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“The Ability to Adapt and Overcome Obstacles:
Machinery Exports of Poland”

by

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The Ability to Adapt and Overcome Obstacles:
Machinery Exports of Poland

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Abstract

From 1980-2009 the Polish economy experienced structural dislocation. The growth and success of the Solidarity movement represented the shift in manufacturing from Soviet bloc trade to membership in the European Union. This paper examines four independent metrics that measure the changing “sophistication” of trade patterns during this modal shift. The common theme underlying the analysis of these indices is that the Polish economy is resilient and adaptable. Poland is expected to compete effectively in its new economic environment after a period of adjustment and progress.

Keywords: Trade Patterns in a Transition Economy; Machinery and Transport Equipment; Exports; Poland; Solidarity; Structural Change; Sophistication Indices; Trade Specialization Index; Intra-Industry Trade; Shock Therapy; Revealed Comparative Advantage; Herfindahl-Hirschman Index; Standard International Trade Classification; Compositional Shifts; Data Aggregation; Dispersion; Market Power;

JEL Classifications: F0, F1, L0, L1, L6, N0, N6, O1, O52, P2, R1

The Ability to Adapt and Overcome Obstacles: Machinery Exports of Poland

Introduction

A cursory examination of Poland's history suggests that the Polish society and economy would likely exhibit a relatively large resiliency to change. From the middle of the seventeenth century to the present, Poland found itself continually sliced up, and at times totally swallowed up by its neighbors, the Prussians, Russians and Austro-Hungary empires (and the Swedes). Then, in the mid twenties century, again Poland was devoured by Germany and Russia, absorbed into the Third Reich, and soon after, following territorial adjustments, became a political and economic satellite of the Soviet empire. This suggests that again and again, Poland found itself affected by one or another border adjustment; adopting, dealing with and adjusting to constantly changing trade regimes. In other words, trade with any given neighboring province or town was likely to evolve into international trade at one time or another. This must have left a remarkably flexible ability to handle changes. In the nineteenth-eighties, once again Poland found itself facing a fundamental change in its political and economic environment. In short, one would expect the unusually high degree of adaptability to unexpected changes to translate to a high level of competitiveness in today's rapidly shifting economic scene.

In the some forty years preceding this last change, Poland essentially played the economic role of a component in a state-trading system, the Council for Mutual Economic Assistance (COMECON), designed to ensure stability in the provision of inputs to the Soviet five-year plan needs. The change in the early 1980s was a dramatic one, as Poland now faced great potential gains and also risks of "privatization" at an international level. No longer did five-year plans dictate "Norms". A guaranteed international market for its production no longer existed. Suddenly, Poland had to find its niche in the competitive and sophisticated markets of the European Union. One may have expected that the shift from the Soviet economic orbit to a trading partner and ultimately a member of the European Union (EU) would lead to a growth in the level of sophistication in Poland's exports. This paper explores the data of Poland's exports of machinery and transport equipment (henceforth machinery) for evidence of an increase in the level of sophistication in Poland's machinery exports. For a discussion explaining the focus on this particular product sector, see Appendix A.

The concept of trade sophistication is rather difficult to conceptualize, and even more complicated to measure and quantify. Four methods are used in this paper to identify and track the degree of sophistication in Poland's exports during the critical transition period of 1980–2009. The first is the degree to which Poland's exports are focused on and specialized in the relatively sophisticated key product sector of 'machinery and transport equipment' (Standard International Trade Classification (SITC0 7)). The second is the extent to which the degree of specialization grew within the key SITC 7 Sector. The third is the degree to which Intra Industry trade characterized the Polish machinery exports. Finally, the use of a recently developed 'Sophistication Index' developed by Lall *et al.* [2006] is analyzed.

The labor turmoil and the formation of 'Solidarity' in 1980 at Gdansk marked an important turning point for Poland. This date marked a major shift away from an externally controlled and constrained (State Trading) system to one with a relatively larger set of opportunities consistent with Poland's economic welfare. It is therefore logical to have expected that the new patterns of specialization evolving after this date to reflect the nature of the Polish revealed dynamic advantage.

The next epochal shift may be argued to have occurred in 1990's. By 1990, 'Solidarity' had swept parliamentary elections and the presidency. In that same year, a 'shock therapy' program was initiated and carried out consistently during the early 1990s. It is argued that this period was characterized by a conscious shift to a democratic, market-oriented economy. The next key date marked in this study is the 21st Century, during which much of the transformation to a market-oriented economy had been largely completed. Poland joined the European Union, and gained access to EU structural funds in 2004.

The remainder of the paper is organized as follows. Section 2 describes the compositional shifts in export patterns of Poland using one digit SITC codes. Section 3 graphically details the compositional evolution by product sector. Section 4 concentrates on presenting the Polish intra-industry trade. Section 5 shows the top ten machinery exports of Poland for the years 1980, 1990, 1995, 2000, 2005 and the last year of the sample, 2009. Section 6 derives the degree of specialization of machinery exports of Poland. Section 7 deduces the degree of sophistication of the machinery exports. Section 8 concludes.

2. Broad compositional shifts in Poland's export patterns

Table 1 identifies those products and product groups that reflected the major gains in Poland's international specialization during the decades between 1980 and 2009.

Table 1. A Survey of Poland's export composition 1980–2009

SITC REV.2	Description	Percent of all exports			
		1980	1990	2004	2009
0	food and live animals	5	13	7	9
1	beverages and tobacco	1	1	0	1
2	crude materials	6	9	3	2
3	mineral fuels etc	20	12	6	2
4	animal based products	0	0	0	0
5	chemicals	6	9	6	7
6	basic manufactures	18	28	25	20
7	machinery	40	20	30	40
8	misc manufactures	10	7	21	14
9	goods not classed	0	0	2	2

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

In 1980, Poland's three predominant export sectors were machinery (SITC 7), 40% of all commodity exports, mineral fuels (oil based) (SITC 3), 20%, basic manufactures (SITC 6), 18%, and miscellaneous manufactures (SITC 8), 10%. Notable was the relative dearth of Polish exports of primary, relatively unsophisticated products (SITC 0, 1, 2, 4). In short, Poland provided the Soviet Bloc with two main SITC codes, one being machinery and the other minerals and oil products.

During the decade 1980–1990 following the labor disturbances that signaled the imminent collapse of the Soviet system, the major changes in Poland's export composition suggest a retreat from specialization and from sophistication. The primary exports of food and live animals increased from 5% to 13% of all Poland's exports. The only sectors that demonstrated a clear relative increase were SITC 2 (crude materials) which grew from 6% to 9%; and SITC 6, basic manufactures, which grew from 18% to 28 % of all exports. The relatively sophisticated sector, the SITC 7 – machinery, declined by 50%, from 40% to 20%, of all exports. In short, the immediate reaction to the collapse of the Soviet system was a shift away from sophisticated exports. A rough interpretation is largely explained by the shift of destination markets for Poland's exports away from the Soviet Union and other Eastern European countries to Germany and Western Europe. A simple classical paradigm would note that relative to the new configuration of markets, Poland had relatively less of a comparative advantage in relatively sophisticated products. Accordingly, the decade of the eighties saw a decline in the sophistication composition of Poland's exports.

The period following 1990 (to 2004) experienced a major reversal of the export compositional shift of the 1980s. This period saw a growing specialization in the relatively

sophisticated machinery categories. During this period, exports of food, fuel, and crude materials retreated as contributors to Poland's exports. The only two sectors that experienced relative growth were machinery (SITC 7) – from 20% to 30% of total Poland's exports, and miscellaneous manufactures (SITC 8), from 7% to 21%. The relatively less sophisticated, and less diversified sector SITC 6 maintained a relatively stable weight in Poland's exports during this period. In short, the relative homogeneous, commoditized primary and less sophisticated – defined by natural resource input – exports lost relative weights in favor of more sophisticated and diversified product groups (SITC 7 and SITC8). This was a sea-change in comparison to the immediate changes that characterized the decade following the traumatic break with the past of the 1980. Thus, during this period, Poland was rapidly finding its comparative advantage in diversified manufactures, and relatively complex and sophisticated machinery exports. In the period preceding the 1980s, Poland had been considered by its Soviet market, as a relatively technologically advanced partner. Though possessing an unsophisticated productive infrastructure relative to Western Europe, Poland had a history of industrial machinery exports, and was now rapidly adjusting to the diversified and sophisticated trading partners in Germany and Western Europe.

During this recent period (2004–2009) Poland became increasingly integrated into the European Union, and demonstrated an increasing degree of specialization and sophistication. Relative growth in the relative weight of its exports appeared to be limited to one sector, SITC 7, machinery, (from 30% to 40%). In 1980, the key destinations for Polish machinery (close to 90%) had been the markets of Soviet and Eastern Europe. By 2009, more than one quarter of its exports were now directed to Germany and other Western European countries. Nevertheless, the relative weight of the machinery sector (SITC 7) was practically identical in 2009 to what it had been in 1980.

3. Compositional shifts by product sector of Poland's exports

The following figures, Figure 1 through Figure 10 indicate the levels and changes in relative (value) weights of each of the major export sectors of Poland from 1980 to 2009. They enable the examination of the compositional shifts over time not only between the various (SITC) trade sectors, but within each of them. The figures present the compositional share in all commodity exports by individual product sectors.

