 firms reported having received help from local authorities in ways not listed in the table; of these, only one was foreign-owned. Four of the 18 firms reporting that local authorities expedited formalities were foreign-owned.

We believe it is justified to conclude that the local government sector is playing a less active role in stimulating economic development than civil society. Perhaps this is to be expected, but we believe that Polish local officials should broaden the range of instruments they use to attract investment. As discussed in Dunin-Wąsowicz et al. (2004), some of the instruments that seem to be more efficient than tax incentives include investment in infrastructure and spatial planning allowing the authorities to provide information about possible investment sites quickly and effectively to investors.

Table 3.54. Forms of support from local authorities (%)

Form of support	%
Local tax reductions / holidays	16.3%
Reduction or waiver of rental fees	0.9%
Assistance in negotiations with central authorities	2.2%
Transfer of land for free or at a reduced price	1.3%
Taking over burdensome property	5.3%
Expediting the necessary formalities	7.9%
Other	8.4%

Table 3.55 illustrates the extent of beneficial contacts with various forms of non-profit and public organizations for the sample as a whole, and the following two tables illustrate breakdowns by industry and by ownership. We see the clear dominance of private business organizations such as industrial associations, local or regional business associations, chambers of commerce, and employers' associations, over public organizations. Among the latter, loan guarantee providers were listed by one firm, and enterprise incubators by none. These services, when available, are usually offered by local or regional development agencies, which are generally majority owned by voivodeship and/or local authorities, sometimes with some private capital participation. Aid from such agencies was reported by 11.5% of the Polish sample.

As early as 1993 there were approximately fifty regional development agencies, and by 1996, their number had risen to 66. Most operate as for-profit companies (although a few are registered as foundations), the most significant shareholders generally being voivodeships, the Industrial Development Agency and local governments. In some cases private businesses also invested in the agencies. The agencies have frequently had to struggle with the problem of insufficient funds available for regional development

programs, and have therefore often engaged in commercial activities in order to raise such funds (Gorzelak, 1998). There appears to be a consensus among experts that there was a high degree of differentiation in the effectiveness of these agencies in carrying out their stated missions. Given the significant level of local government involvement in these organizations, encouraging a benchmarking process allowing for mutual learning leading to the increased effectiveness of these organizations would likely be a valuable part of a good strategy for generally increasing the effectiveness of local governments in stimulating economic development.

Table 3.55. Contacts with non-profit organizations

Type of organization	%
Industrial associations	32.2%
Employers' associations	9.7%
Local or regional business associations	13.2%
Local or regional development agencies	11.5%
Enterprise incubator	0.0%
Institutions providing loan guarantees	0.4%
Chambers of Commerce	14.1%
Embassies	5.3%
Other	4.4%

Our case studies also provide some insights here. We found the co-operation of two auto parts producers with chambers of commerce and Polish embassies to be instrumental in their establishment of subsidiaries in Ukraine. Additionally, a foreign-owned pharmaceuticals firm said that it does *not* co-operate with industrial and employers' associations because foreign-owned companies are not treated on equal terms with other members by such organisations. For this reason, its contacts with the embassy and chamber of commerce of its mother company's country of origin are more important. The first case may represent a model worthy of attention and efforts at replication, while the second may represent a problem of various sorts of Polish business associations which needs to be rectified if they are to fulfil their functions as modern organisations in a global economy.

4. Summary and conclusions

Competitiveness

Exports. Foreign-owned companies seem to have the most intense export activity. Consistently with national manufacturing data, the two consumer goods industries seem to focus quite strongly on the domestic market, while the two industries with a higher share of production of intermediate goods have more export activity. Export revenues seem to be growing robustly in all industries except food and beverages. However, with the exception of pharmaceuticals, exports to the EU-15 countries have been growing at much lower rates. The automotive industry is by far the most export intensive, whereas the two consumer goods industries – pharmaceuticals and food – are the least export intensive.

Financial performance. With respect to the growth in total revenues and sales revenues, we observe very strong differentiation within the industries, with pharmaceuticals having the least variance. Automotive and pharmaceutical companies seem on the whole to have the best performance here, with food and electronics firms on the whole having rather negative performance (but with spectacular exceptions); again, this is consistent with national data. We observe the highest ratio of revenues to costs in pharmaceuticals; in the other industries, it does not seem to be strongly differentiated. It is therefore not surprising that pharmaceuticals companies have best gross profitability (which is, of course, characteristic of this industry world-wide). In general, gross profitability is low and falling (only in electronics is it stable). Wages represent a small portion of total costs, with the lowest proportion in the food and beverages industry; however, this proportion is growing in all industries.

