Pol. J. Environ. Stud. Vol. 20, No. 6 (2011), 1531-1539

Original Research

Export Competitiveness of Polish Environmental Products in Select Manufacturing Sectors

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Received: 22 December 2010
Accepted: 7 June 2011

Abstract

Since Poland entered the European Union six years ago, many activities have been undertaken to protect the natural environment, and to put industry on a path toward sustainability. While the creation of environmental products is a long-term process, it can increase the competitiveness of the different industrial sectors and the economy. The aim of our paper is to analyze the competitiveness of environmental goods and services in nine selected manufacturing sectors in Poland to assess their export potential, primarily in third markets, including developing countries (DEV), by calculating RCA, IMP, RTA, and CR indexes. Conducted analysis proved that in recent years Poland had no comparative advantages over DEV in the field of environmental goods compared to OECD countries. It was also shown that increased outlays for environmental protection and the development of environmental technologies is an opportunity to make the analyzed sectors more competitive on the international market.

Keywords: comparative advantage, environmental goods, manufacturing sectors, international trade

Introduction

Worldwide development, competitive access to essential import markets and growing awareness of the ecological problems associated with business activity set new challenges for European exporters and open new opportunities as well. The most recent programs of the global organizations and EU strategies all emphasize the necessity to introduce environmental technologies [1], rational use of natural resources, and to create environmental-products, all with the objective of improving the competitiveness of the economy. Moreover, the promotion of international trade in environmental goods and services and liberalization of trade can help disseminate green technology, thus supporting adaptation to a low-carbon economy while building on and further developing European competitiveness in environmental sectors [2].

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Competitiveness may be defined in different ways. According to the definition approved by the OECD, competitiveness means the ability to generate relatively high incomes from manufacturing sectors and a high employment level in conditions of international competition [3, 4] over a long period. Therefore, competitiveness may be understood as success in markets, which results in general growth of prosperity. Whereas a competitive product is a product that constitutes a more advantageous offer than its alternative in respect to a certain criterion, which may be either price, quality or any other characteristic, a competitive export of goods and services may be connected with its dynamics, size, and share in the imports of a given country. From this point of view, high export dynamics for a given merchandise with a considerable volume of deliveries, and a significant share in the market, may prove to have high or increasing competitiveness. Studies completed so far on the changing competitiveness of products and goods resulting from action taken to protect the environment were based on theoretical solutions [5]. There is more and more evidence

that environmental protection affects a general increase in the competitiveness of the EU economy, enterprises, and products themselves. In the ecological industry alone, the EU-25 reached a turnover of 227 billion Euro in 2007, of which 214 billion Euro was the share of the EU-15 countries. Goods and services for this industry in the EU-25 contribute approximately 2.2% to GDP (Gross Domestic Product). The largest shares of the ecological industry market are held by enterprises in France, Germany, Great Britain, Italy and Holland. The share of the new member states is only 5.7% (half of it in Poland) [6]. This is a result of development in most of these countries' intensive industrial sectors in central planned economies, as well as just after transformation the result of foregn direct investments located mainly in manufacturing sectors (chemical, non-metallic) [10]. It could be in accordance with pollution haven hypothesis, which assumes that environmental regulations have a strong effect on industrial location. On the other side in the economic literature there is the competing factor endowment hypothesis, which asserts that it is not differences in pollution policy, but differences in endowments or technology that determine trade [11]. Numerous studies based on both hypotheses have analyzed the relationship between trade and the environment [7-9]. However, there is a lack of such models that taking into account countries from former central planned economies and environmental goods (according to the OECD definition, i.e. the ecological products and services industry includes "goods and services used for measurement, prevention, limiting, minimizing, or improving water, air, and soil quality, and helping to solve problems related to waste, noise, and ecosystems").