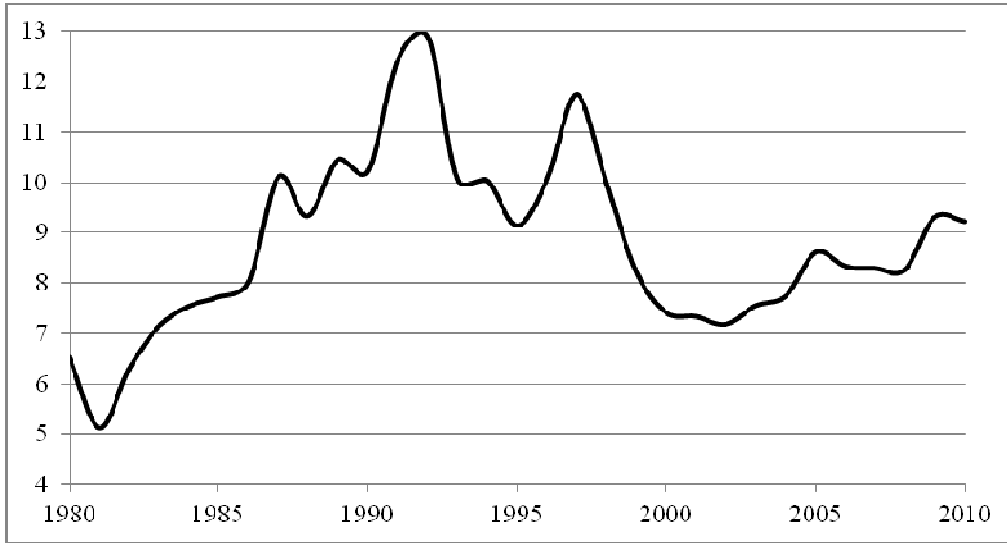


Figure 1. Share of food and live animals (SITC = 0) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

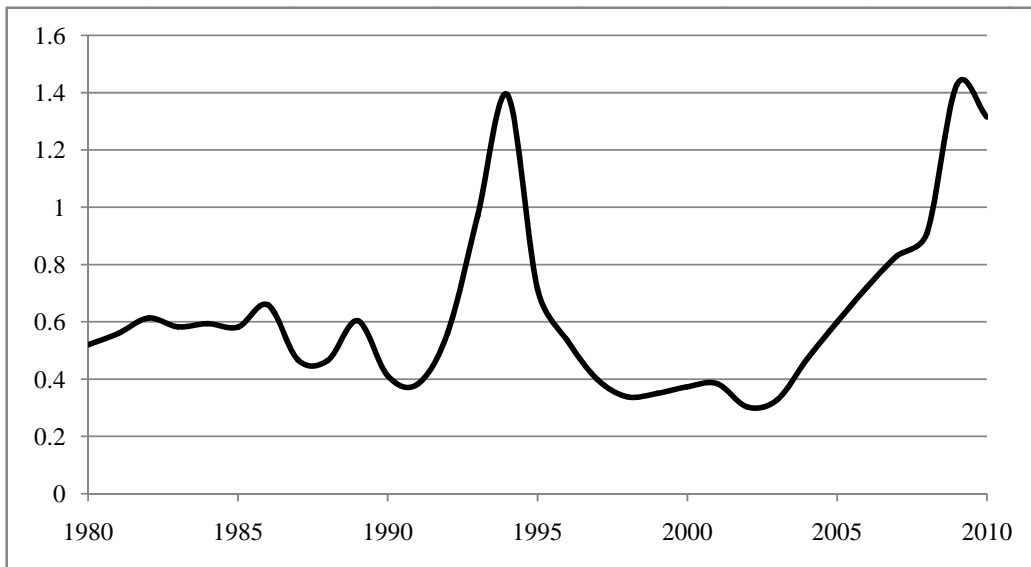


Figure 2. Share of beverages and tobacco (SITC = 1) in total commodity exports

Source: Own Calculations Based on International Merchandise Trade Statistics, United Nations Statistics.

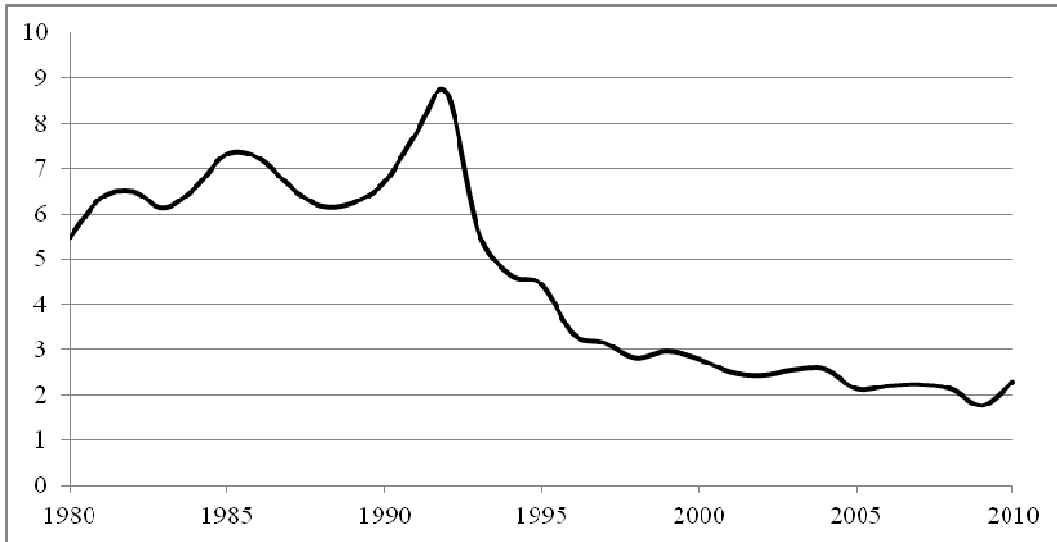


Figure 3. Share of crude materials (SITC = 2) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

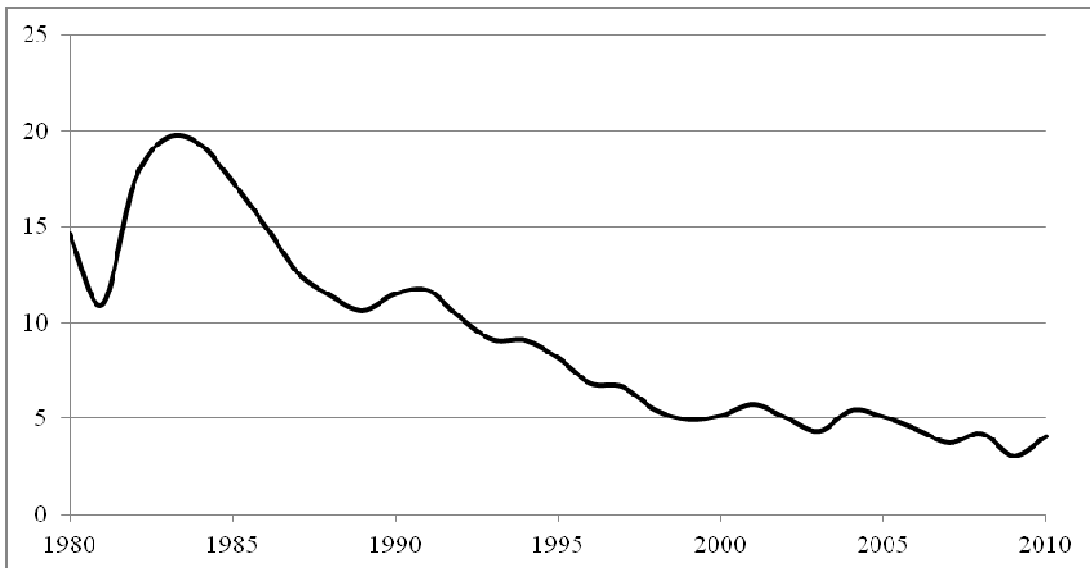


Figure 4. Share of mineral, fuels, etc. (SITC = 3) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

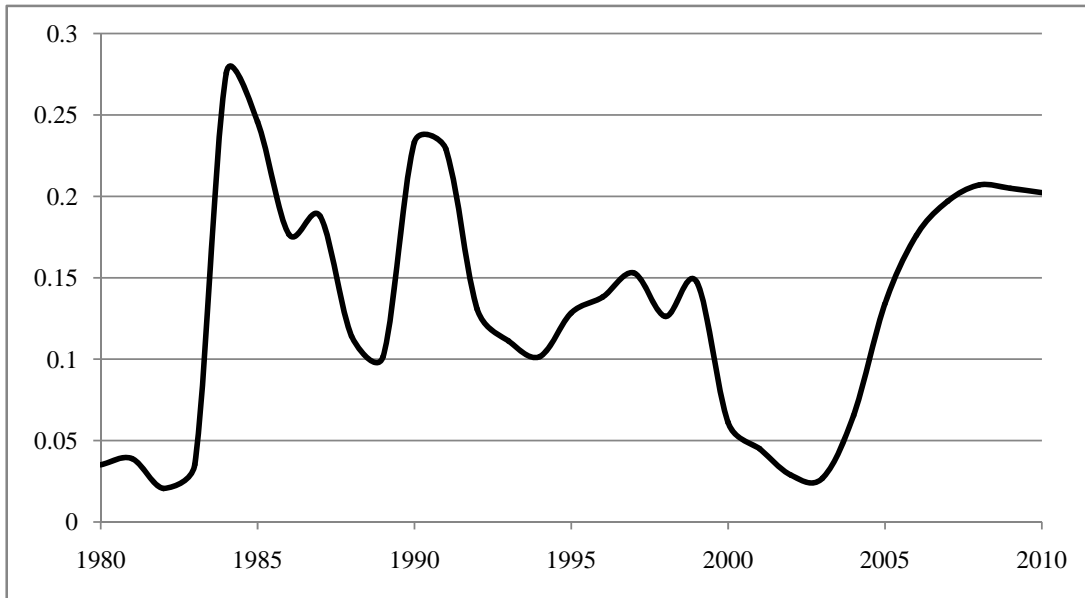


Figure 5. Share of animal based products (SITC = 4) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