Ownership type seems to be a strong differentiating factor here. With respect to sales and total revenues, the state-owned companies have performed quite poorly. Foreign-owned companies have had by far the best performance, followed by domestically owned private companies. The increase in export revenues is less strongly differentiated, being largely positive across various ownership groups. Export intensity, however, is again strongly differentiated – not surprisingly, the foreign-owned

companies have the highest indicators here (though it is perhaps worth noting that the state-owned sector does not do badly here, comparing favorably with domestic private companies). The situation with regard to export in general is mirrored almost exactly with respect to export to the EU. The ratio of revenues to costs is strongest among companies in the "other" category, followed by foreign-owned companies, and worst in state-owned companies; this situation is very similar with respect to gross profitability. Gross profitability is generally in decline in the period examined (which was one of decline for most of Polish manufacturing), most strongly among state-owned enterprises. Contrary to what one might expect, state-owned companies do not have the highest share of labor costs in total costs; rather, the companies with dispersed ownership and foreign individual ownership do.

Evaluation of own product and technological competitiveness. Typically, a quarter to a third of the sample in all industries sees itself as weak on international markets, with respect to both products and to technology. The same pattern is found in the breakdown by ownership. However, there is also a small group of leaders in each industry which consider themselves to be very competitive internationally; this group is largest for products in electronics and for production technologies in pharmaceuticals. Self-evaluations for the domestic market are also strongest in electronics and pharmaceuticals. The self-proclaimed leaders in international product competitiveness are firms owned by foreign individuals, and the leaders in international production technology competitiveness are firms owned by both foreign individuals and foreign corporate investors. We find exactly the same pattern for both product and production technology competitiveness in the domestic markets.

Innovation and patents. In this sample, there appears to be no trade-off between product and process innovation: the patterns are the same for both. The automotive industry is the leader, followed by electronics and pharmaceuticals (again, the relatively poor showing of this industry is surprising, especially given the high self-rated level of competitiveness in this industry), with food and beverages in last place. The automotive and electronics companies are well ahead of the pharmaceuticals firms (not to mention food and beverages) in innovations on international markets. Strangely, the strong performance of the automotive firms is not reflected in their ratings of their own competitiveness. The differences tend to be less pronounced across ownership groups, suggesting that innovation is more strongly determined by industry than by ownership. Firms owned by foreign individuals have the best performance, followed by those owned by domestic individuals and foreign companies. This reflects the competitiveness self-rating patterns with respect to ownership. Electronics companies have the best performance in the area of patent applications, followed by

pharmaceuticals with respect to domestic applications and automotive companies with respect to international applications (note that pharmaceutical companies are in third place with respect to international patent applications!). The relatively strong performance of the state sector and of firms with dispersed ownership (i.e., the firms with presumably the weakest corporate governance) contrasts with the performance of foreign-owned firms, whose level of patent activity is not distinguished. However, the performance of the latter is very likely due to concentration of intellectual property related activity in the home country.

Investment. Both electronics and pharmaceuticals have seen declines in investment spending, whereas the food and automotive industries are seeing growth in investment.

Employment growth and skill structure of work force. Total employment growth has been least differentiated in pharmaceuticals, which also seems to have the strongest performance, while the other three industries seem to be extremely heterogeneous. There is strong heterogeneity within ownership groups as well, though the performance of the state-owned sector and companies without controlling owners seems to have been fairly consistently poor, while companies owned by foreign individuals saw strong employment growth. Thus, there may be grounds to believe that this measure is more sensitive to corporate governance factors than to industry specifics.

Using the share of white-collar employees and technical staff in total employment as a measure of the skill level of the work force, we find electronics and pharmaceuticals to have the highest measures. Employment in the most highly skilled groups seems generally to be growing at a higher rate than total employment. Differences in the share of skilled employees in total employment across ownership groups seem to be much less striking than the cross-industry differences, with the exception that foreign-owned companies seem to have much smaller technical staffs. Similarly, if we look at growth in employment of those groups considered to be most highly skilled, all ownership groups except the foreign-owned companies seem to perform poorly. However, growth in the skilled work force was slower for the foreign-owned companies than total employment growth, reflecting the aforementioned low share of such employees in the work forces of those companies.

