

**Changes in Foreign Trade Patterns
and Its Impact on Labor Productivity:
Applying Input-Output Methodology
to the Case of Poland**

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Empirical study for Poland

Can we prove, on the basis on available statistics, that **changes in foreign trade** influenced the **effectiveness of the economy**, and if so, to what extent?

Two types of **changes**:

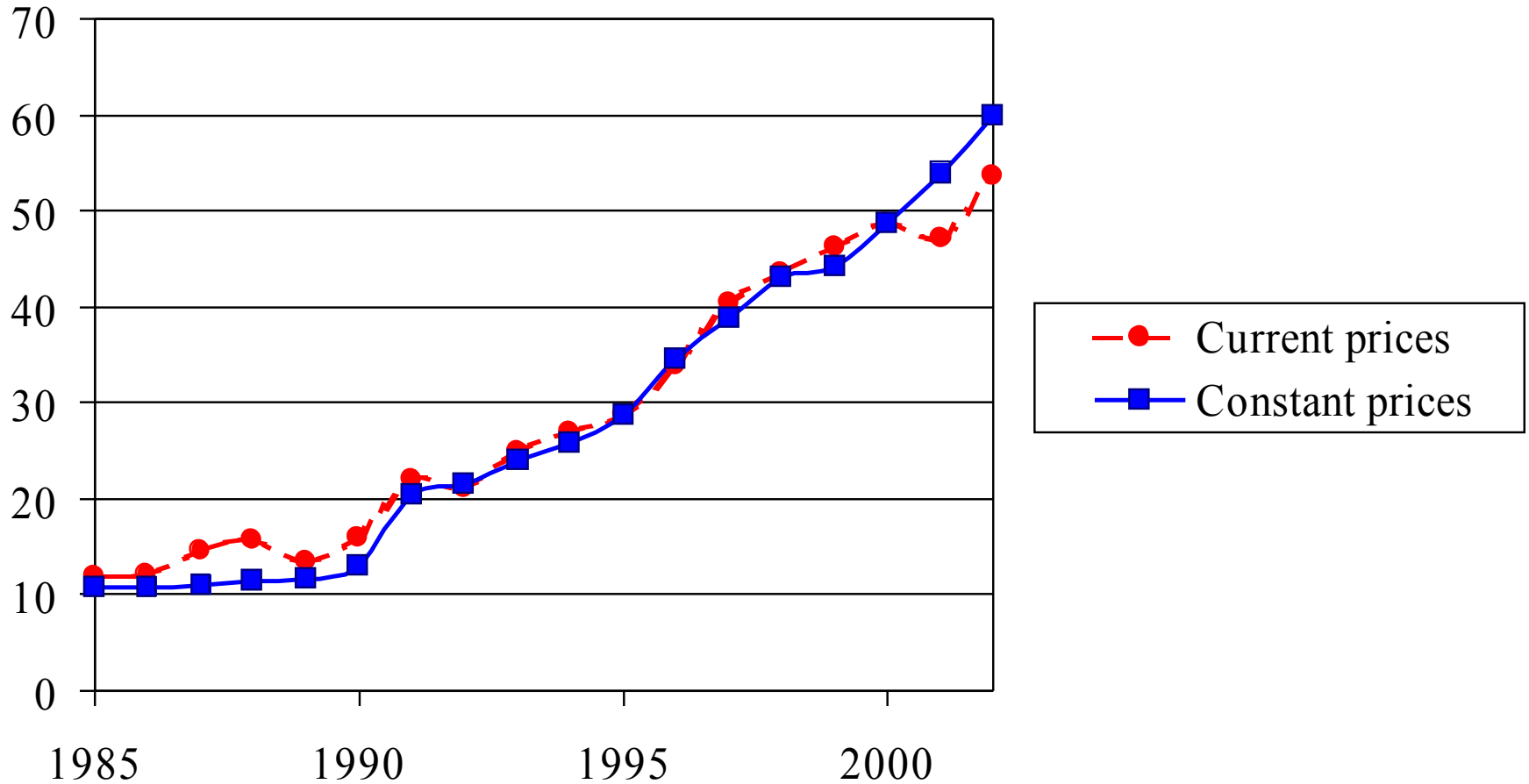
Openness in sense of growth in shares of foreign trade in the economy