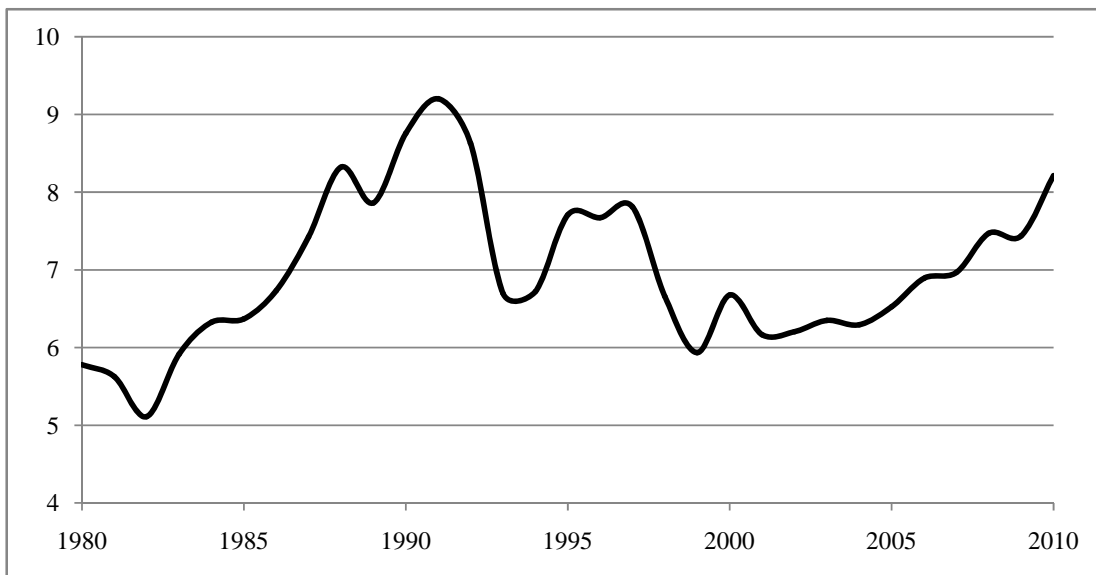


Figure 6. Share of chemicals (SITC = 5) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

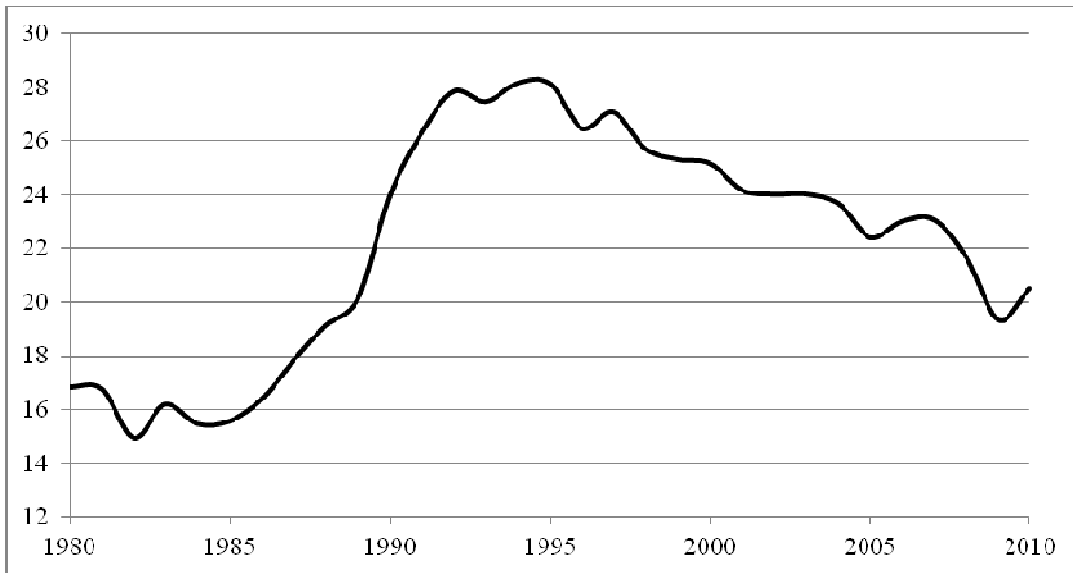


Figure 7. Share of basic manufactures (SITC = 6) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

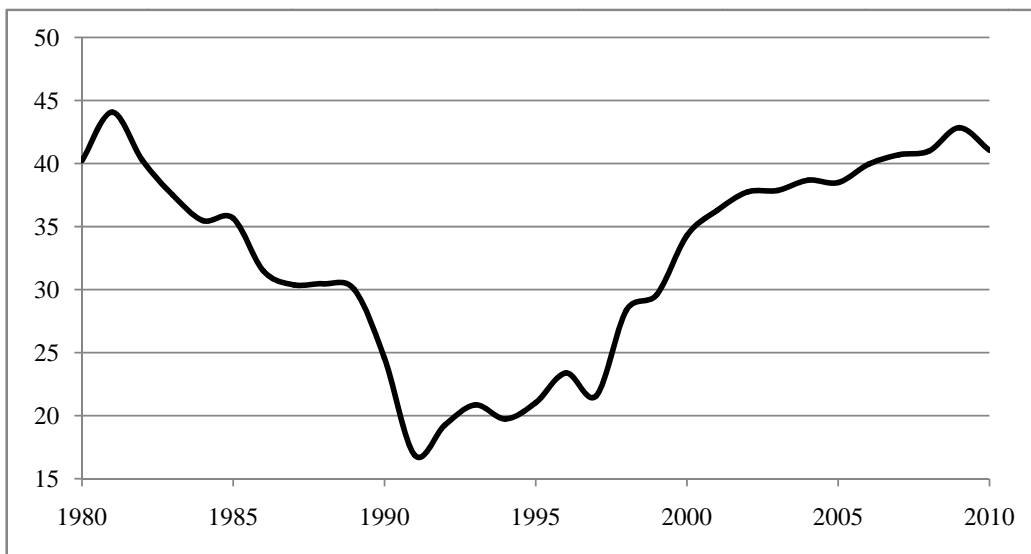


Figure 8. Share of machinery (SITC = 7) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

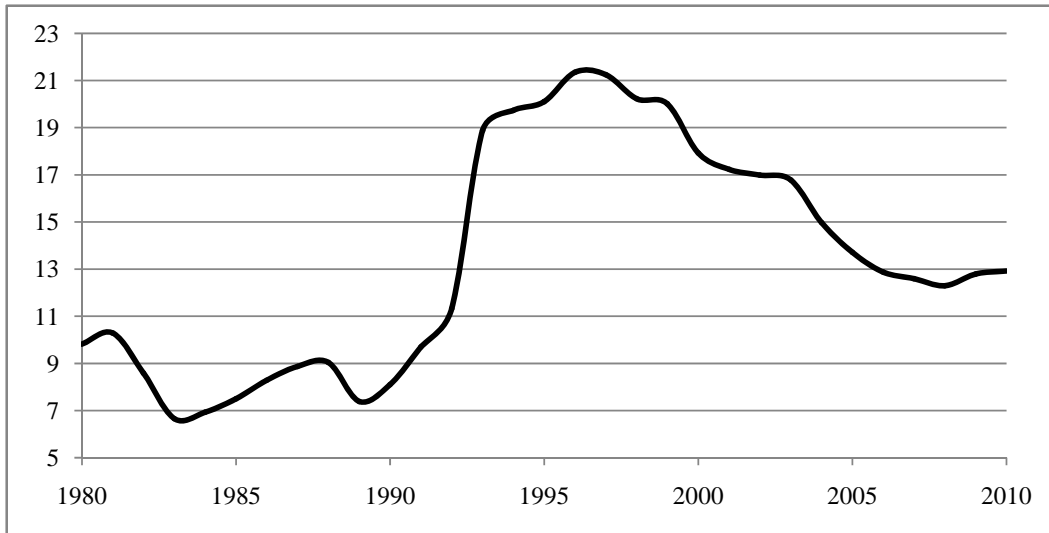


Figure 9. Share of miscellaneous manufactures (SITC = 8) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

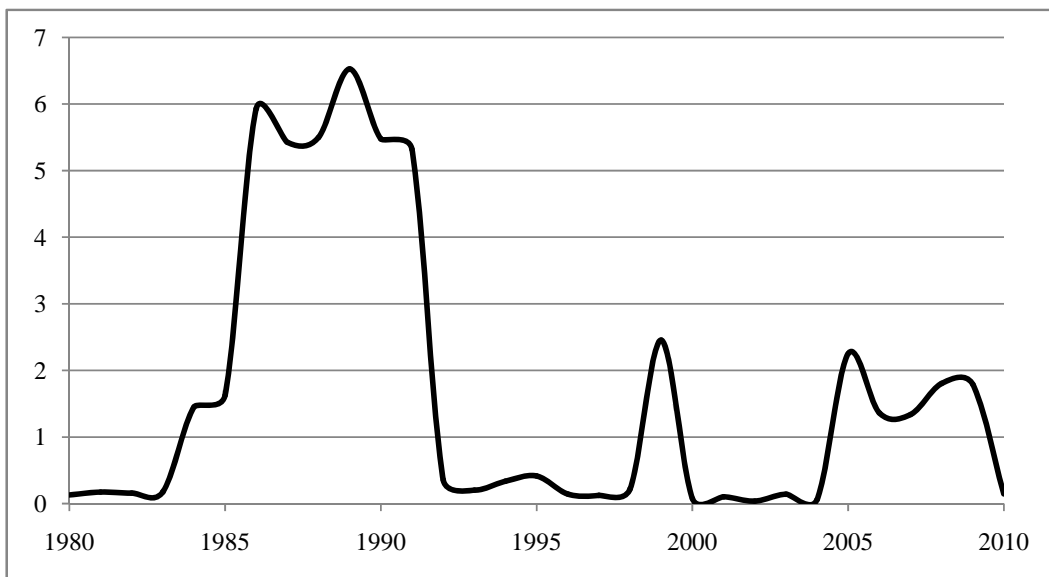


Figure 10. Share of goods not classified (SITC = 9) in total commodity exports

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

A commonality that is found to characterize each and every product sector is the sharp break in the dynamic pattern of the 1980s from that following 1990. These graphs were created using observations at relatively high levels of aggregation, i.e. one-digit SITC Rev 2. The presentations and discussion of subsequent findings in this paper utilize quite detailed, disaggregated data at the four-digit SITC Rev 2. Of especial relevance to the competitiveness of Poland's economy is the clear shift to machinery exports (SITC 7) in relative focus of its exports, since the early 1990's.