It comes as no surprise that the industries with high R&D and patent intensity also seem to value training the highest, and it is also not surprising that the importance of employee training is rated well below that of management training, especially in food and beverages, the least knowledge-intensive industry. With respect to ownership, once again state-owned companies rate the importance of training particularly highly; so do companies owned by foreign individuals (managerial training is also very important in

widely-held firms, which is hardly surprising, given that these are the companies with the most managerial latitude due to lack of a controlling owner). Again, managerial training is seen as more important than employee training.

Certification. As one would expect, ISO certification is most prevalent in industries dominated by companies producing intermediate goods, with only about a third of the companies in the industries producing consumer goods – food and beverages and pharmaceuticals – being certified. The low level of CE certification gives cause for concern, indicating that EU export markets may not be very important for the firms in the sample (at least in the case of consumer goods producers) – and indeed, over half of the firms in the two consumer goods industries report no export to the EU. With respect to industry-specific certificates, such as HACCP and GMP, the food and beverage industry seems most advanced. There appears to be little significant differentiation across ownership groups, except for the fact that firms owned by domestic individuals seem to obtain ISO certification less than other ownership groups (the ownership category "other" also seems to be exceptional for some reason).

Quality control and R&D facilities. Differences across industry and ownership groups with respect to whether a company has a quality control lab or not (almost all firms do) are much smaller than differences with respect to whether it has an R&D or design unit or not. Less than one in five food and beverage companies have such a unit; almost half of the automotive industry companies do, and a majority of pharmaceuticals and electronics companies have such a unit (interestingly, a significantly higher proportion of electronics companies have such units than is the case in pharmaceuticals). There is virtually no difference between companies owned by foreign and domestic companies with respect to whether they have R&D or design units.

Overall competitiveness indicators. With respect to both overall competitiveness and competitiveness determinants (i.e., work force growth, share of export revenues in total revenues, high profits and low outside costs, share of high-skilled work force in total employment), the electronics firms do best; the automotive industry is second, followed by pharmaceuticals, with the food industry in last place. When we look at individual components of competitiveness, we see that the electronic industry has the highest values of three competitiveness components (self-evaluation of competitiveness, innovation and domestic market share), whereas the automotive industry is the most competitive sector with respect to factors involving international components.

Networks

Suppliers. The food and beverage industry relies much more heavily on the domestic market for its supplies than do the other three industries. The European

Union decidedly dominates as the source of supplies outside Poland. The pharmaceuticals industry seems to be the only one with significant foreign supply relationships outside the EU. We see no significant differences with respect to different ownership groups, apart from the fact that the foreign-owned firms seemed to use EU supply markets somewhat more intensively than others (though the difference is far smaller than one might expect).

Various types of cooperation and their benefits. There is a clear dominance of arm's-length relationships like OEM and subcontracting over equity-based relationships (acquisitions, joint ventures) and strategic alliances; surprisingly, however, licensing does not appear to be particularly popular. Technical assistance is also a widespread form of cooperation. Most forms of cooperation (except for subcontracting and technical assistance) seem to be more frequent with customers than with suppliers (and among customers, more frequent with domestic ones than with foreign ones). There is less industry differentiation in the area of cooperation with suppliers. Electronics firms engage in these types of cooperation most frequently, food and beverage firms least frequently. There is little cooperation with competitors, but somewhat more with domestic competitors than with foreign ones. As one would expect, foreign-owned companies more frequently cooperate with foreign partners than do domestically owned companies. Interestingly, we see that cooperation with domestic competitors is most frequently engaged in by foreign-owned companies. State-owned companies and foreign-owned companies are notable for OEM and technical assistance relationships.

Firms benefit most frequently from cooperation with suppliers, then customers, and then other firms in the industry, with investors being listed very infrequently. Benefits from cooperation with domestic partners are cited more often than benefits from cooperation with foreign partners, reflecting the greater frequency of the former.

Cooperation with suppliers yields benefits most frequently in the areas of timeliness and terms of delivery and product quality improvement. State-owned companies and companies owned by foreign individuals noted benefits from such cooperation more frequently than other types of companies. The latter benefit chiefly in the areas of employee training, product quality, and modernization of production equipment. State-owned companies also note product quality, timeliness and terms of delivery, and modernization of production equipment (note the high level with which cooperation with foreign partners is mentioned).