The purpose of this article is to analyze the competitiveness of environmental goods and services in selected manufacturing sectors to assess their export potential, most of all in third markets, including developing countries (DEV). The analysis was based on data ordered from statistical offices and should provide answers to the question as to whether increased outlays for environmental protection, the development of environmental technologies, and the environmental services sector, and the expanding export of broadly understood environmental goods and services, provide an opportunity to make it more competitive. Analysis was based on the following indexes: RCA – revealed comparative advantage (concerning exports), IMP – import penetration index, RTA – relative trade advantage index, and the CR index – concentration ratio. Taking into account the above, it is important to analyze the potential of the different manufacturing sectors paying special attention to the opportunities and risks. This may complete the range of research carried out so far, adjusting the conditions provided to the opportunities for strategic environmental management. The following sectors were included in the scope of the analysis:

- Agriculture and food
- Automotive
- Electric and electronics
- Wood-based
- Glass
- Chemical
- Plastics and rubber
- Light
- Construction materials

The analyzed manufacturing sectors produce more than 10% of the Polish Gross Domestic Product (GDP), create more than 2 million jobs, and have a high sales value. In 2007 the estimated GDP of these sectors varied between 8 and 39 million PLN, employment between 33,000 and 452,000 people, and sales value between 7.2 and 153 billion PLN. The leaders in terms of amount of turnover are agriculture, food, and automotive, followed by wood-based, electric and electronics, chemical, construction materials, plastics and rubber, and light sectors. The agriculture, food, and wood-based sectors dominate as regards employment and the amount of added value that results. All of the analyzed manufacturing sectors showed a trade surplus with the highest export values attained by the automotive, wood-based, electric and electronics, and plastics and rubber sectors. Sectors such as electric and electronics, plastics and rubber, and glass demonstrated a trade surplus in environmental goods as well as the highest proportion of these goods in the total export of goods of a given sector. This ranged from 5% to 8%, and the contribution of the value of environmental goods in total exports ranged from 0.08% to 5.6%.

Analysis of those selected manufacturing sectors, which have the greatest potential for development in the contemporary world economy (high technology, medium-high technology, medium-low technology, low technology) [12], and thus are important from the political and strategic point of view in Poland (since they have a growing and relatively high share in GDP), indicates that the highest outlays for environmental protection have been allocated by agriculture and food, wood-based, and the construction materials, plastics, and rubber sectors.

Expenditure on Environmental Protection as the Base for Producing Environmental Goods

Investments in ecological technologies promote the development of companies, resources, and opportunities that are the basis of competitive supremacy [13, 14]. Economists who have studied technological change agree that the rate and direction of innovation is affected both by exogenous "technological opportunity" and by the endogenous expected rate of return to particular innovations [15-17].

In the literature there is also a debate on the dependencies between actions taken for environmental protection and competitiveness [18], especially in the manufacturing sectors [5]. It is emphasized that investments in action in favour of the environment (e.g. technologies for managing resources), among other things will contribute to the development of innovation, learning, and the integration of the organizations concerned [19]. Enterprises that develop their potential in the environmental protection field are able to obtain better financial results. There are already companies

in Europe that are leaders in some ecological solutions (e.g. wind energy) [20], but their position is under threat from rivals in China, North America, and Japan. For example, Japan has decided to reach the position of world leader in the field of energy-saving technologies with special support from the "top-runner" program, while Canada has announced an ambitious strategy on environmental technologies supported by a budget of $1 billion CAD [6]. Europe may also achieve a leading position in the world environmental technology market that will be of interest to other countries. First steps in this direction have already been taken. Great Britain and Austria have stated that ecological innovations and environmental technologies foster economic growth and create new jobs. During its leadership of the EU, Finland promoted a "new generation ecological policy" based on ecological efficiency and ecological innovation [21]. Germany called on its partners to conclude a "new agreement" on environment, economy, and employment [22]. In addition, legislation on environmental protection significantly affects innovation and the development of technologies, which allows companies to achieve considerable cost reductions [12].