Changes in the structure of foreign trade

Most commonly used measure of **effectiveness** – labor productivity

Openness of the Polish economy 1985-2002

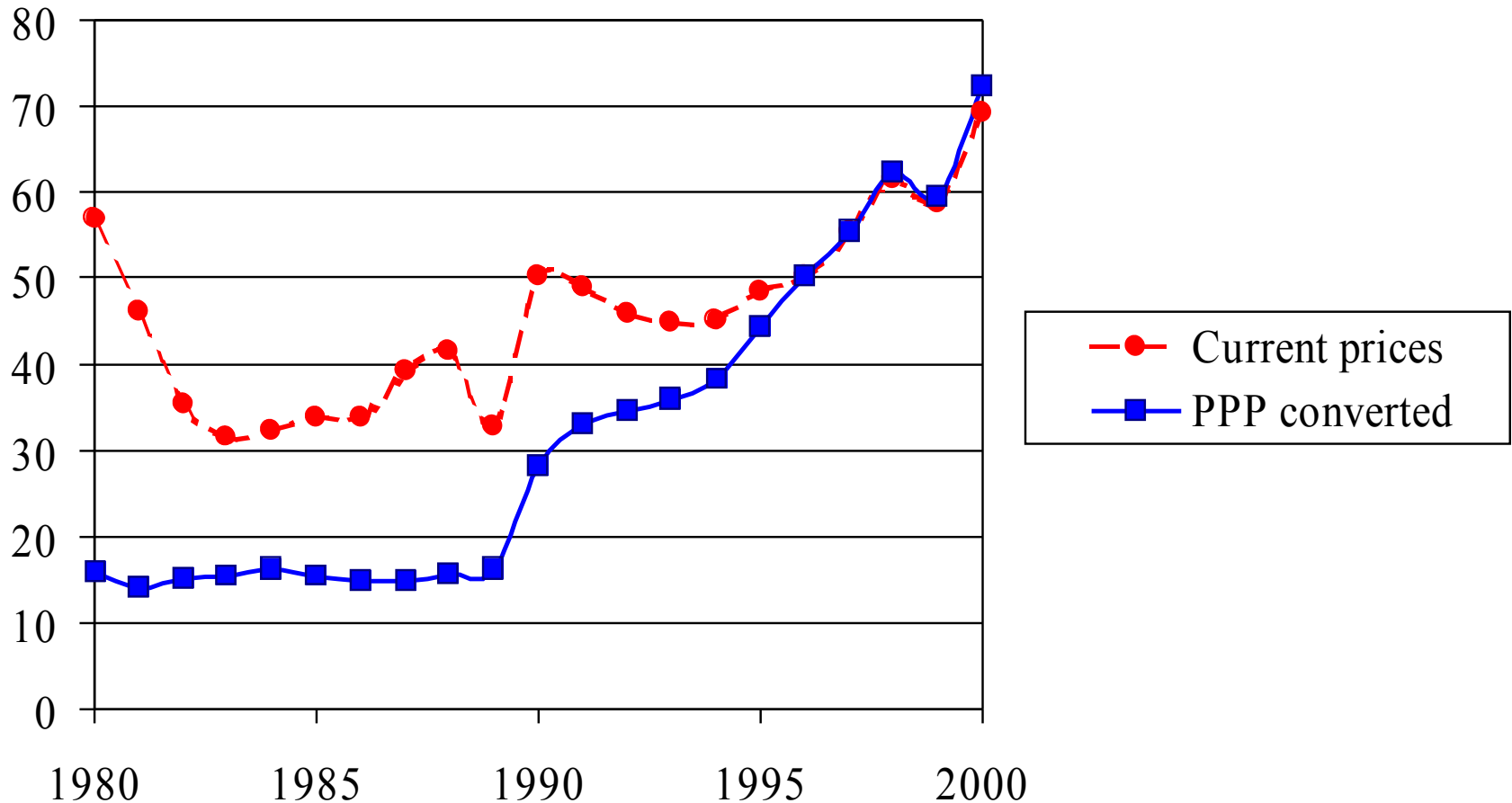
$\text{Import}/(\text{Output}-\text{Export}) * 100\%$ commodities