With respect to *cooperation with customers*, benefits are perceived most frequently in product quality improvement, timeliness and terms of delivery, and access to new markets (in order of frequency with which they were named by respondents). Foreign-

owned companies note benefits more frequently than other companies in the areas of improved product quality and improvements in production process (as one might expect, there is a high frequency of benefits from cooperation with foreign customers). Companies with foreign corporate owners also noted improved access to modern technologies as a benefit more frequently than other companies. State-owned companies are notable for benefiting from cooperation with customers in the area of product specification and design. Improved marketing is an area of benefits noted particularly frequently by companies owned by the state and other domestic companies, which also mention cooperation with foreign customers relatively frequently. Companies owned by the state and by other domestic companies note benefits from foreign cooperation as frequently as foreign-owned companies in the area of access to new markets.

Given that firms generally have a good deal fewer investors than customers and suppliers, benefits from *cooperation with investors* are noted much less frequently than benefits from cooperation with customers and suppliers; however, those benefits come most frequently in the areas of access to finance, modernization of production equipment, and product quality improvement. Benefits from cooperation with investors are most frequently noted by pharmaceutical companies. It is interesting that companies owned by foreign individuals almost never cite cooperation with their investors as a source of benefits; by contrast, companies owned by foreign corporate investors note cooperation with investors as a source of benefit more frequently than any other companies (interestingly, they frequently mention cooperation with *domestic* investors). We observe the opposite situation among domestically owned companies: companies owned by domestic individuals cite cooperation with investors much more frequently than companies held by domestic companies.

Benefits from *cooperation with other firms in the industry* are found most frequently in employee and management training, product quality improvement, modernization of equipment and improved access to modern technologies. Again, not surprisingly, electronics firms most frequently note benefits from cooperation with all types of partners, except investors (since they most frequently engage in it); food and beverage firms note them least frequently. Electronics firms also frequently note the benefits of cooperation with foreign suppliers. There appears to be virtually no significant differentiation by type of ownership.

Cooperation in innovation and R&D. In R&D activity, the group most often cooperated with is clearly suppliers of raw materials; a majority of firms in all industries except food and beverages cooperate with them. Only pharmaceuticals companies cooperate with another group more frequently (domestic universities). The

next two groups most frequently cooperated with are public domestic research institutes and machinery and equipment suppliers. Domestic universities are also important for the electronics and pharmaceuticals firms; these two industries are also the ones most intensively involved in R&D cooperation. The food and beverage firms seem to cooperate least frequently, probably reflecting their low level of R&D activity. There is little of interest to say about the breakdown with respect to ownership; what seems noteworthy is the relatively high propensity of the state-owned companies to work with universities, both domestic and foreign (with the latter even more frequently than foreign-owned companies), and, as one might expect, the propensity of foreign-owned companies to work with foreign private research institutes.

If we look at subcontracting relationships in R&D, we observe, first, that this type of relationship is rather rare (much rarer than cooperation), and second, that it is strongly concentrated in domestic research institutes and universities. Quality control is the most popular area for subcontracting, and is particularly favored by the two consumer goods industries – pharmaceuticals and food and beverages. With respect to ownership, we note that companies owned by corporate investors (both domestic and foreign) engage in scientific research more often than others, and subcontracting of design work is favored by state-owned companies and companies owned by domestic industrial companies.

Looking at types of R&D work done in-house, we see that quality control is named most frequently (as noted above, it is also the most frequently subcontracted). Product and process development are also named very frequently. Electronics firms, which cooperate and subcontract most frequently in the R&D area, also do in-house work in this area most frequently. Likewise, food and beverage companies, which cooperate and subcontract least frequently in the R&D area, also have the lowest propensity to do in-house work in this area. Differentiation across ownership groups is generally not as strong as differentiation across industry.

The pattern is the same with respect to cooperation in the innovation process: Generally electronics firms cooperate more often than companies in other industries in all stages of the innovation process, whereas the food companies engage in the least cooperation. There is a trend to cooperate most in the early stages of innovation and less in later stages, with an increase in cooperation at the end of the process, when results are evaluated. This is the same across all industries. With respect to ownership, state-owned enterprises are clearly the least cooperative in innovation, but other ownership groups are not strongly differentiated.