The result of the survey conducted in Poland in 2006 confirmed that 90% of enterprises have been interested in implementation of proecological solutions [23]. The legal aspects (25% of respondents) associated with the need to meet increasing regulatory requirements, financial factors (25%, i.e. the reduction in production costs or reduction of environmental fees and penalties), and increasing environmental awareness of employees and company management (19%) are the main factors motivating the implementation of procecological investment.

Poland has its own programs for cleaner production and eco-innovation. The Operational Program Infrastructure and Environment program increases the investment attractiveness of Polish regions through the development of technical infrastructure, which simultaneously protects and improves the environment. A total of € 37.6 billion was allocated to this program for 2007-13. Other Polish funds support studies and investment on environmental protection, but subsidies for eco-innovation projects are still relatively low.

In Poland in 2006-08 eco-innovative activities have introduced a total 26.2% of industrial enterprises and 15.5% of companies in the services sector [24]. Mostly as a reason for the introduction of eco-innovations, included are already existing regulations on the environment (as indicated by 11.2% of surveyed enterprises in industry and 6.2% of the enterprises in the services sector) and also expected future environmental regulations (7.2 % in industry and 3.4% in the services sector). The level of expenditure for environmental protection in Poland (including expenditure on fixed assets and current costs in the public and privet services related to environmental protection and households) increased from 31.8 billion PLN (2004) to 39.7 billion PLN (2007), while their share in GDP remained at an unchanged level, 3.4%, compared to 2004. Between 2004 and 2007, expenditure on fixed assets used for environmental protection purposes increased by 40% (7.5 billion PLN). In 2007 the highest growth of costs concerned protection from air pollution and waste management. For a few years now, the distribution of expenditure has been as follows: highest expenditure allocated to sewage disposal and water protection (over 60%), with smaller amounts for atmospheric air and climate protection (ca. 22-44%), and waste management (12-14%).

The financing of fixed assets for environmental protection comes primarily from the investors' own resources, hovering around 50% (in 2004 – 48.1%, in 2007 – 47.6%). Ecological investment funds (credits, loans, and subsidies) constitute another source of financing – their share ranges from 24.1% (2004) to 20.9% (2007), with additional small amounts of funding from central, voivodeship, district, or borough budgets. Between 2004 and 2007 they showed a slight tendency to grow – from 2.8 % to 3%. A considerable increase in the proportion of funds coming from foreign structural funds observed during the first period of spending (2004-06) dropped to 14.8% in 2007 [25]. This was probably the result of preparing for another period of EU funds programming (2007-13).

Expenditure on environmental protection in 9 selected manufacturing sectors in the period 2004-07 ranged from 444 to 606 million PLN. The highest sums for this purpose were allocated by the construction materials, agriculture and food, wood-based, and chemical sectors (Table 1).

Analyses also take into account data from the Central Statistical Office of Poland, which allow one to separate so-called "end-of-pipe" projects and "integrated undertakings." The first do not interfere in the production process but reduce or neutralize contamination generated during the production process, whereas the purpose of the second is to modernize manufacturing processes so as to ensure that they become cleaner and more environmentally friendly. In 2007, the share of "end-of-pipe" investments in expenditure on fixed assets used for environmental protection purposes in the selected sectors was over 88% (457.5 million PLN). The value of investments in integrated technologies was over 59 million PLN (Fig. 1) in 2007. In the group examined, the highest sums for "end-of-pipe" investments were allocated by the light sector (190.2 million PLN), and for integrated technologies – by the agricultural and food sectors (22.15 million PLN).

Assessment of Foreign Trade in Polish Goods and Environmental Services

Increasing expenditure on environmental protection promotes the development of ecological activity, the level of export of domestic goods and import of foreign goods, and the competitiveness of economic entities. Ecological activity in the sectors discussed covers goods and services used to measure, prevent, and minimize environmental pollution, including water, air, and soil pollution. According to the OECD definition, the ecological products and services industry includes "goods and services used for measurement, prevention, limiting, minimizing, or improving water, air, and soil quality, and helping to solve problems related to waste, noise, and ecosystems." The products and

Table 1. Expenditures for fixed assets used for environmental protection purposes in selected sectors in 2004-07 (current prices, million PLN), and the share of expenditures for fixed assets used for environmental protection purposes in total outlays for fixed assets (in %).

