



Bartosz Michalski

University of Wrocław
Faculty of Social Sciences
Institute of International Studies
bartosz.michalski@uwr.edu.pl

**BEST AND POOR PERFORMERS IN THE POLISH
HIGH-TECH EXPORTS IN 2013-2017.
CLIMBING UP TECHNOLOGICAL LADDER**

We are climbing, Jacob's ladder
Every rung goes higher and higher
Every new rung just, just makes us stronger
from *Jacob's Ladder*, Afro-American Song

Summary: Creation and commercialization of high-tech knowledge determine prospects of economic development and competitiveness. The author embarks on the analysis of the Polish exports considering its technological sophistication. The primary purpose of the paper is to assess the performance of high-tech product clusters between 2013-2017. The particular emphasis is placed on the most significant high-tech categories, i.e., only those exceeding 0.2% share in the total Polish exports in 2017. Recent changes in their dynamics, compared with those in the global trade, provide evidence of their competitive position. Up to their results, they rank accordingly. Moreover, they may justify tailored and targeted measures within the strategic trade and industrial policy to support areas of high-tech specialization. Against this backdrop, the author also calls for a more integral approach when evaluating the impact of the foreign direct investments as they profoundly shape the structure and results of the Polish exports.

Keywords: technological change, technological sophistication, high-tech trade, exports, Poland.

JEL Classification: F14, F15, F21, O14, O33.

Introduction

Contemporary competition for a favorable position within the international division of labor requires the potential to create, enforce and commercialize

knowledge-driven ideas [Fagerberg, Srholec & Knell, 2007]. Among crucial success factors for policy-making, one can stress the relevance of institutional framework and public measures addressing these vital goals in the long run. Moreover, there must be companies able to take proper advantage of incentives. To verify whether they do well or struggle for survival, research covering their performance in the global trade must be conducted on a regular basis. It is primarily about how to grasp transformations in the technological sophistication of exports while stressing the utmost importance of mid- and high-tech product clusters. Should the latter increase their shares, it would mean that the competitive position of an economy improves correspondingly.

In this specific context, the fundamental question is whether the way policy-makers enforce reforms is the correct one and what should be considered as the pillar supporting expected transformations. A genuine dilemma remains if positive changes result from endogenous factors, i.e., enhanced competitiveness of domestic firms [cf. Gashi, Hashi & Pugh, 2014], or – on the contrary – are brought about by the inflow of foreign direct investments (FDI), the knowledge they transfer and higher productivity of foreign-owned businesses [cf. Uzagalieva, Kocenda & Menezes, 2012; Bertschek, Hogrefe & Rasel, 2015]. In case of the latter competitive advantages may be relatively short-lived. The main reason stems from the threat of delocalization and limited capabilities to absorb foreign know-how¹. These two sustain the pressure on keeping low cost incentives to attract international companies. Furthermore, it makes the escape from the foreign technological guidance [Ohno, 2009, p. 28] a considerable challenge and fosters structural burden typical of the middle-income trap (MIT)².

The remainder of the paper is structured as follows. In the next section the author defines the principal purpose of this research and its methodological concept. Then he introduces a broader context behind this study, which is how the technological sophistication of the Polish exports has been evolving since 2001. The subsequent section covers the main body of analysis. It deals with shifts of competitive position of selected high-tech goods between 2013 and 2017. The last part concludes and offers some policy recommendations.

¹ According to Temouri, Driffield & Higón [2010, p. 961], there is a large literature that shows how absorptive capacity plays a crucial role in determining the scale and scope of spill-overs from FDI, and as absorptive capacity in host countries improves, so does the possibility of technology leaking out to local firms.

² “This happens [...] when the state’s tax capacity is too low for the elite to benefit from switching to innovation-based growth, or the commitment to a low enough tax rate to incentivize entrepreneurs to innovate does not exist even though the elite want to switch to innovation” [Wang, 2016, p. 176].

1. Research purpose and methodological approach

The primary purpose of this research is to evaluate the performance of high-tech goods in the Polish exports in 2013-2017. The author embarks on a comparative examination of dynamics in the Polish exports and world imports of high-tech product clusters covered by this study. This approach allows for the identification of five cases, coined as stars for the fact they represent the most desired groups of goods in the Polish exports. These are:

- superstars, when their average growth in the Polish exports in 2013-2017 (p.a.) was higher than their average growth in world imports in 2013-2017 (p.a.),
- ordinary stars, when their average growth in the Polish exports in 2013-2017 (p.a.) was lower than their average growth in world imports in 2013-2017 (p.a.),
- struggling stars, in case of their average growth in the Polish exports in 2013-2017 (p.a.) and their simultaneous decline in world imports in 2013-2017 (p.a.),
- fading stars, if they experienced the average decline in the Polish exports in 2013-2017 (p.a.), while the world imports grew on average between in 2013-2017 (p.a.),
- falling stars, when the average decline in the Polish exports in 2013-2017 (p.a.) was accompanied by the average reduction in world imports in 2013-2017 (p.a.).