An important insight in International Trade Theory, pioneered by I.B. Kravis, is that major manifestations of competitiveness associated with the modern era have been embodied in a focus on exports of machinery and transport equipment (SITC 7). This subset has consistently been found to be a key to international competitiveness, as machinery exports more than other subsets of commodity exports, tend to continually embody technological innovations. For a citation here, see Appendix A below.

4. Patterns of Polish Intra-Industry Trade 1980–2009

One of the important features of modern international trade theory is intra-industry trade (IIT). Beginning in the 1960s, the presence of two-way trade among countries within individual product categories became noticeable [Grubel 1967]. This intra-industry trade has gone from being a curiosity to a major component of international trade. Whether the IIT phenomenon is of the "horizontal" or "vertical" type, it has generally been identified with relatively high levels of economic sophistication. Hence, most of the studies dealing with IIT find it characteristic of country trade for those countries that belong to the Organization for Economic Co-operation and Development (OECD). We therefore take this IIT measure as a proxy for the level of sophistication of the revealed comparative advantage of Poland.

A voluminous literature on IIT exists. However, this extensive literature has focused almost completely on explaining the causes of IIT. This emphasis has left a puzzling gap in the literature. Specifically, it is almost impossible to determine the level of IIT for a particular country. Furthermore, there is almost no information on the level of IIT at the industry level either globally or by country. In this paper we provide estimates of IIT for Poland. Further, we provide the levels, and changes over time in the IIT measure for each of ten different SITC commodity groups.

Figure 11 through Figure 21 present the total IIT of Poland, for each year from 1980 to 2009, and the IIT for each of the ten product categories SITC 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. These calculations are calculated by using the formula pioneered by Grubel and Lloyd [1971; 1975]:

$$\text{IIT Index} = 1 - |X_i - M_i| / (X_i + M_i)$$

where X_i denotes the export, M_i the import of good i .

If IIT index equals 1, there is only intra-industry trade, no inter-industry trade. Conversely, if the index is equal to zero, there is no intra-industry trade, only inter-industry trade.

This is the common equation used to calculate IIT in the literature. Figure 11 presents the 'country' IIT level for Poland, calculated at the two-digit SITC level of aggregation. Figure 12 through Figure 21 repeat the calculation for each of the ten SITC Product Sectors. Note that the IIT index ranges from a 0 (no two-way trade), to a value of unity (1), indicating 100% of all trade for that product sector may be characterized as two way trade.

POLAND INTRA-INDUSTRY TRADE 2-digit 1980-2009

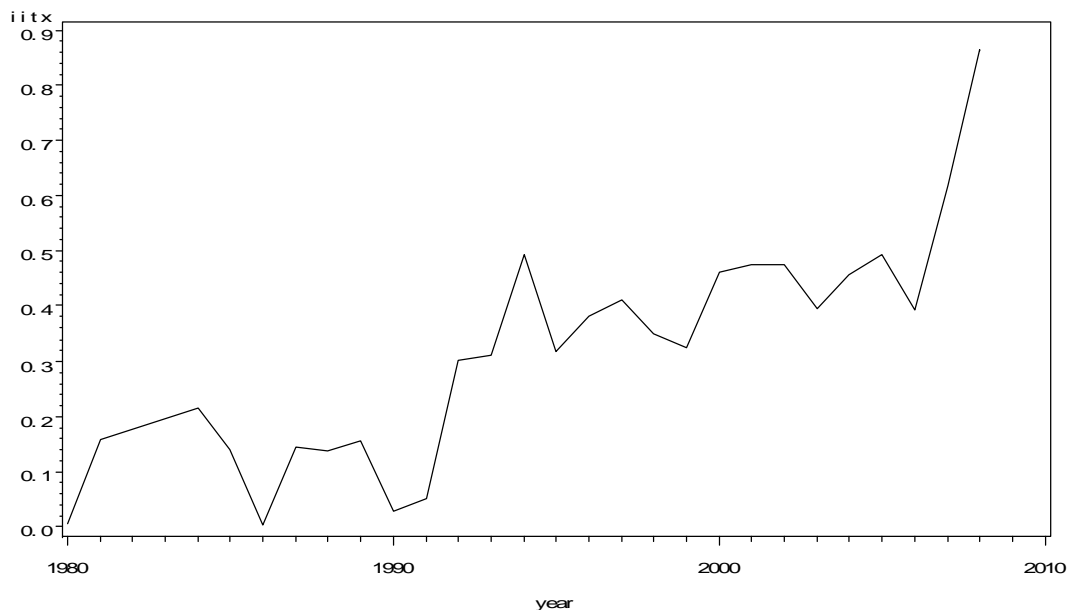


Figure 11. Poland Intra-Industry Trade (4-digit SITC classification) 1980-2009

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

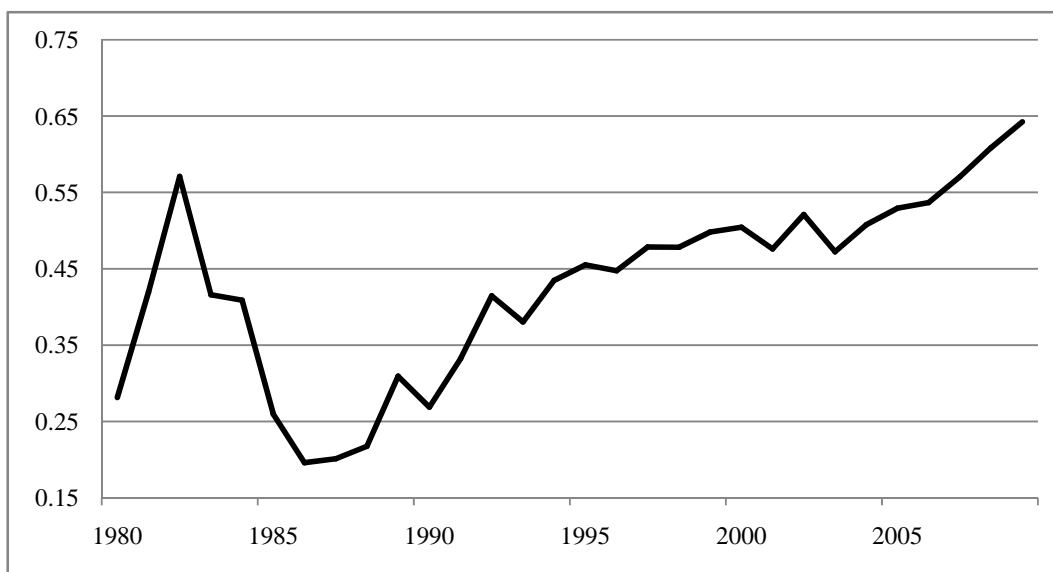


Figure 12. Poland Intra Industry Indices by one-digit SITC category for year 1980-2009 food and animals (SITC = 0)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

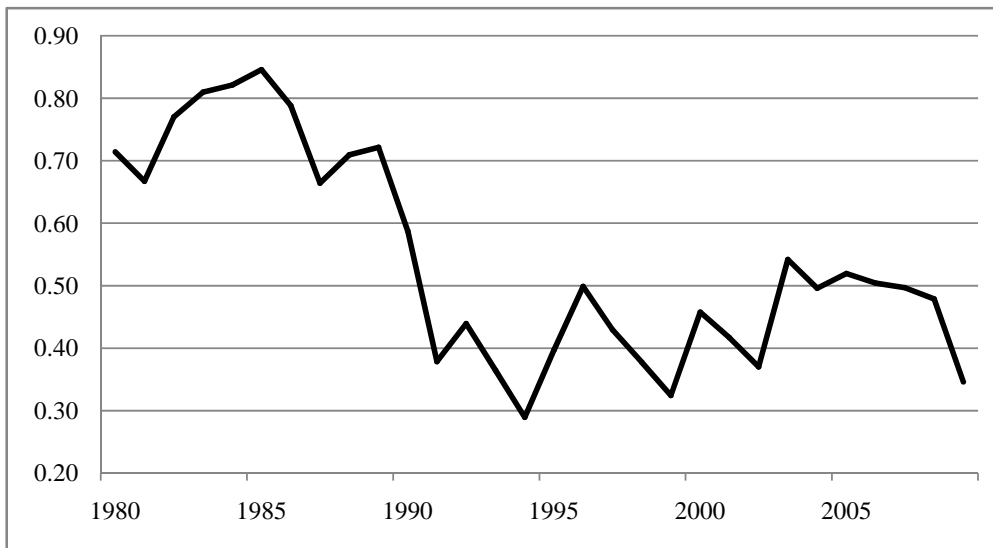


Figure 13. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 beverages and tobacco (SITC = 1)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

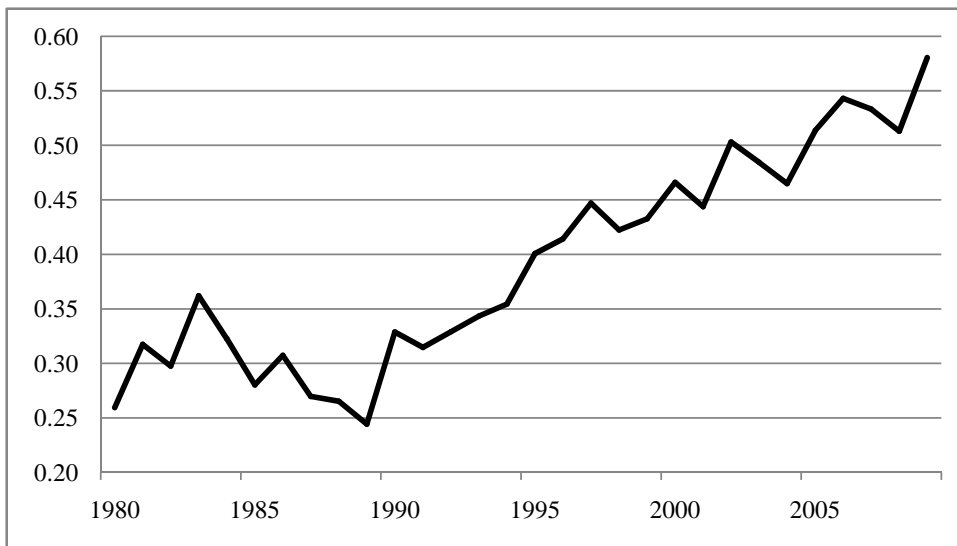


Figure 14. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 crude materials (SITC = 2)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