Manufacturing sectors	2004		2005		2006		2007	
	mln PLN	%	mln PLN	%	mln PLN	%	mln PLN	%
Agriculture and food	137.5	2.04	96.5	1.61	138.8	2.11	112.0	1.57
Automotive	12.8	0.38	9.6	0.29	10.3	0.37	6.8	0.14
Electric and electronics	11.0	0.70	23.4	1.63	18.8	0.62	15.5	0.43
Wood-based	43.5	1.09	79.4	1.93	57.6	1.35	86.5	1.66
Glass	27.6	no data	12.7	no data	31.6	no data	3.7	no data
Chemical	124.5	4.80	308.9	11.74	84.5	3.61	72.2	2.62
Plastic and rubber	21.6	0.94	10.1	0.36	5.9	0.17	19.2	0.49
Light	6.3	0.64	4.2	0.43	66.2	6.89	8.2	0.89
Construction materials	59.4	2.70	61.2	2.23	188.6	6.30	192.8	5.24
TOTAL	444.1		606.0		602.5		516.9	

Source: Own study based on data from Central Statistical Office.

services discussed are connected with cleaner technologies that consume natural resources in a rational manner and reduce emissions [26]. OECD subdivides goods promoting environmental protection into 3 groups:

I. Pollution management: manufacturing processes, equipment (goods), and methods (services) whose purpose is to measure, control, process, and limit pollution, environmental degradation, and impoverishment of mineral resources; this group may also comprise integrated technologies, and technological processes that are less harmful to the environment than corresponding alternative solutions.
II. Clean technologies and products: technologies, goods, and services designed at the same time to reduce, prevent, and eliminate environmental harm, including harm from waste, sewage, polluting emissions into the atmosphere, soils and groundwater, and sources of noise, vibration, and landscape transformation.
III. Resource management technologies: technologies, goods, and services used to manage (and/or protect) natural resources; this group comprises technologies and products related to material reuse and recycling, management of material resources, and measurements and control, as well as products related to renewable energy sources.

The value of exports of environmental goods in the EU-25 in 2007 was estimated at €13 billion, and the value of imports at ca. €11.1 billion. The main exporters of environmental products in the EU are Germany, France, and Great Britain. In Poland – from analyzed manufacturing sectors – the highest export value for environmental goods was reached in 2007 by the following sectors: automotive, 4.13 billion PLN; plastics and rubber, 1.4 billion PLN; and electric and electronic, 1.7 billion PLN (Table 2).

The highest contribution by value of all environmental goods and services in total exports was made in the plastics and rubber (8.1%), glass (6.2%), electric and electronics