Due to editorial limitations, the author took under closer scrutiny only these high-tech goods which weighted more than 0.2% in the Polish exports in 2017. This corresponds with around 500 million USD of annual exports.

The author carried out the examination using trade data at the four-digit (in selected cases also at the six-digit) level of disaggregation of the Harmonized System (HS) available in the Trade Map [www 1] database. Identification of high-tech categories reflects the classification of the United Nations Conference on Trade and Development [www 2] based on the Standard International Trade Classification (SITC) which were converted to achieve coherence with HS taxonomy.

The author remains fully aware that the way the Polish trade evolves depends to a great extent on the production fragmentation, thus on the increasingly deeper involvement of the Polish economy in global value chains (GVC). Against this backdrop, the analysis of trade in value added [cf. Koopman, Wang

& Wei, 2014] provides new inspiring insights as it covers Central and Eastern European economies [Ambroziak, 2016, 2018ab; Folfas, 2016ab; Fronczek, 2016; Kuźnar, 2017; Ulbrych, 2017; Olczyk & Kordalska, 2017]. These studies show clearly that shares of domestic content in high- and medium-technology products in the Polish exports have been declining³. Moreover, the lack of most recent data remains a fundamental weakness of this approach as they mainly cover 1995-2011 period [www 5]. This is why studies placing greater emphasis on newer data need to be conducted to provide evidence-based recommendations for policy-making.

2. Technological sophistication of the Polish exports. Some stylized facts

The investigation of structural transformations in the Polish exports between 2001-2017 (Figure 1) provides optimistic observations: the shares of resource- and labor-intensive and low-tech goods dropped to the level of 16.4 and 12.6% in 2017 accordingly, while those of mid- and high-tech were thriving: their respective shares in 2017 reached 32.7 and 18.6%. This means a slow evolution in the desired direction to intensify the technological sophistication of exports.

These tendencies need also to be confronted with statistics provided by the Central Statistical Office in Poland [www 3]. In the period 2010-2016 shares of high-tech industry (HT), measured by sold production, dropped from 6.8 to 5.4%, while those of medium-high technology (MHT) grew slightly from 27.2 to 28.9%⁴. The inability to boost the significance of the first group is thus balanced by the consolidation of the latter. There is a constant, but a bit unsuccessful search of unique competitive advantages in niche sectors. Competitive pressures and fast ageing of HT may be thus considered as factors why sectors of MHT, where economies of scale matter, have a much greater impact on the manufacturing production in Poland.

³ Xing [2014, p. 122] refers to the Chinese experience and claims that high-tech products, mainly made of imported parts and components, should be called 'assembled high-tech'.

⁴ These two, as well as medium-low and low technology sections, are derived from the Statistical Classification of Economic Activities in the European Community – NACE Rev. 2, so there is a slight inconsistency with the author's methodological approach.

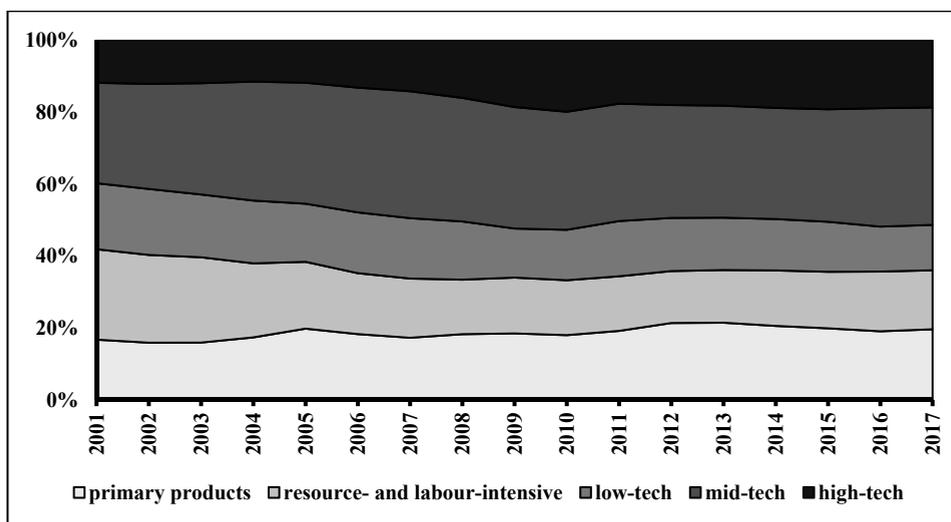


Figure 1. Technological sophistication of the Polish exports in 2001-2017

Source: Author’s calculations based on: [www 1; www 2].