The most important partners in the innovation process are domestic research institutes and labs (most frequently mentioned by electronics firms, followed by

pharmaceuticals and then automotive companies, with food and beverage producers cooperating least) and domestic industrial customers. The importance of the latter is much greater for producers of intermediate goods (automotive and electronics industries) than for producers of consumer goods. Companies owned by foreign individuals cooperate with this group very seldom; state-owned companies are also relatively weak in this form of cooperation. Cooperation with foreign industrial customers is much less frequent, and is named significantly more often by electronics companies than by companies in other industries. Again, companies owned by foreign individuals very seldom cooperate with this type of partner; interestingly, however, state-owned companies do so relatively frequently.

Cooperation with domestic end-product consumers is relatively undifferentiated across industry, except that in the case of pharmaceuticals companies it is limited more strongly than in other industries to the first (formulation of idea) and final (evaluation) stages of the innovation process. With respect to ownership, again we observe very weak cooperation among companies owned by foreign individuals. Cooperation with foreign end-product consumers is named frequently only by electronics companies, though there is also some propensity for pharmaceuticals companies to such cooperation in the first phase of innovation. Looking at the breakdown by ownership, it is interesting to note that domestic companies cooperate much more frequently with foreign end-product consumers than do foreign-owned companies.

Both domestic and foreign raw material suppliers are fairly important partners in the innovation process for electronics companies (and are also named by some pharmaceutical companies for the information collection phase). With respect to ownership, we again observe the weakness of companies owned by foreign individuals in this type of cooperation. In particular, state-owned companies cooperate relatively frequently with domestic suppliers.

Domestic technology suppliers are relatively more important for electronics and food manufacturers than for companies in other industries. Foreign technology suppliers are also relatively important for electronics producers. Looking at the breakdown by ownership, we see relatively little differentiation with respect to domestic technology suppliers, except that companies owned by foreign individuals never cooperate with this type of partner. Foreign technology suppliers appear to be relatively more important for foreign-owned companies than for other companies.

Links with "sister companies" – i.e., companies owned by the same owner as the respondent company – are most frequent in the automotive industry. They are much more important for foreign-owned firms than for domestically owned firms. In general, there has been very little acquisition of subsidiaries by the respondent companies.

Respondents seem to believe that their partners have benefited from cooperation with them more often than they have benefited from cooperation with their partners. However, the areas in which they believe benefits have most frequently accrued to their partners are largely the same as the areas in which they believe themselves to have benefited most frequently. Generally, they believe that customers have benefited more frequently than suppliers. The most frequently named areas of benefits for customers are product quality, timeliness and terms of delivery, employee training and marketing. The most frequently named areas of benefits for suppliers are timeliness and terms of delivery, product quality, and inventory management.

How networks and other factors affect competitiveness

Generally, our regression results indicate that cooperating with different partners makes the firm more competitive. More specifically, we see a strong positive link between competitiveness and the following forms of cooperation:

- cooperation with suppliers (including acquisition of foreign suppliers) in the areas of product design, access to modern production technologies and increasing production opportunities,
- cooperating with suppliers to improve inventory and delivery management,
- outsourcing related to obtaining new EU suppliers,
- obtaining technical assistance from customers,
- engaging in OEM cooperation and strategic alliances, and
- participating in trade fairs with customers and suppliers.

It is interesting to note, however, that factors relating to R&D cooperation and cooperation with sister companies and subsidiaries did not turn out to have significant effects on the competitiveness of the Polish firms we studied.

With respect to internal determinants of competitiveness, work force growth seems to be inversely related to competitiveness in the sample, while there may be a positive relationship between competitiveness and investments in human capital in the form of training.

The number of years since foundation and number of years since acquisition are not linked to the degree of competitiveness. However, foreign ownership seems to be positively related to competitiveness.

Policy implications

Concerns are often raised that foreign investors may supply themselves in foreign markets to an extent which minimizes the benefits to the domestic economy from their

presence. However, the evidence presented here does not seem to point to the presence of such a problem in the four Polish industries examined. If we look, for example, at the proportions of supplies obtained from the domestic market by companies owned by foreign industrial investors and domestic industrial investors, we find that they are almost identical. This suggests the need for skepticism regarding calls for the creation of new, or extension of any existing, requirements regarding domestic content.

While there is little difference between domestically owned and foreign-owned companies with respect to the propensity to innovate, it is not clear what the policy implication of this observation is. It could mean, for example, that there is no need for a policy of attracting foreign investment in order to stimulate innovation in the Polish economy. But it could also mean that Polish policy on foreign investment, while focusing on medium-term employment guarantees and the like, has to date placed too little priority on attracting investors with a high propensity to innovate (our analysis suggests, for example, that foreign-owned companies have an unremarkable level of activity with respect to training).