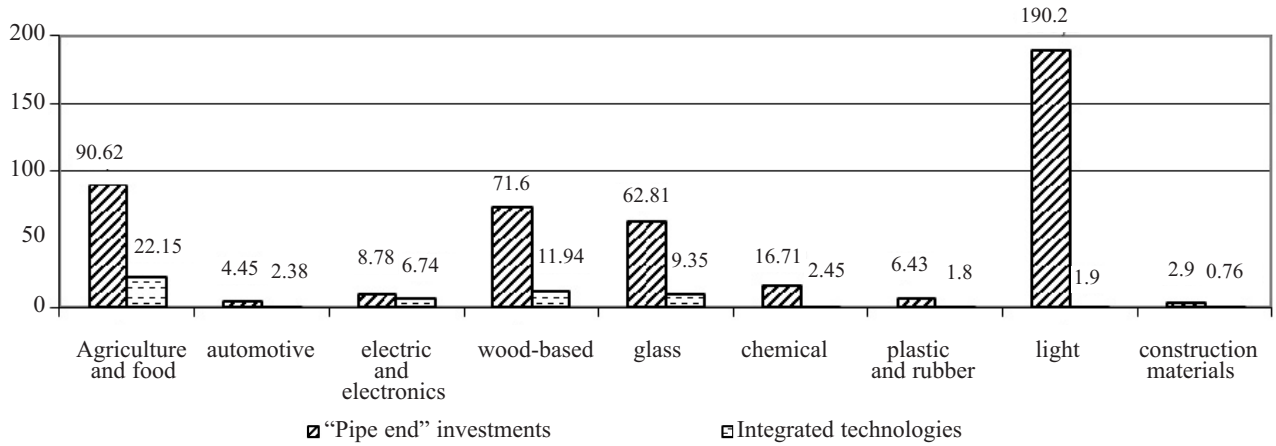

Fig. 1. Expenditure on "end-of-pipe" investments and integrated technologies in fixed assets used for environmental protection purposes in selected sectors in 2007 (million PLN, current prices).

Table 2. Export and import value of goods supporting environmental protection in individual sectors in 2004-07 (current prices, million PLN).

Manufacturing sectors	2004	2005	2006	2007
Export				
Agriculture and food	37.1	34.1	15.6	18.7
Automotive	2,224.5	2,766.9	3,456.9	4,128.7
Electric and electronics	1,349.3	1,271.2	1,480.3	1,725.5
Wood-based	121.6	133.3	178.7	194.1
Glass	69.9	103.4	171.4	229.8
Chemical	402.1	445.5	504.9	484.2
Plastic and rubber	914.4	1,009.8	1,197.6	1,402.6
Light	84.4	67.0	72.7	72.6
Construction materials	82.1	74.4	105.7	104.8
TOTAL	285.5	5,905.7	7,183.9	8,361.2
Import				
Agriculture and food	435.5	353.1	376.1	588.0
Automotive	8,004.9	8,174.8	8,327.5	8,798.5
Electric and electronics	1,262.3	1,155.5	1,301.3	1,550.5
Wood-based	525.2	473.4	531.9	698.2
Glass	65.5	76.1	77.8	65.0
Chemical	920.0	635.1	747.9	748.2
Plastic and rubber	523.1	521.4	624.6	719.4
Light	124.2	94.6	100.0	90.9
Construction materials	286.7	322.4	281.9	223.8
TOTAL	12,147.5	11,806.6	12,369.1	13,482.5

Source: Own study based on data from the Central Statistical Office.

(5.4%), and automotive sectors (4.5%). For other sectors it was small and never exceeded 2.5%. Environmental goods and services are exported primarily to the European Union countries (mainly to Germany and France) and Russia. The share of export to developing countries (e.g. China, India, Republic of Korea) has been growing.

The turnover of environmental goods in manufacturing sectors is dominated by the pollution management products group (over 95%). The only exception here is the electric and electronics sector, in which, besides the pollution management products classification (60.8%), a relatively high share is taken by resource management technologies (39%). In 2007 the value of pollution management product sales to individual countries in the sectors discussed ranged from 4.9 million PLN to 4.13 billion PLN. The largest buyers for this type of product in individual sectors were:

- electric and electronics: Germany (34.4%), Spain (8.7%), Italy (5.3%)
- automotive: Germany (47.3%), France (14.1%), Hungary (5.6%)
- plastics and rubber: Germany (31.9%), France (7.2%), Russia (6.3%)
- agriculture and food: Belarus (22.2%), Germany (22.8%), Russia (25.8%)
- light: Germany (47.2%), the Netherlands (15.6%), Ukraine (4.8%)
- wood-based: Germany (37.4%), Great Britain (13.9%), Slovakia (10.9%)
- glass: Ireland (29%), Germany (16.7%), Brazil (14.6%)
- chemical: Czech Republic (31.3%), Sweden (17.8%), Germany (11.1%)
- construction materials: Germany (33.1%), Norway (15.2%), France (12.4%)

The share of pollution management products in exports to developing countries (DEV) ranged from 1 to 16.4%. The highest share of this product group was observed in five sectors: glass (16.4%), chemical (14.5%), electric and electronics (7.8%), and agriculture and food (5.1%).