Among mid- and high-tech product clusters exceeding 1 bn USD in 2017, which have been experiencing a gradual expansion since 2001⁵ (Table 1), one should notice most of all automotive, machine, electric, and electronic industries, where foreign capital dominates⁶.

Table 1. Best growing mid-tech and high-tech product clusters in the Polish exports between 2001-2017

HS code	Type	Product label	Average growth rates (% p.a.)				Share in 2017 (%)
			2001-2005	2005-2009	2009-2013	2013-2017	
1	2	3	4	5	6	7	8
4016	mid-tech	Articles of vulcanized rubber	37.4	14.5	16.6	5.6	0.68
8411		Turbo-jets, turbo-propellers and other gas turbines	34.2	40.3	21.9	18.3	1.23
8421		Centrifuges, filtering and purifying machinery	37.5	22.8	12.1	15.0	0.51
8504		Electric transformers, static converters	19.8	13.9	8.1	6.6	0.53
8537		Board & panels, equipped with switches, fuses	61.7	17.7	24.5	11.1	0.47
8704		Trucks, motor vehicles for the transport of goods	70.5	11.1	13.4	12.8	1.33
8708		Parts & accessories of motor vehicles	38.5	18.4	10.1	6.8	5.60

⁵ Average growth in the periods 2001-2005, 2005-2009, 2009-2013, 2013-2017 above 5%.

⁶ 2/3 of the Polish exports and around 50% of industrial production is generated by foreign (co-owned) companies [Ministerstwo Rozwoju, 2017, p. 24].

Table 1 cont.

1	2	3	4	5	6	7	8
3004	high-tech	Medicament mixtures put in dosage	38.1	36.4	18.1	7.5	1.49
3920		Other plates, sheets, film, foil, tape, strip of plastics	28.9	21.4	23.4	5.2	0.46
8523		Prepared unrecorded media for sound record (tapes)	93.1	534.2	15.6	22.4	0.61
SUM							12.91

Source: Author's calculations based on [www 1; www 2].

These results imply that the positive structural change of the Polish exports has to be drawn to the inflow of FDI. Hence, the potential of the Polish economy to grow remains dependent on the absorption of foreign know-how. Surprisingly, this factor seems to play a vital role also in boosting substantial growth rates of primary products (HS 2402: cigars, cheroots, cigarillos & cigarettes) as well as resource- and labor-intensive goods (HS 9405: lamps & lighting fittings, signs, illuminated nameplates).

3. Results and discussion

The comparison of average growth and decline rates of the Polish exports and world imports for 11 selected high-tech product clusters allows for a clear distinction of the categories mentioned above (Figure 2):

- superstars: HS 3002 (human & animal blood for therapeutic, prophylactic or diagnostic uses, antisera, other blood fractions and immunological products, vaccines, toxins, cultures of micro-organisms), HS 8523 (discs, tapes, solid-state non-volatile storage devices, optical media, smart cards), HS 9018 (instruments and appliances used in medical, surgical, dental or veterinary sciences);
- ordinary stars: HS 3304 (beauty or make-up preparations);
- struggling stars: HS 3402 (organic surface-active agents, e.g., soap, surface-active preparations, washing and cleaning preparations), HS 3907 (polyacetals, other polyethers and epoxide resins, polycarbonates, alkyd resins, polyallyl esters and other polyesters), HS 3920 (plates, sheets, film, foil and strip, of non-cellular plastics), HS 8471 (automatic data-processing machines and units thereof, magnetic or optical readers);
- fading stars: HS 8517 (telephone sets, e.g. telephones for cellular networks or other wireless networks), HS 8803 (parts of aircraft and spacecraft);

- falling stars: HS 8528 (monitors and projectors, reception apparatus for television).