Source: Polish Statistical Office

Openness of the Polish economy 1980-2000

$(\text{Import} + \text{Export}) / \text{GDP} * 100\%$



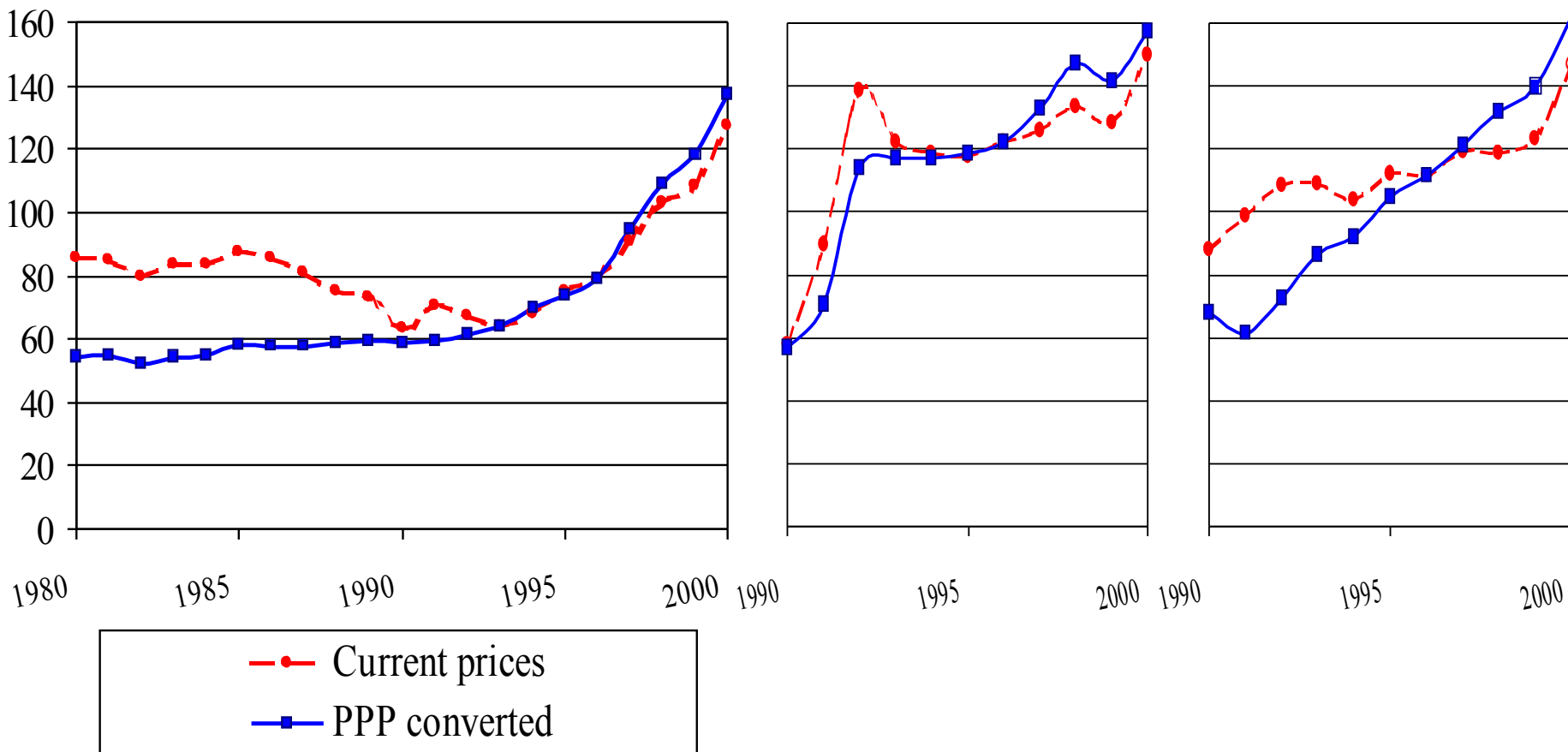
Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002.