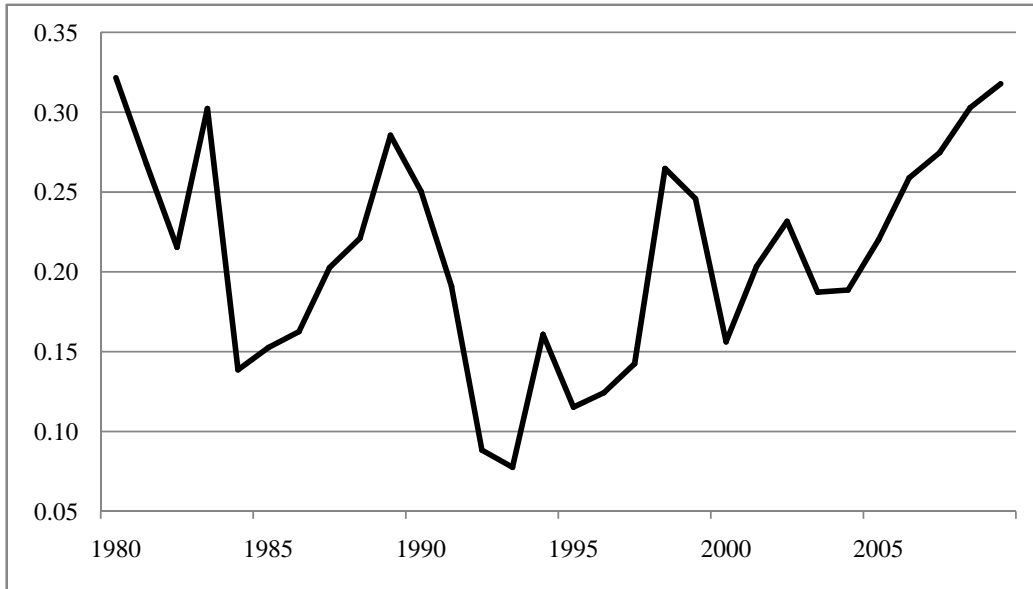


Figure 15. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 mineral, fuels, etc. (SITC = 3)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

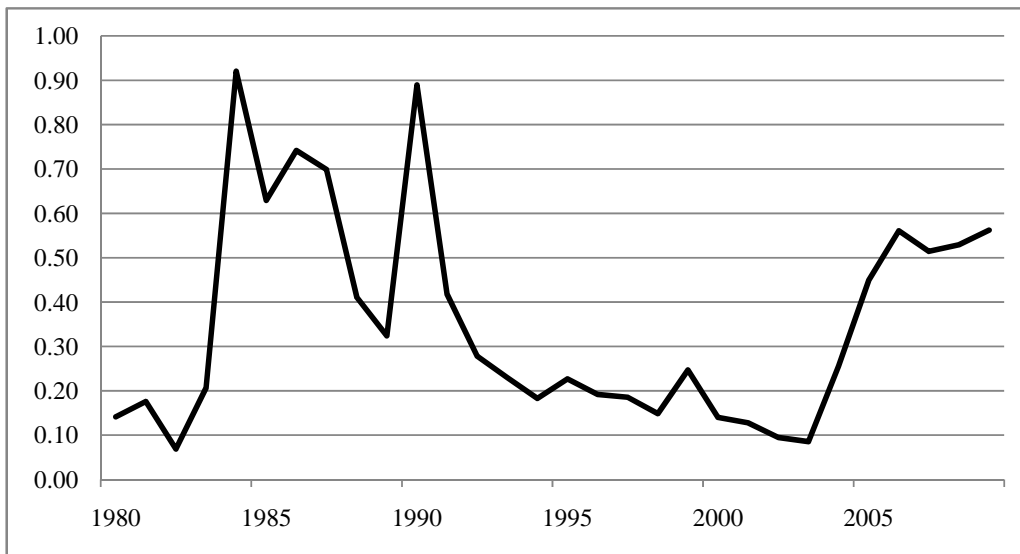


Figure 16. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 animal based products (SITC = 4)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

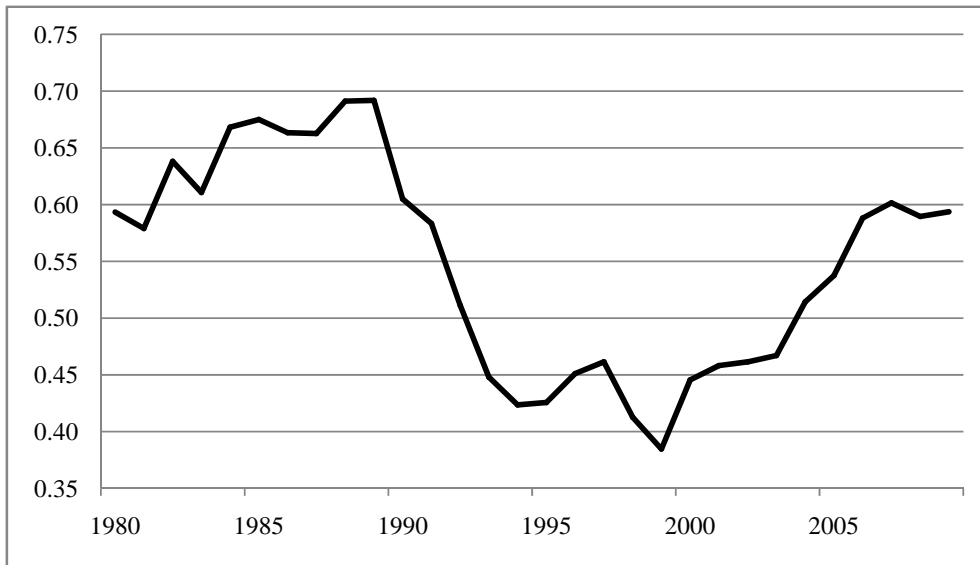


Figure 17. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 chemicals (SITC = 5)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

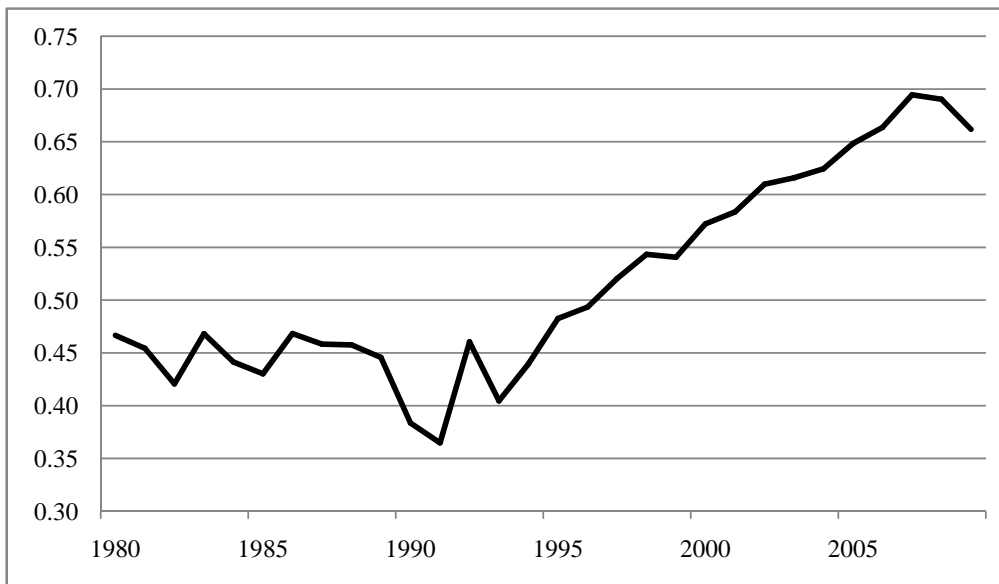


Figure 18. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 basic manufactures (SITC = 6)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

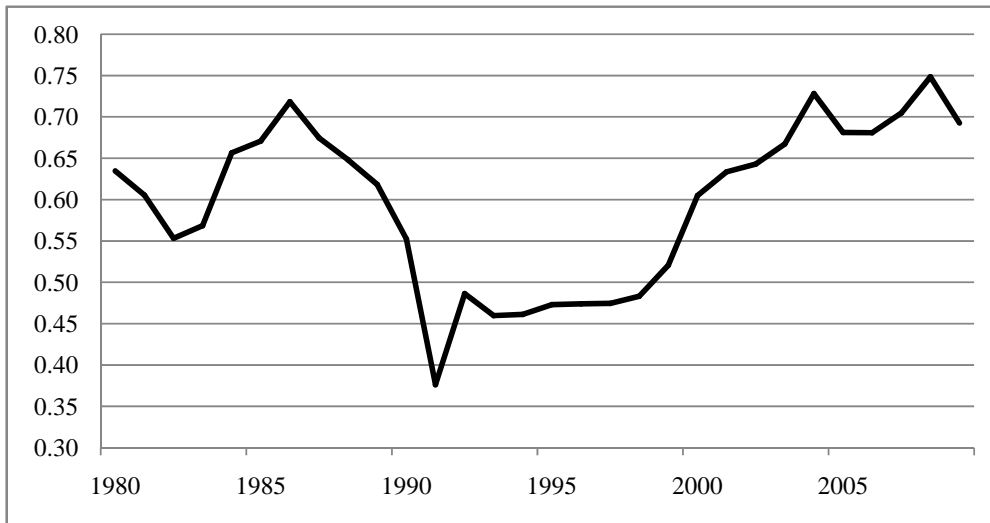


Figure 19. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 machinery (SITC = 7)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