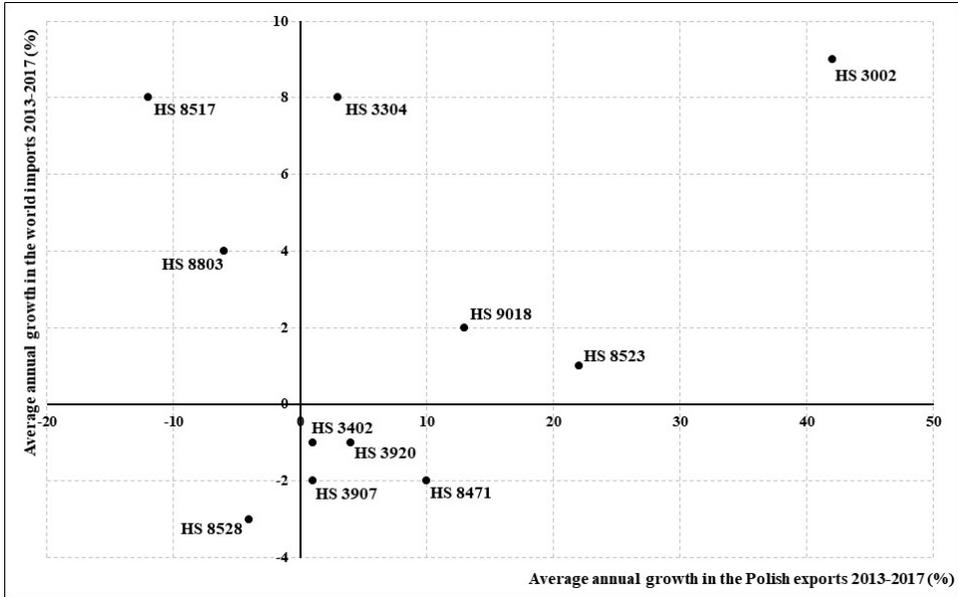


Figure 2. Average annual growth rates in the Polish exports and world imports in 2013-2017 of selected high-tech product clusters

Source: Author’s calculations based on: [www 1; www 2].

The success of product clusters coined here as superstars may put across the idea that the Polish economy encompasses a human capital potential in life science (HS 3002 and HS 9018). As for today, their importance remains rather modest for their shares in the world exports do not exceed 1%, with Germany being the main trading partner (for the latter also the U.S. market). This characteristic may imply an essential impact of GVC and the emphasis placed on lower production costs with the strategic aim to penetrate markets of developed countries. Moreover, robust growth rates of HS 8523 sustained the position of Poland in the global exports (share of 2.6% in 2017). However, it would be a challenging task to find Polish-owned companies in this industry. This, in turn, means that this product cluster comprises only so-called assembled high-tech.

In the case of ordinary stars, the performance of HS 3304 may suggest that manufacturing of cosmetics has become an area of high competencies (almost 3% share in the world exports), where Polish firms succeed (especially HS 330499: beauty or make-up preparations and preparations for the care of the

skin). An excellent feature of this expansion relates to a significant diversification of exporting markets (Germany, Russian Federation, United Kingdom, Belgium).

Category of struggling stars comprises products which were growing against the backdrop of a minor decline in the world imports (1-2%). The Polish exports expansion of HS 3402⁷, HS 3907 and HS 3920 may again imply solid competencies in the chemical and plastics industries. However, they are subjected to an increasingly growing pressure on lower costs. This comes from the fact that in the period covered by this analysis their growth in value was accompanied by the more steady increase in quantity [cf. *www 1*]. As far as HS 8471 is concerned, a deeper insight into the trade data allows for the identification of its essential product: data-processing machines, in the form of systems comprising at least a central processing unit (HS 847149). Hence, Poland serves likely as a cheap manufacturer assembling final goods from parts and accessories imported mainly from China. It seems just when looking at trade data in the product cluster HS 8473 (parts and accessories of automatic data-processing machines or for other machines of heading 8471).

Tendencies typical of fading stars stem from the average decline of the Polish exports in HS 8517 which took place due to telephones for cellular networks or other wireless networks (HS 851712) and their excessive dependence on the German market. Primary competitors for Poland-based manufacturers would come from China, Vietnam and Slovakia, the latter being an astounding case [cf. *www 1*]. Moreover, a particular characteristic of this industry relates to a stronger consumer loyalty to global brands. These are intended to pledge that the final goods assembled from made-in-Asia parts will meet up not only quality expectations, but will be an essential element of consumer's everyday life⁸.