$(\text{Import} + \text{Export}) / \text{GDP} * 100\%$

Hungary

Czech Rep.

Slovak Rep.



Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002.

The input – output tables

1990 – based on MPS and recalculated to SNA with old classification, product by industry, 43 categories, including 27 categories of commodities (and 16 kinds of services)

2000 – SNA, product by product, originally 54 categories, but due to the lack of data on employment, aggregated to 39 categories including 27 categories of commodities (and 12 kinds of services)

Labor productivity and trade in 1990

	Labor prod., mln PLZ/ employee	Export/ Output		Import/ Output	
		sh	r	sh	r
Products of the fuel industry	631,0	0,122	20	0,335	2
Products of non-ferrous metallurgy	457,7	0,370	3	0,060	17
Products of ferrous metallurgy	303,1	0,213	10	0,089	11
Products of power engineering	301,7	0,020	34	0,003	35
Products of the food industry - animal origin	241,1	0,166	15	0,033	25
Products of the food industry - fruits and vegetables	239,0	0,072	25	0,068	15
Chemicals I	193,9	0,366	4	0,147	6
Chemicals II	191,5	0,142	18	0,148	5
Products of coal mining	45,1	0,409	2	0,003	36
Communication	44,8	0,144	17	0,044	22
Health care and social service	40,6	0,001	39	0,015	30
Education	29,5	0,005	36	0,016	29
Municipal services	20,5	0,000	42	0,000	42
Agricultural services	20,5	0,072	26	0,006	33
Products of agriculture - plants	20,0	0,000	41	0,000	41
Products of agriculture - animals	19,6	0,062	28	0,032	26
Correlation (Pearson)		0,139		0,372	

sh – share, r - rank

Labor productivity and trade in 2000

	Labor prod., th. PLN/ employee	Export/ Output		Export to EU/ Output		Other Export/ Output		Import/ Output		Import from EU/ Output		Other import/ Output	
		sh	r	sh	r	sh	r	sh	r	sh	r	sh	r
Coke, refined petroleum products	1433,1	0,12	22	0,09	22	0,03	25	0,15	21	0,06	21	0,09	18
Tabacco products	446,6	0,09	25	0,04	26	0,05	22	0,01	31	0,01	30	0,00	31
Motor vehicles	305,0	0,50	6	0,45	4	0,06	16	0,67	8	0,53	6	0,15	12
Chemicals and chemical products	279,4	0,26	15	0,13	17	0,12	7	0,94	6	0,68	5	0,26	6
Office machinery and computers	279,3	0,31	12	0,19	12	0,11	10	6,17	1	2,17	1	4,00	1
Radio, television and communication	270,6	0,58	3	0,45	3	0,13	6	1,51	3	0,85	3	0,66	3
Electricity, gas, steam and hot water	247,3	0,01	33	0,01	34	0,01	32	0,00	32	0,00	32	0,00	32
Paper and paper products	243,2	0,32	11	0,17	14	0,16	3	0,65	9	0,52	7	0,13	14
Hotel and restaurant services	90,7	0,05	27	0,04	27	0,01	28	0,00	36	0,00	36	0,00	36
Cold water and its distribution	88,5	0,00	37	0,00	37	0,00	37	0,00	34	0,00	34	0,00	34
Leather and leather products	69,5	0,53	5	0,36	6	0,17	2	0,54	11	0,38	10	0,16	10
Fishing products	58,8	0,06	26	0,05	23	0,01	31	0,23	18	0,08	20	0,16	11
Wearing apparel, furs	55,9	0,58	2	0,52	2	0,07	13	0,13	22	0,06	23	0,08	19
Education services	41,4	0,00	39	0,00	39	0,00	39	0,00	38	0,00	38	0,00	38
Health services	41,4	0,00	35	0,00	35	0,00	35	0,00	39	0,00	39	0,00	39
Agriculture, hunting and forestry products	15,3	0,03	30	0,02	30	0,01	30	0,09	24	0,04	26	0,05	22
Correlation (Pearson)		-0,035		-0,043		-0,008		0,071		0,064		0,066	