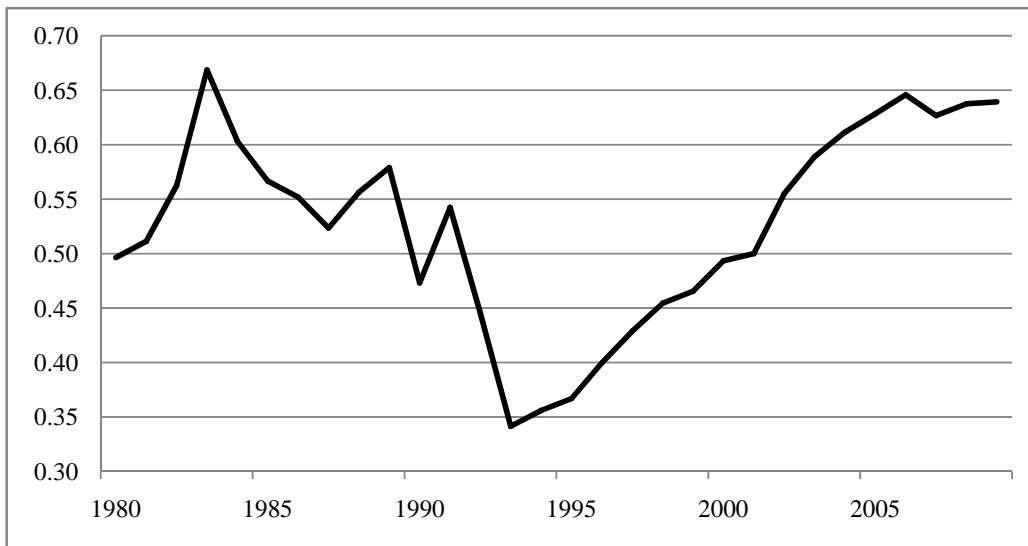


Figure 20. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 miscellaneous manufactures (SITC = 8)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

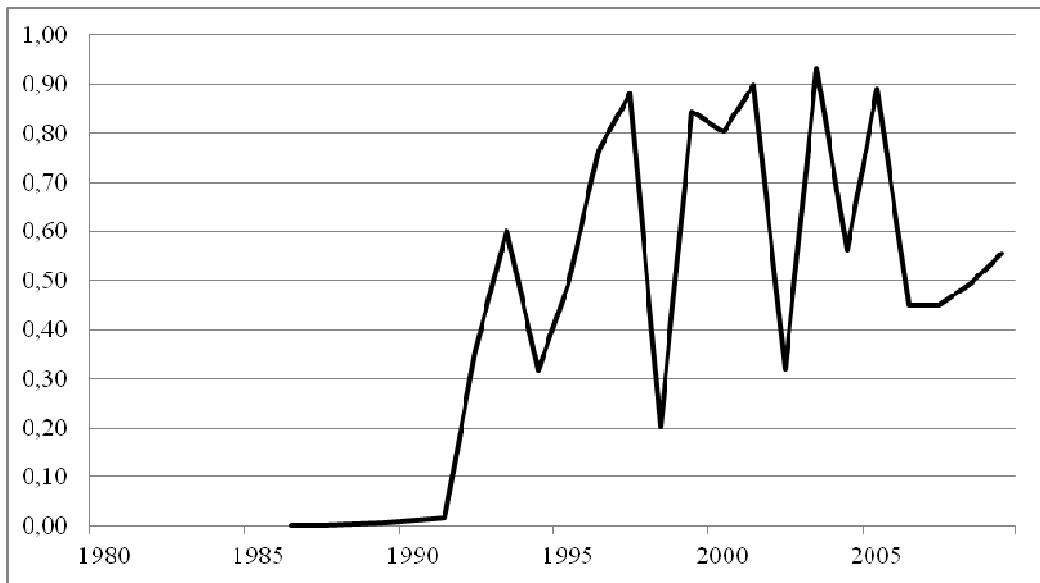


Figure 21. Poland Intra Industry Indices by one-digit SITC category for year 1980–2009 goods not classified (SITC = 9)

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

Figure 11 shows that from 1980 to 1990, the level of IIT remained relatively stagnant. However, from 1990 to 2009, an upward trend in IIT levels is evident. The question that must be answered is whether the patterns noted in Figure 11 are typical, or prevalent throughout the various export sectors, or whether they represent a compositional shift in the direction of sectors with rising IIT levels since 1990. An examination of the individual sectoral IIT patterns in Figures 12–21 finds that the aggregated pattern in Figure 11 is not replicated in the case of each and every product sector. It is, however, clear that the general all-Poland pattern in Figure 11 is found replicated in two of the relatively sophisticated, and the most rapidly growing sectors, notably that of SITC 7 that grew from 20% of all Poland’s commodity exports in 1990 to 40% in 2009. Hence, the overall pattern characterizing all of Poland’s commodity exports is both a reflection of the IIT pattern in SITC 7 (machinery), and also of the compositional shift from 1990 in favor of machinery as a rapidly growing component in Poland’s trade. Both the shift toward the relatively sophisticated product Sector ‘machinery’, and the intra-sectoral shift within the ‘machinery’ sector lead to expectations of high levels of competitiveness of Poland in its international markets during the current period as the markets emerge from the effects of the global crisis.

5. Top Ten Machinery Exports of Poland 1980–2009

Table 2 identifies the ten specific machinery products whose exports constituted the largest value in each of the years 1980, 1990, 1995, 2000, 2005 and 2009.

Table 2. Ten Top Machinery Exports by year 1980–2009

Year	SITC	Export (USD 000)	Description
(1)	(2)	(3)	(4)
1980	7783	\$61,661,440.00	Automotive electrical equipment and parts thereof, nes
1980	7782	\$54,140,712.00	Electric filament lamps and discharge lamps arc-lamps
1980	7648	\$36,572,752.00	Telecommunications equipment, nes
1980	7788	\$28,871,294.00	Other electrical machinery and equipment, nes
1980	7643	\$10,571,164.00	Television, radio-broadcasting transmitters, etc
1980	7518	\$5,267,232.00	Office machines, nes
1980	7784	\$4,928,335.00	Electro-mechanical hand tools, and parts thereof, nes
1980	7415	\$4,004,299.00	Air conditioning machines and parts thereof, nes
1980	7511	\$3,877,240.00	Typewriters cheque-writing machines
1980	7641	\$812,707.00	Electrical line telephonic and telegraphic apparatus
1990	7782	\$46,779,496.00	Electric filament lamps and discharge lamps arc-lamps
1990	7788	\$30,181,665.00	Other electrical machinery and equipment, nes
1990	7783	\$14,514,442.00	Automotive electrical equipment and parts thereof, nes
1990	7648	\$13,753,583.00	Telecommunications equipment, nes
1990	7641	\$5,234,288.00	Electrical line telephonic and telegraphic apparatus
1990	7415	\$5,201,719.00	Air conditioning machines and parts thereof, nes
1990	7643	\$3,882,640.00	Television, radio-broadcasting transmitters, etc
1990	7518	\$1,461,113.00	Office machines, nes
1990	7784	\$1,372,719.00	Electro-mechanical hand tools, and parts thereof, nes
1990	7511	\$1,303,864.00	Typewriters cheque-writing machines
1995	7932	\$950,377,024.00	Ships, boats and other vessels
1995	7810	\$658,944,000.00	Passenger motor vehicles (excluding buses)
1995	7731	\$268,716,992.00	Insulated electric wire, cable, bars, etc
1995	7821	\$179,848,992.00	Motor vehicles for the transport of goods or materials
1995	7761	\$164,968,000.00	Television picture tubes, cathode ray
1995	7782	\$132,884,000.00	Electric filament lamps and discharge lamps arc-lamps
1995	7491	\$93,456,000.00	Ball, roller or needle roller bearings
1995	7234	\$87,633,000.00	Construction and mining machinery, nes
1995	7788	\$84,431,000.00	Other electrical machinery and equipment, nes
1995	7861	\$72,803,000.00	Trailers and transports containers
2000	7810	\$1,462,904,960.00	Passenger motor vehicles (excluding buses)
2000	7932	\$889,832,000.00	Ships, boats and other vessels
2000	7611	\$635,113,984.00	Television receivers, color
2000	7731	\$614,838,016.00	Insulated electric wire, cable, bars, etc
2000	7821	\$446,376,992.00	Motor vehicles for the transport of goods or materials

(1)	(2)	(3)	(4)
2000	7782	\$194,356,992.00	Electric filament lamps and discharge lamps arc-lamps
2000	7761	\$179,116,000.00	Television picture tubes, cathode ray
2000	7491	\$144,314,000.00	Ball, roller or needle roller bearings
2000	7931	\$122,165,000.00	Warships
2000	7758	\$121,121,000.00	Electro-thermic appliances, nes
2005	7810	\$5,379,791,288.00	Passenger motor vehicles (excluding buses)
2005	7731	\$1,943,587,577.00	Insulated electric wire, cable, bars, etc
2005	7611	\$1,791,935,883.00	Television receivers, color
2005	7821	\$1,052,248,109.00	Motor vehicles for the transport of goods or materials
2005	7751	\$599,706,129.00	Household laundry equipment, nes
2005	7831	\$511,849,590.00	Public service type passenger motor vehicles
2005	7491	\$372,133,414.00	Ball, roller or needle roller bearings
2005	7783	\$345,504,823.00	Automotive electrical equipment and parts thereof, nes
2005	7711	\$300,709,094.00	Transformers, electrical
2005	7641	\$299,422,873.00	Electrical line telephonic and telegraphic apparatus
2009	7810	\$9,670,629,651.00	Passenger motor vehicles (excluding buses)
2009	7611	\$6,631,951,168.00	Television receivers, color
2009	7731	\$1,815,552,754.00	Insulated electric wire, cable, bars, etc
2009	7522	\$1,354,455,029.00	Complete digital data processing machines
2009	7751	\$1,292,010,589.00	Household laundry equipment, nes
2009	7821	\$1,281,142,379.00	Motor vehicles for the transport of goods or materials
2009	7831	\$1,141,301,272.00	Public service type passenger motor vehicles
2009	7783	\$657,105,531.00	Automotive electrical equipment and parts thereof, nes
2009	7753	\$523,906,680.00	Domestic dishwashing machines
2009	7711	\$498,596,539.00	Transformers, electrical

An examination of the respective ‘top ten’ machine exports reveals that during the 1980s the rate of introduction of new products was relatively slow. Of the top ten exported machinery products in 1990, only two were ‘new’, in the sense that they were not found in the top ten list of 1980 (telecommunications equipment nes, and electrical line telephonic and telegraphic apparatus). In other words, eight of the ten products in the top ten of 1990 were also in the top ten of 1980.