We do observe significant differences across industry with respect to innovativeness, suggesting that any national innovation policy, in order to be successful, would have to take into account these industry differences. But we are unable to answer the questions whether a post-Communist state like Poland's, with its limited capacity and high rate of corruption, can handle the challenge of constructing such a fine-tuned policy well, or in what ways the design of such a policy would need to reflect the constraints of EU competition policy.

We observe the local government sector playing a less active role in stimulating economic development than civil society organizations. This is not in itself is necessarily a problem, but we believe that Polish local officials should broaden the range of instruments they use to attract investment, shifting their focus from tax incentives to other methods. In particular, given the high level of involvement of local and regional authorities in local and regional development agencies, we believe it would be beneficial if these authorities organized a benchmarking system allowing for mutual learning about how to increase the effectiveness of these organizations in stimulating development.

Our analysis shows that the (almost entirely public) science and technology sector in Poland is playing a role of some importance for industry. Thus, the situation with regard to linkages between the S&T sector and industry in Poland may not be quite as bleak as many critics have implied in the past.

It seems safe to say that the low level of innovation-related cooperation in the state-owned companies represents a weakness in this ownership group. In general, the patterns of co-operation with R&D institutes and universities seem to develop mostly along the lines one would expect, with the more science-based industries (electronics and pharmaceuticals) engaging in significantly more cooperation than in the case of the other two industries, and industrial R&D institutes engaged more often in co-operation related to applications than is the case in the more theory-oriented universities. Importantly, we do not have the data which would allow us to comment on the dynamics of these relationships.

Another caveat concerns the fact that while the results of regressions of competitiveness measures on measures of network activity and other factors indicate that competitiveness can be improved by various forms of co-operation, what is conspicuously missing are factors relating to R&D cooperation and cooperation with sister companies and subsidiaries, which did not turn out to have significant effects on the competitiveness of the Polish firms we studied.

The low level of CE certification, even among firms from industries whose products require such certification in order to be sold on EU markets, suggests that the European Commission might be well advised review the policy requiring CE certification, to determine to what extent the requirements are genuinely respected in practice in the new member states. If a problem is identified in this area, it is likely that the doubtful benefits to consumers do not justify the continued existence of these certification requirements.

Bibliography

Central Statistical Office (2001), *Rocznik statystyczny 2001* (Statistical Annual 2001). Warsaw.

Central Statistical Office (2002), *Rocznik statystyczny 2002* (Statistical Annual 2002). Warsaw.

Central Statistical Office (2003), *Mały rocznik statystyczny 2003* (Concise Statistical Annual 2003). Warsaw.

Dunin-Wasowicz, S., Górzyński, M., Woodward, R. (2004), Integration of Poland into EU Global Industrial Networks: The Evidence and the Main Challenges, in F. McGowan, S. Radosevic, N. von Tunzelmann (eds.), *The Emerging Industrial Structure of the Wider Europe*, London: Routledge.

Gorzelak, G. (1998), *Regional and Local Potential for Transformation in Poland*, Warsaw: European Institute for Regional and Local Development.

Gorzelak, G., Jalowiecki, B., Kuklinski, A., Zienkowski, L. (1995), *Eastern and Central Europe 2000: Final Report*. Brussels: European Commission.

Kraslawski, A., Gajewski, M. (2000), *Development of a National and Regional Innovation System for Poland*. CNA Veneto Euro-In Consulting, Danish Technological Institute, and Uniconsult. Prepared for the Phare Sci-Tech II Programme (Phare PL96.11.02.05).

Radosevic, S. (1999), Patterns of innovative activities in countries of Central and Eastern Europe: An analysis based on comparison of innovation surveys. SPRU Electronic Working Papers No. 35, Brighton: University of Sussex.

Radosevic, S. (2004), What Future for Science and Technology in Central and Eastern Europe in the 21st Century? In W. Meske (ed.), *From System Transformation To European Integration: Science And Technology in Central and Eastern Europe at the Beginning of the 21st Century*, Münster-Hamburg-Berlin-Vienna-London: Lit Verlag.

Woodward, R.; Yoruk, D.E.; Bohata, M.; Fonfria Mesa, A.; O'Donnell, M., Sass, M. (2005), The role of networks in stimulating innovation and catching-up in European enterprises: A literature review, *Opere et Studio pro Oeconomica* vol. II no. 1.