sh – share, r - rank

Average labor productivity

X – output

E – export

M – import

i - category
of good

$$n_i = \frac{N_i}{X_i}$$

	1990 employe nt/bln PLZ	2000 employem t/mln PLN	1990 mln PLZ/empl oyee	2000 th PLN/emp loyee
$\frac{\sum_i n_i (X_i - E_i)}{\sum_i (X_i - E_i)}$	13,41	11,08	74,57	90,25
$\frac{\sum_i n_i E_i}{\sum_i E_i}$	10,82	8,27	92,46	120,90
$\frac{\sum_i n_i X_i}{\sum_i X_i}$	13,08	10,70	76,44	93,48
$\frac{\sum_i n_i M_i}{\sum_i M_i}$	8,59	7,58	116,42	131,77

Poland – EU 2000

	employment/ mln PLN	th PLN/ employee
Export to EU	8,41	118,9
Other export	7,95	125,8
Import from EU	7,24	138,15
Other import	8,14	122,86

Labor productivity and trade in 1990 – value added

	Labor prod., mln PLZ/ employee	Export/ Output		Import/ Output	
		sh	r	sh	r
Products of the fuel industry	252,8	0,122	20	0,335	2
Products of non-ferrous metallurgy	179,0	0,370	3	0,060	17
Non-market services	138,4	0,003	37	0,038	23
Products of the printing industry	123,0	0,003	38	0,051	19
Products of the food industry - fruits and vegetables	118,8	0,072	25	0,068	15
Products of ferrous metallurgy	109,3	0,213	10	0,089	11
Products of power engineering	97,5	0,020	34	0,003	35
Other market services	81,7	0,079	23	0,062	16
Health care and social service	22,2	0,001	39	0,015	30
Education	22,2	0,005	36	0,016	29
Other products	21,3	0,036	31	0,079	12
Municipal services	20,3	0,000	42	0,000	42
Products of coal mining	17,0	0,409	2	0,003	36
Products of agriculture - plants	11,0	0,062	28	0,032	26
Other processing of agricultural products	7,3	0,015	35	0,020	28
Products of agriculture - animals	3,6	0,072	26	0,006	33
Correlation (Pearson)		0,008		0,317	

sh – share, r - rank

Labor productivity and trade in 2000 – value added

	Labor prod., th. PLN/ employee	Export/ Output		Export to UE/ Output		Other Export/ Output		Import/ Output		Import from UE/ Output		Other import/ Output	
		sh	r	sh	r	sh	r	sh	r	sh	r	sh	r
Coke, refined petroleum products	250,9	0,12	22	0,09	22	0,03	25	0,15	21	0,06	21	0,09	18
Tabacco products	137,8	0,09	25	0,04	26	0,05	22	0,01	31	0,01	30	0,00	31
Crude oil, natural gas, metal ores and other mining products	102,7	0,10	23	0,05	24	0,05	20	3,51	2	0,15	14	3,36	2
Real estate and business services	90,7	0,02	32	0,01	32	0,00	34	0,05	27	0,03	27	0,02	26
Public administration services	88,3	0,00	38	0,00	38	0,00	38	0,00	37	0,00	37	0,00	37
Electricity, gas, steam and hot water	85,5	0,01	33	0,01	34	0,01	32	0,00	32	0,00	32	0,00	32
Chemicals and chemical products	85,0	0,26	15	0,13	17	0,12	7	0,94	6	0,68	5	0,26	6
Printed matter and recorded media	81,7	0,03	31	0,02	31	0,01	29	0,06	26	0,04	25	0,01	28
Furniture, other manufactured goods	32,0	0,50	7	0,38	5	0,12	9	0,25	17	0,15	15	0,10	16
Wood and products of wood	31,2	0,35	10	0,30	8	0,05	17	0,10	23	0,06	22	0,04	25
Health services	29,3	0,00	35	0,00	35	0,00	35	0,00	39	0,00	39	0,00	39
Food and beverages	29,1	0,10	24	0,05	25	0,05	19	0,08	25	0,04	24	0,04	24
Leather and leather products	26,2	0,53	5	0,36	6	0,17	2	0,54	11	0,38	10	0,16	10
Wearing apparel, furs	21,6	0,58	2	0,52	2	0,07	13	0,13	22	0,06	23	0,08	19
Fishing products	16,9	0,06	26	0,05	23	0,01	31	0,23	18	0,08	20	0,16	11
Agriculture, hunting and forestry products	5,3	0,03	30	0,02	30	0,01	30	0,09	24	0,04	26	0,05	22
Correlation (Pearson)		-0,212		-0,216		-0,141		0,112		-0,001		0,155	