Despite the significantly dynamic performance of exports for environmental products and goods in some

Polish sectors, the value of imports in 2004-07 exceeded the value of exports. The balance of total turnover of environmental goods and services is admittedly negative, but it is continuously improving. In 2007 the balance was – 5.1 billion PLN, and within that the automotive sector contributed as much as 4.7 billion PLN. Indeed, it is the largest exporter, but also an importer of environmental goods and services. Next, the electric and electronics sector is also both an exporter and an importer, with a positive balance in the turnover. And the third exporter is the plastics and rubber sector, which also shows the highest positive balance in its turnover of environmental goods and services in all analyzed sectors (Table 2).

Assessment of Competitiveness in the Polish Environmental Goods and Services Sector

In spite of improvement in recent years, statistical data unfortunately indicate a distinct delay in building the "green economy" in Poland. Among other things, this is shown by the relationship of the heading environmental goods turnover in trade with DEV, which differs from developed countries. While Poland targets only ca. 3% of its total export of environmental goods in markets in the DEV, in practice its total import of environmental goods (ca. 97%) comes from exactly these countries. Whereas in the case of OECD countries this turnover is more balanced, that is the share DEV reaches respectively: 22% in export and 37% in import of environmental goods by OECD countries. This means that, compared to OECD countries, Poland proves its lack of competitive advantage in the environmental goods trade with DEV. It is slightly better in the case of some manufacturing sectors. Competitive advantage in the total turnover of environmental goods occurs in the case of three sectors (out of nine sectors analyzed): electric and electronics, glass, and plastics and rubber.

The development of environmental technologies should lead to increasing competitiveness of Polish industry in the sectors analyzed. The competitiveness of environmental goods in foreign trade, for every sector, was assessed using a few indexes, including: RCA – revealed comparative advantage – concerning exports [27], IMP – import penetration index, RTA – relative trade advantage index, and the CR index – concentration ratio. Indexes were calculated using the following formulae:

$$RCA=(X_{PL/DEV}/X_{PL/T})/(X_{OECD/DEV}/X_{OECD/T})$$

...where:
RCA – revealed comparative advantage
$X_{PL/DEV}$ – total export of environmental goods and products from Poland to DEV
X_{PL} – total export of environmental goods and products from Poland to total countries in the world
$X_{OECD/DEV}$ – total export of environmental goods and products from OECD countries to DEV
$X_{OECD/T}$ – total export of environmental goods and products from OECD countries to total countries in the world

$$IMP=(Y_{PL/DEV}/Y_{PL/T})/(Y_{OECD/DEV}/Y_{OECD/T})$$

...where:
IMP – import penetration index
$Y_{PL/DEV}$ – total import of environmental goods and products to Poland from DEV
$Y_{PL/T}$ – total import of environmental goods and products to Poland from total countries in the world
$Y_{OECD/DEV}$ – total import of environmental goods and products to OECD countries from DEV
$Y_{OECD/T}$ – total import of environmental goods and products to OECD countries from total countries in the world

The comparative advantages of Poland were assessed on the basis of the ratio of the relative share of environmental goods in the imports/exports between Poland and the DEV to the share of the same class of goods in the exports from OECD countries.

$$RTA = RCA/IMP$$

...where: RTA – relative trade advantage

The RTA index, calculated as the ratio of RCA to IMP, allows one to evaluate competitive advantage by weighing the relative advantages of imports and exports. In the calculations of indexes for OECD countries' imports and exports for the period 2004-07, detailed export and import values were only obtained for 2002 (data from Tariffs and Trade in Environmental Goods Workshop On Environmental Goods, Geneva, 11 October 2004, Bijit Bora and Robert Teh WTO Secretariat), and thus these index values were taken for the following years. Comparison of the RCA, IMP, and RTA indexes for the individual years in 2004-07 indicates a considerable lack of diversity in their values. They stood at similar levels, fluctuating around the following values: RCA – 0.15, IMP – 2.60, RTA – 0.06 (Tables 3, 4).