Comparing this to the rate of change in new products in the decade of the 1990s indicates an entirely different picture emerges. Of the top ten machinery exports of 2000, each and every one of these ten was new! In other words, not one product in the top ten exports of 1990 appear in the list of the top ten Polish machinery exports in the year 2000. Clearly, this was a dynamic period in which growing levels of product sophistication were being continually and rapidly introduced as novel products incorporating new technologies became the norm in the mix of machinery exports as Poland entered the XXI Century.

When comparing the identities of products in the top ten Polish machinery exports in 2009 with the list in the year 2000, evidence is found of a continued wave of new product introduction and, presumably of continual rapid technological ‘newness’, as six of the top ten in 2009 were not in the list of the top ten in 2000.

Table 3 presents the share of the ten top machinery exports as a percentage of total exports and as a share of total machinery exports for selected years, 1980–2009.

Table 3. Share of ten top machinery exports out of total exports and total machinery exports and by year 1980–2009

Year	SITC	Description	Share out of total exports	Share out of total machinery
(1)	(2)	(3)	(4)	(5)
1980	7783	Automotive electrical equipment and parts thereof, nes	0.927%	9.744%
1980	7782	Electric filament lamps and discharge lamps arc-lamps	0.814%	8.556%
1980	7648	Telecommunications equipment, nes	0.550%	5.780%
1980	7788	Other electrical machinery and equipment, nes	0.434%	4.563%
1980	7643	Television, radio-broadcasting transmitters, etc	0.159%	1.671%
1980	7518	Office machines, nes	0.079%	0.832%
1980	7784	Electro-mechanical hand tools, and parts thereof, nes	0.074%	0.779%
1980	7415	Air conditioning machines and parts thereof, nes	0.060%	0.633%
1980	7511	Typewriters cheque-writing machines	0.058%	0.613%
1980	7641	Electrical line telephonic and telegraphic apparatus	0.012%	0.128%
1990	7782	Electric filament lamps and discharge lamps arc-lamps	0.740%	15.620%
1990	7788	Other electrical machinery and equipment, nes	0.477%	10.078%
1990	7783	Automotive electrical equipment and parts thereof, nes	0.230%	4.846%
1990	7648	Telecommunications equipment, nes	0.218%	4.592%
1990	7641	Electrical line telephonic and telegraphic apparatus	0.083%	1.748%
1990	7415	Air conditioning machines and parts thereof, nes	0.082%	1.737%
1990	7643	Television, radio-broadcasting transmitters, etc	0.061%	1.296%
1990	7518	Office machines, nes	0.023%	0.488%
1990	7784	Electro-mechanical hand tools, and parts thereof, nes	0.022%	0.458%
1990	7511	Typewriters cheque-writing machines	0.021%	0.435%
1995	7932	Ships, boats and other vessels	4.181%	19.768%
1995	7810	Passenger motor vehicles (excluding buses)	2.899%	13.706%
1995	7731	Insulated electric wire, cable, bars, etc	1.182%	5.589%
1995	7821	Motor vehicles for the transport of goods or materials	0.791%	3.741%
1995	7761	Television picture tubes, cathode ray	0.726%	3.431%
1995	7782	Electric filament lamps and discharge lamps arc-lamps	0.585%	2.764%
1995	7491	Ball, roller or needle roller bearings	0.411%	1.944%
1995	7234	Construction and mining machinery, nes	0.386%	1.823%
1995	7788	Other electrical machinery and equipment, nes	0.371%	1.756%

(1)	(2)	(3)	(4)	(5)
1995	7861	Trailers and transports containers	0.320%	1.514%
2000	7810	Passenger motor vehicles (excluding buses)	4.627%	13.551%
2000	7932	Ships, boats and other vessels	2.815%	8.243%
2000	7611	Television receivers, colour	2.009%	5.883%
2000	7731	Insulated electric wire, cable, bars, etc	1.945%	5.695%
2000	7821	Motor vehicles for the transport of goods or materials	1.412%	4.135%
2000	7782	Electric filament lamps and discharge lamps arc-lamps	0.615%	1.800%
2000	7761	Television picture tubes, cathode ray	0.567%	1.659%
2000	7491	Ball, roller or needle roller bearings	0.456%	1.337%
2000	7931	Warships	0.386%	1.132%
2000	7758	Electro-thermic appliances, nes	0.383%	1.122%
2005	7810	Passenger motor vehicles (excluding buses)	6.019%	15.638%
2005	7731	Insulated electric wire, cable, bars, etc	2.175%	5.650%
2005	7611	Television receivers, colour	2.005%	5.209%
2005	7821	Motor vehicles for the transport of goods or materials	1.177%	3.059%
2005	7751	Household laundry equipment, nes	0.671%	1.743%
2005	7831	Public service type passenger motor vehicles	0.573%	1.488%
2005	7491	Ball, roller or needle roller bearings	0.416%	1.082%
2005	7783	Automotive electrical equipment and parts thereof, nes	0.387%	1.004%
2005	7711	Transformers, electrical	0.336%	0.874%
2005	7641	Electrical line telephonic and telegraphic apparatus	0.335%	0.870%
2009	7810	Passenger motor vehicles (excluding buses)	7.077%	16.677%
2009	7611	Television receivers, colour	4.854%	11.437%
2009	7731	Insulated electric wire, cable, bars, etc	1.329%	3.131%
2009	7522	Complete digital data processing machines	0.991%	2.336%
2009	7751	Household laundry equipment, nes	0.946%	2.228%
2009	7821	Motor vehicles for the transport of goods or materials	0.938%	2.209%
2009	7831	Public service type passenger motor vehicles	0.835%	1.968%
2009	7783	Automotive electrical equipment and parts thereof, nes	0.481%	1.133%
2009	7753	Domestic dishwashing machines	0.383%	0.904%
2009	7711	Transformers, electrical	0.365%	0.860%

6. The degree of specialization of Poland's machinery exports

This section examines the degree of specialization in Poland's machinery exports and its changes over the period covered in this paper. The technique used is that presented and developed by the authors in a recent article [Kellman and Shachmurove 2011].

The Trade Specialization Index (TSI) used here and presented in the following Figure is similar conceptually the Herfindahl-Hirschman index (HHI) used by the U.S. Federal Trade Commission when determining the degree of market concentration in a group of

industries, see, for example, Peppall, Richards, and Norman (2008). The higher the TSI index, the higher is the degree of specialization [see Kellman and Shachmurove 2011]. These measures are calculated using the relatively detailed, or disaggregated, data at the 4-digit SITC Rev 2. Just as the HHI index is typically interpreted as measure of competitiveness within an industry, so the TSI measure can be interpreted as a measure of potential competitiveness of the international trade sector of a country.

The Specialization Index defines ‘specialization’ as coinciding with, or consisting of, the level of dispersion between the volumes exported. The higher the dispersion is, the higher the degree of specialization. As discussed in the article referenced above, the problem of identifying and measuring the degree of specialization in international trade is conceptually similar to the need for a sensible measure of market power in Industrial Organization. As noted, the Trade Specialization Index (TSI) is methodologically similar to the HHI index [see Kellman and Shachmurove 2011].

It is clear that during the decade and a half following the collapse of the COMECON state-trading system from 1980 to 1995, there was a clear decrease in the degree of specialization in Polish exports. This was a period in which Poland's exports of relatively sophisticated machinery tended to decrease as a proportion of all commodity exports. Within the machinery product sector, one might have expected the opportunity to export to a relatively sophisticated West European market to have elicited a growing degree of specialization in those types and varieties in which Poland may have enjoyed a comparative advantage. In fact, this is not what happened. It seems that this period up to the mid 1990s was one in which the need to establish new and unfamiliar marketing channels brought forth a broadening of selection, both in types of machines, and presumably varieties of quality. This was also a period in which non-sophisticated commodity exports grew relatively rapidly. However, from 1994, when Poland officially was accepted as a member of the European Union, its machinery exports increasingly demonstrated a growing degree of specialization as Poland pursued a narrower band of specialization in which its comparative advantage has been revealed.



Figure 22. Poland machinery exports specialization index

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

7. Degree of sophistication of Poland's machinery exports

This section presents an index that was specifically designed to measure the level of sophistication of a country's export mix. Lall, Weiss and Zhang [2006] first presented and calculated this index in *The "Sophistication" of Exports: A New Trade Measure*. That article presented two indices, one built on trade data in 1990, and the other for the year 2000. We utilize both indices. Each point in the following Figures 23 and 24 indicates a weighted average for each of the two Sophistication indices. The weights are Poland's export values, calculated at the 4-digit SITC Rev 2 level of aggregation. The indices refer to data aggregated up to the 3-digit level, as presented in Lall, Weiss and Zhang [2006]. To our knowledge, this is the first time the sophistication index has been used in an empirical examination of the characteristics of trade of any transitional economy.