sh – share, r - rank

Average labor productivity - value added

X – output

E – export

M – import

i - category
of good

$$n_i = \frac{N_i}{D_i}$$

		1990 employment /bln PLZ	2000 employment /mln PLN	1990 mln PLZ/empl oyee	2000 th PLN/emp loyee
	$\frac{\sum_i n_i (X_i - E_i)}{\sum_i (X_i - E_i)}$	27,67	24,19	36,14	41,34
	$\frac{\sum_i n_i E_i}{\sum_i E_i}$	26,32	22,02	37,98	45,04
	$\frac{\sum_i n_i X_i}{\sum_i X_i}$	27,52	23,94	36,33	41,77
	$\frac{\sum_i n_i M_i}{\sum_i M_i}$	19,64	22,79	50,92	43,88

Decomposition of final demand

$$N = n_1 X_1 + n_2 X_2 + \dots + n_n X_n$$

$$N = \mathbf{n}^T \mathbf{X}$$

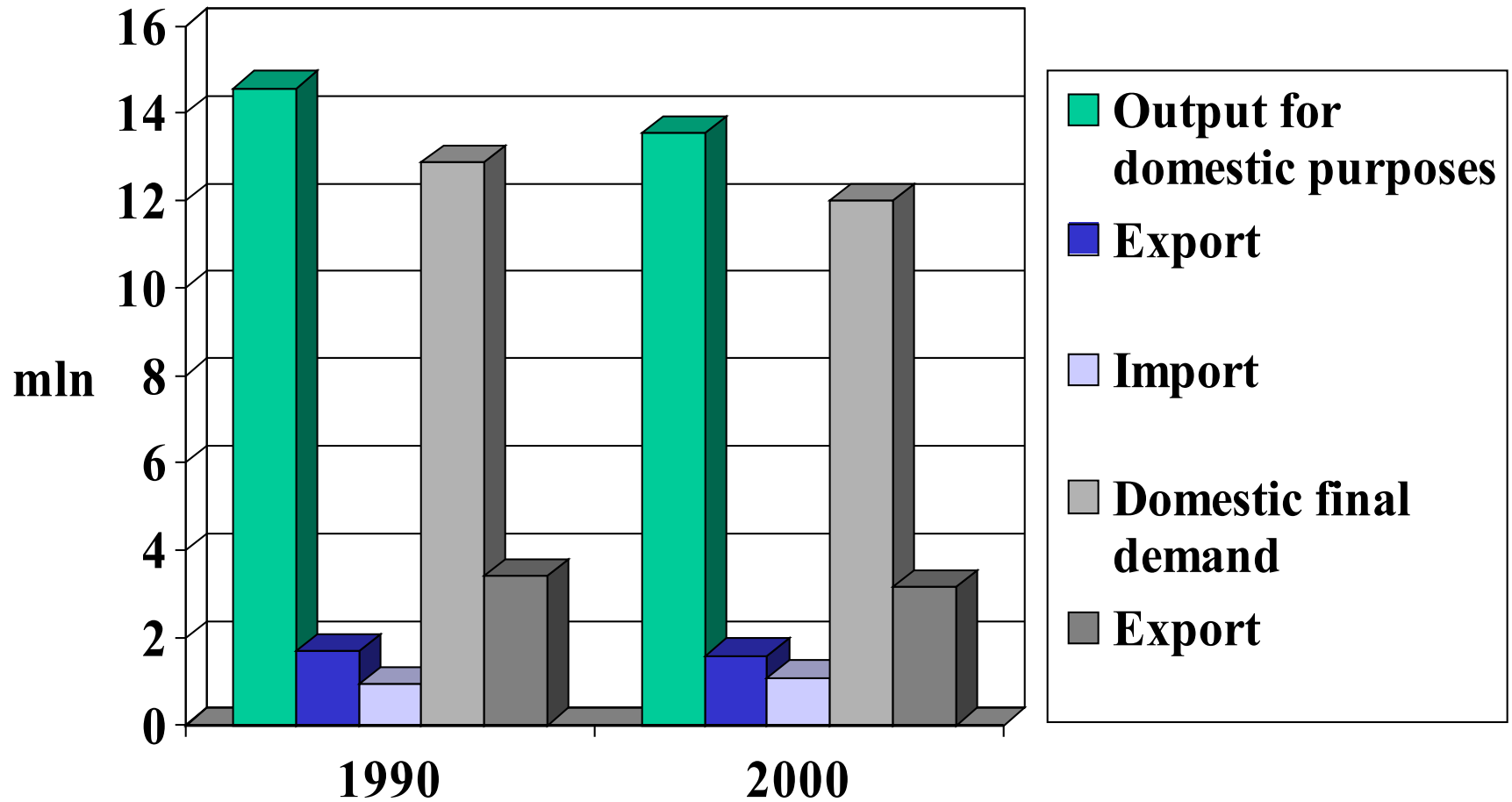
$$N = \mathbf{n}^T (\mathbf{I} - \mathbf{A})^{-1} \mathbf{Y}$$