An RCA index value exceeding 1 indicates that a given country has a comparative advantage as regards the group of goods examined, and if it is less than 1, there is no advantage at all. Analysis of the RCA index proved that during the period examined, Poland had no comparative advantages over developing countries in the field of environmental goods compared to OECD countries in 2004-07. The lack of comparative advantage is also proven by the IMP index value, which in the successive years of the period examined stayed over 1. This confirms that there was no competitive advantage.

The RTA index values indicate a lack of competitive advantage for Poland compared to the OECD countries in the trade in environmental products with developing countries in the years 2004-07. Throughout that period its values remain under 1 (the lowest value – 0.05 was observed in 2006, and the highest – 0.07 in 2005, showing a drop of more than 28%).

The competitiveness of foreign trade in environmental goods and services for individual manufacturing sectors was analyzed using the CR index (the lack of detailed data concerning the values of import and export of environmental goods in individual sectors, e.g. for the EU and OECD

Table 3. Values of the RCA and IMP index in relations of environmental goods export to DEV countries from Poland and OECD countries, 2004-07.

Specification		2005		2007
RCA index in relation to environmental goods export to DEV countries from Poland and OECD				
$X_{PL/DEV}/X_{PL}$	0.04	0.04	0.03	0.03
$X_{OECD/DEV}/X_{OECD}$	0.22	0.22	0.22	0.22
RCA	0.17	0.18	0.14	0.15
IMP index in relation to environmental goods import to DEV countries from Poland and OECD				
$Y_{PL/DEV}/Y_{PL/T}$	0.97	0.97	0.97	0.98
$Y_{OECD/DEV}/Y_{OECD}$	0.37	0.37	0.37	0.37
IMP	2.61	2.61	2.62	2.64

Source: own calculations based on CSO and WTO data.

Table 4. Values of the RTA index to determine competitive advantage of environmental goods for Poland, 2004-07.

Specification	2004	2005	2006	2007
RTA index	0.06	0.07	0.05	0.06

Source: own calculations based on CSO and WTO data.

countries, excluded the use of RCA index). The index was calculated for three variants according to the following formulae:

$$CR_T = X_{i\,T}/M_{i\,T} \cdot 100$$

$$CR_{EU15} = X_{i\,EU15}/M_{i\,EU15} \cdot 100$$

$$CR_{DEV} = X_{i\,DEV}/M_{i\,DEV} \cdot 100$$

...where:
M – import value
X – export value
i – environmental goods
T – total countries in the world
DEV – developing countries
EU15 – 15 countries of the European Union

Relative competitive advantage over partners is proven by CR>100. Analyses completed in years 2004-07 prove that competitive advantage occurs most often in the case of total foreign exchange (CR_T). The CR index for three sectors (electric and electronics, glass, and plastics and rubber) was always over 100. The occurrence of these sectors is also characteristic of the fact that the indexes for the EU-15 countries were usually higher than for DEV. In general, the index value for the chemical sector fluctuates around 50, and for light sector around 70, and again these indexes are higher in relation to the EU-15 countries. In the construction materials sector the index value indicates improving trends, growing from 28 to 46, and for this branch the index for DEV was usually higher than for the EU-15 countries. On the other hand, the lowest values of this index were demonstrated for agriculture and food. In the case of exchange with DEV it was under 1 (Table 5).