In today's international environment in which comparative advantages are not typically associated with natural resource endowments, but rather are created in part by trade environments and trade policies, competitiveness is typically believed to be closely associated with the ability to maintain levels of sophistication in those products in which a country gains international market shares. Sala-i-Martin [2010, p. 9], in De Grauwe's *Dimensions of Competitiveness* [2010] explicitly cites level of sophistication as one of the key 'pillars of competitiveness' (the 11th Pillar).

1990 Sophistication index

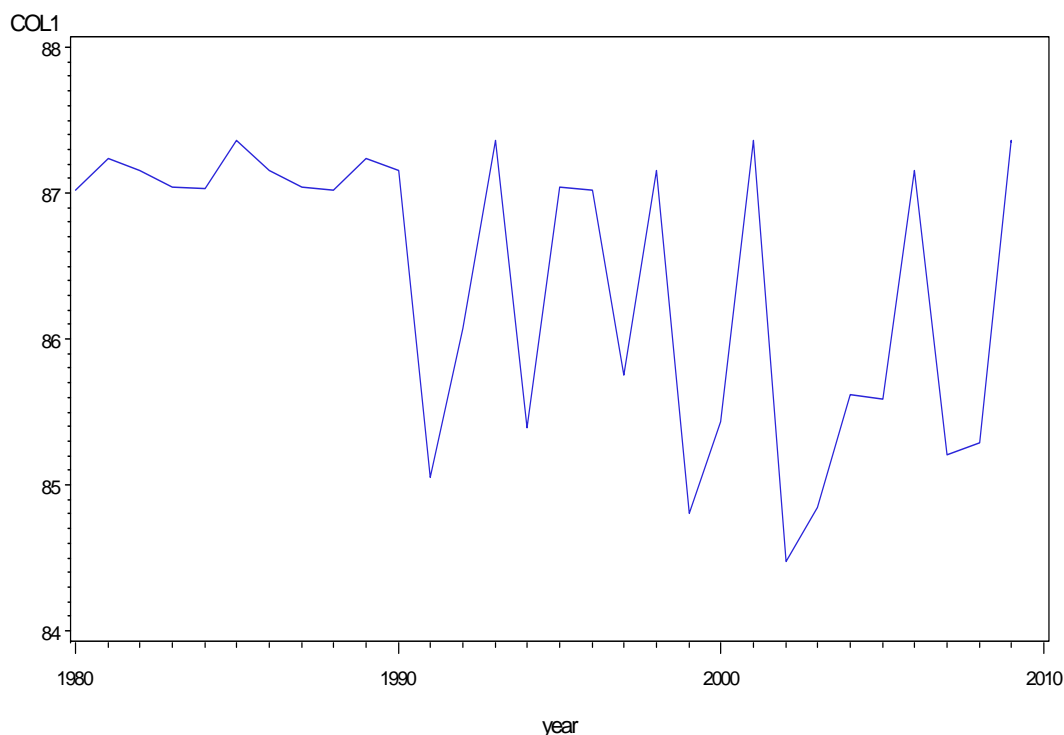


Figure 23. 1990 Sophistication Index

Source: Own calculations based on International Merchandise Trade Statistics, United Nations Statistics.

It seems clear from Figure 23, that during the first decade following 1980, there were relatively small changes in the measured sophistication of Poland's machinery exports. Then, during the 1990s, there seemed to be a tendency for a decrease in this measure of sophistication. Next, from 1999 to 2009, the trend seems to be somewhat positive.

In order to obtain an objective indication of the trend, we estimate an Ordinary Least Squared (OLS) econometric trend for the entire period. The time trend coefficient shows a decreasing level of sophistication (significant at the 5% significance level). When the estimation is repeated for the years from late 1999's to 2009, the coefficient is somewhat positive (significant only at the 10% level). These results are obtained for the indices based on 1990 indices.

1990 Sophistication Index

The REG Procedure; Model: MODEL1 (1980–2009)
 Dependent Variable: COL1
 Number of Observations Read 30
 Number of Observations Used 30

Analysis of Variance					
Source	DF	Sum of squares	Mean square	F Value	Pr > F
Model	1	7.09759	7.09759	9.68	0.0043
Error	28	20.52311	0.73297		
Corrected Total	29	27.62070			

Parameter Estimates					
Variable	DF	Parameter estimate	Standard error	t Value	Pr > t
Intercept	1	198.49903	36.01893	5.51	<.0001
year	1	-0.05620	0.01806	-3.11	0.0043

The REG Procedure; Model: MODEL2 (2001–2009)
 Dependent Variable: COL1
 Number of Observations Read 8
 Number of Observations Used 8

Analysis of Variance					
Source	DF	Sum of squares	Mean square	F Value	Pr > F
Model	1	3.08120	3.08120	4.15	0.0877
Error	6	4.45004	0.74167		
Corrected Total	7	7.53124			

Parameter Estimates					
Variable	DF	Parameter estimate	Standard error	t Value	Pr > t
Intercept	1	-457.50280	266.50451	-1.72	0.1369
year	1	0.27085	0.13289	2.04	0.0877

Conclusions

This paper applies several mutually independent statistical tests to examine the hypothesis that Poland reacted to the major shift in its international economic environment flexibly, rapidly and rationally. The results obtained from all five tests support the assumption that this transition was accomplished in a relatively short period of time despite the major disruptive changes called for by the nature of the new competitive challenges.

The first test, examining relatively aggregate (one-digit SITC) data documents the immediate or impact effect during the decade of the 1980s. In this short period, Poland was able to shift away from a relatively high concentration on relatively sophisticated relatively low quality machines due to the fact that the Soviet system did not reward quality. While the pre 1980 fulfilled the needs of the Soviet Union that tended to focus quality issues within a narrow military scope, it was the wrong 'mix' for the new consumer-directed market environment. During the relatively short period, Poland managed to create a major change in its export composition, away from those relatively sophisticated sectors in which it suffered a clear comparative disadvantage vis-à-vis its new and increasingly dominant trade partners in Western Europe.

The same shift in compositional pattern was evidenced when the data focused on detailed, product groups at the four-digit SITC level of aggregation. Whereas the first part of the study noted a systematically decreasing weight of machines in all exports (an inter-sector perspective), the second takes an intra-sectoral point of view. This second stage of this paper examines the measure of product specialization **within** the machine (SITC 7) product group. Note that this section focuses solely on exports of machines (SITC 7). The findings is that in the 1980s, Poland tended to become less concentrated or specialized in a relatively small number of types of machinery. In other words, Poland was producing a larger variety of machines, and in this way was becoming less specialized within the machinery product export sector.

The third part of the study calculates the (Grubel) measure of intra-industry ('two-way') trade. Since this measure has been used in the literature as a measure of sophistication, and has typically been associated primarily with the exports of relatively rich and relatively sophisticated producers, we use this measure as a proxy for product sophistication. Again, it is found that the relative weight of intra-industry exports within the machinery exports of Poland tended to decline during the 1980s.

The fourth test applied the Lall, Weiss and Zhang 'Sophistication Index'. This index, developed only recently [Lall, Weiss and Zhang 2006], and has not to our knowledge applied to examine the shifts in sophistication of any given country, notably any transitional economy. This is the first such application of this new index in the literature. The Lall Weiss and Zhang Index associates the degree of sophistication that attaches to any given exported product with the per capita income associated with the country mix of the exports of any given exported product, at three and then again at the four-digit SITC levels of aggregation. We use the indices calculated for 1990 and then again 2000 in Lall, Weiss and Zhang [2006]. In this case, the index we use had been designed to reflect the level of prod-

uct sophistication. It is important to note that this Sophistication Index is not related functionally or conceptually with the measures we have used to this point (e.g., with the Kellman–Shachmurove TSI index, or the Grubel IIT measure).

We obtain one value for the Sophistication Index (SI) for each year. This is the weighted average of the product specific values of SI calculated by Lall, Weiss and Zhang for 1990. These are in turn weighted by the specific composition of Poland's machine exports for each year. Though the time pattern of the weighted SI are not as clear and obvious to the eye as those obtained from the other indices and measures in this paper, it is still valid that the pattern obtained from the other indices is, if weakly, supported by the time pattern for SI. In short, the levels of overall sophistication of the Polish machinery exports tend to decrease over the 1980s. This is in turn supported by an econometric estimation applying an OLS time trend model with the SI as the explained variable, and the year as the independent variable. The results are found to be significant at the five- percent level.

In each of the five independent measurements of the degree of sophistication embodied in Polish machinery exports, there is a consistently observed, and explicitly estimated, positive time trend characterizing the period roughly from the point at which Poland joined the European Union to the last year of the sample, the year 2009. Finally, the results summarized in this chapter were found to reveal a clear capability to maintain international Competitiveness even during the recent major Global Crisis that affected all of Poland's major international markets.

Appendix A

Why Focus on SITC 7?

We chose the subset entitled machinery and transport equipment, following the extensive work pioneered by Kravis and Lipsey [1982]. The products, which fall within SITC 7, include all machinery, transport equipment telecommunications equipment, and computer-related products. These would include all ‘finished capital goods’ (as defined in Vollrath and Johnston 1991), which require intense use of skilled labor and of capital. These would also encompass most ‘producer goods’ (as defined by Richardson and Zhang 2001, p. 205). Finally, Kravis and Lipsey (1982) note in several places, that this group of products is especially important in international trade. This special or key importance of this product group – machinery (SITC 7) is widely followed and cited in the literature [Lipsey 1971; Kravis and Lipsey 1982a; 1982b;]. Finally, whereas products falling in categories 0 through 6 tend to be raw material intensive, and homogeneous; those in category 7 are not. This means that neither centralized commodity exchange pricing, nor fortuitous availability of raw materials (or the lack thereof) are likely to affect the levels or changes in revealed comparative advantage for these products. Hence, we may focus directly on ‘Acquired’ comparative advantage (rather than on ‘Natural’ comparative advantage), which is more likely to be affected by trade policy within the exporting country.

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