$$N^k = \mathbf{n}^T (\mathbf{I} - \mathbf{A})^{-1} \mathbf{Y}^k$$

k=1 domestic final demand

k=2 export

Employment due to domestic production and export



Final demand per employee

	1990 mln PLZ /employee	2000 th PLN/ employee
Domestic final demand	39,04	50,59
Export to EU		61,80
Other exports		58,73
Total export	46,33	60,85

Effects of changes in structure of trade

	Actual LP in 1990	LP in 1990 assuming structures of 2000	Change in %
Production for domestic purposes	74,57	78,79	5,66
Export	92,46	95,58	3,37
Output	76,44	80,58	5,42
Import	116,42	107,18	-7,94
Domestic final demand	39,04	41,37	5,97
Export	46,33	49,37	6,56

Effects of changes in structure of trade

	Actual LP in 2000	LP in 2000 assuming structures of 1990	Change in %
Production for domestic purposes	90,25	77,63	-13,99
Export	120,9	106,64	-11,79
Output	93,48	80,61	-13,77
Import	131,77	130,92	-0,65
Domestic final demand	50,59	43,65	-13,72
Export	60,85	52,39	-13,90

Effects of changes in structure of trade

	Actual LP in 1990	LP in 1990 assuming shares of 2000	Change in %
Production for domestic purposes	74,57	72,64	-2,59
Export	92,46	100,92	9,15
Output	76,44	76,44	0,00
Import	116,42	104,49	-10,25
Domestic final demand	39,04	41,81	7,10
Export	46,33	51,83	11,87

Effects of changes in structure of trade

	Actual LP in 2000	LP in 2000 assuming shares of 1990	Change in %
Production for domestic purposes	90,25	91,94	1,87
Export	120,9	110,79	-8,36
Output	93,48	93,48	0,00
Import	131,77	135,68	2,97
Domestic final demand	50,59	47,88	-5,36
Export	60,85	55,00	-9,61

Conclusions

The study confirmed positive influence of foreign trade on labor productivity in the period of transition in Poland.

The effects seem rather small, as we consider 10 year period.

The „real” effects are probably much bigger, but they are reduced by changes in relative prices.