Conclusions

Facing huge competition-related pressure in export markets regarding a growing number of materials, companies should be more competitive toward their leading business partners. This may be achieved by increasing productivity or launching new goods and services, e.g. environmental. However, analysis of presented indexes proved that in recent years Poland has had no comparative advantages over developing countries in the field of environmental goods compared to OECD countries. This is proven by the manufacturing sectors analyzed, where three out of nine have a competitive advantage (electric and electronics, glass, and plastics and rubber). Only these sectors have a positive balance of trade in environmental goods and services. They are characterized by significant dynamics in the export of environmental goods and services. In these sectors the number of organizations which have ISO 14001 certificate are relatively high [28]. The expenditure on environmental protection in theses sectors is also significant. Moreover, in 2006-08 enterprises from electric and electronic industries and rubber industries invested for innovative solutions, i.e. 1.4 billion PLN and 1.2 billion PLN.

However, for Poland the values of the RCA and IMP index in relation to environmental goods export to DEV countries from Poland and OECD countries were rather stable and ranged for RCA 0.14-0.18 and for IMP 2.61-2.64 in years 2004-07. The value of the RTA index, which determine competitive advantage of environmental goods for Poland, were also stable, varied from 0.05 to 0.07. Due to the lack of detailed long-term data (no data available about trade of environmental goods), there is no evidence about any correlation of these values either with environmental programs or with

Table 5. CR indexes for environmental goods, 2004-07 (in %).

Manufacturing sectors	2004			2005			2006			2007		
	CR_T	CR_{EU15}	CR_{DEV}	CR_T	CR_{EU15}	CR_{DEV}	CR_T	CR_{EU15}	CR_{DEV}	CR_T	CR_{EU15}	CR_{DEV}
Agriculture and food	8.52	1.12	0.28	7.82	0.77	0.03	3.59	0.99	0.09	4.29	1.22	0.21
Automotive	27.79	24.74	0.66	34.56	27.84	1.11	43.18	34.23	0.80	51.58	42.50	1.02
Electric and electronics	106.89	71.82	6.67	100.70	71.20	5.87	117.27	84.74	7.10	136.69	97.25	9.23
Wood-based	23.14	16.97	0.33	25.39	17.82	0.26	34.01	24.96	0.71	36.96	24.82	1.22
Plastic and rubber	174.81	118.91	2.52	193.05	130.65	3.52	228.95	160.44	3.43	268.14	188.90	6.17
Light	67.99	33.90	314.72	70.83	56.64	37.10	72.73	65.27	14.19	79.93	68.21	3.11

Source: Own study based on data from Central Statistical Office.

technological changes. But it is highly probably that the more stringent EU environmental regulations have influenced improving RCA of environmental products in these industrial sectors that have significant trade value with EU countries.

The factors necessary to improve Poland's chance to be competitive are increased outlays for environmental protection, the development of environmental technologies and services sector, and dynamizing export of broadly understood environmental goods and services. Polish manufacturing companies should carry on with introducing environmental technologies into the market, which will allow it to use resources efficiently in the whole economy. Investing in new environmental technologies has an effect on pollution reduction and use of natural resources in a manner ensuring its longer availability. This includes not only individual technologies, but also their entire systems, manufacturing processes, products, services, equipment, and organizational procedures and management[1]. Projects that help to implement environmental technologies that fully and efficiently use the potential of ecological innovations to meet ecological challenges, to keep up the pace of economic growth, and to increase competitiveness, constitute an important element of support for both the ecological and the innovation policies of enterprises.

Abbreviations

GDP – gross domestic product
DEV – developing countries
OECD – Organization for Economic Co-operation and Development
WTO – World Trade Organization
RCA – revealed comparative advantage
IMP – import penetration index
RTA – relative trade advantage index
CR – concentration ratio
EU15 – 15 countries of the European Union
EU25 – 25 countries of the European Union

[1]According to the definition introduced in Announcement COM (2004) 38 referring to the definition provided in Chapter 34 of Agenda 21, UNO.

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