As for HS 8803, it being classified into fading stars is somewhat accidental and thus not well-founded. In the base year 2013, the value of its exports skyrocketed to the level of 837.5 million USD due to deliveries of parts of airplanes or helicopters (HS 880330) to the U.S. market. Thus a significant decline between 2013 and 2014 was not compensated with steady growth rates later on.

⁷ Poland as the tenth largest world exporter in 2017.

⁸ "Cell phone marketers are well aware of the factors that affect consumer decision making when purchasing mobile phones – factors that take into account not only aspects like speed, connectivity, and special features, but psychological characteristics like personality, lifestyle, and brand loyalty. This awareness is exemplified in mobile phone advertisements and commercials, which tend to emphasise style and emotion, showing just how a phone could improve a consumer's lifestyle" [*www 4*].

The exports in HS 8528, coined here as a falling star, may be an unpleasant and painful experience for the Polish economy. The point is that this production is embedded in the activity of foreign companies, mainly from the Republic of Korea and Japan. The share of this product cluster remains more than vital as it accounted for 2% of the total Polish exports. This resulted in a 4.8% share of Poland in its global exports (sixth position in 2017). While analyzing trade data in the period covered, one may spot the tendency of delocalization. This means that manufacturing processes are moved to low-cost Asian economies (China, Vietnam) as the technology ages, demand in developed economies is satisfied and prices are brought down. Therefore in the nearest future, substantial reconfigurations of GVC and production organization in the Polish affiliates are here to come. For that reason, a strategic challenge emerges which seems to be an urgent need to look for high-tech alternatives related to the inflow of FDI and those arising from the expansion of Polish companies.

Conclusions and policy recommendations

How to climb up the technological ladder? If looking for an answer in the light of the obtained results, several issues have to be considered.

First, the Polish high-tech exports are mainly driven due to the application of foreign knowledge ('assembled high-tech'). In the long run it petrifies a structurally unsatisfactory position of a dependent market economy [Nölke, Vliegenthart, 2009]. Therefore, policy aimed at attracting FDI should evolve towards greater selectivity. The pre-evaluation of business projects has to diagnose their position in GVC and allowing for a comprehensive analysis of their impact on the Polish economy. What also needs to be emphasized is the long-term condition to drive and boost local technological spill-overs.

Second, the emergence of domestic producers requires a smart support of their internationalization and diversification of exporting markets. However, the proximity of Germany fosters the German-Central European Supply Chain [Elek-dag, Muir & Wu, 2015], which may be recognized as a kind of blight [Michalski, 2018]. This means the localization of production centers able to deliver cheap parts and accessories and to assembly high-tech goods exported then to Germany and thus sustaining the exposure to global shocks.

Third, stepping up efforts to climb the technological ladder needs to mitigate challenges of MIT. FDI which transfer ageing high-tech knowledge as well as still low abilities of domestic companies to innovate may pose through exter-

nal price and cost pressures new structural burdens hampering the process of catching up with developed economies.

To sum up, technological progress, escape from MIT included, should be based on domestic sources of capital and creativity. A prevalent belief in the Polish debate that low costs and shrinking profit margins are the primary roots of success needs to be contested as fallacious.

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**NAJLEPSZE I NAJSŁABSZE GRUPY W POLSKIM EKSPORCIE
HIGH-TECH W LATACH 2013-2017.
WSPINAJĄC SIĘ PO TECHNOLOGICZNEJ DRABINIE**

Streszczenie: Kreacja oraz komercjalizacja zaawansowanej wiedzy determinuje perspektywy rozwoju gospodarczego i konkurencyjności. Autor podejmuje w artykule analizę polskiego eksportu z perspektywy jego zaawansowania technologicznego. Głównym celem badania jest ocena wyników produktów *high-tech* w polskim eksporcie w latach 2013-2017. Zasadniczy akcent jest położony na najważniejsze dobra *high-tech*, tj. te, których udział w polskim eksporcie w 2017 r. przekraczał 0,2%. Zmiany w ich dynamice na tle handlu światowego stanowią dowód ich pozycji konkurencyjnej. W zależności od uzyskanych wyników zostały one odpowiednio sklasyfikowane oraz mogą uzasadniać stosowne działania w ramach strategicznej polityki handlowej i przemysłowej, wspierając obszary specjalizacji *high-tech*. Na tym tle autor wskazuje także na konieczność kompleksowej oceny zagranicznych inwestycji bezpośrednich, ponieważ oddziałują one na strukturę oraz wyniki polskiego eksportu.

Słowa kluczowe: zmiana technologiczna, zaawansowanie technologiczne, handel *high-tech*, eksport, Polska.