How do prices of primary energy carriers influence the competitiveness of the Polish economy

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Previous research

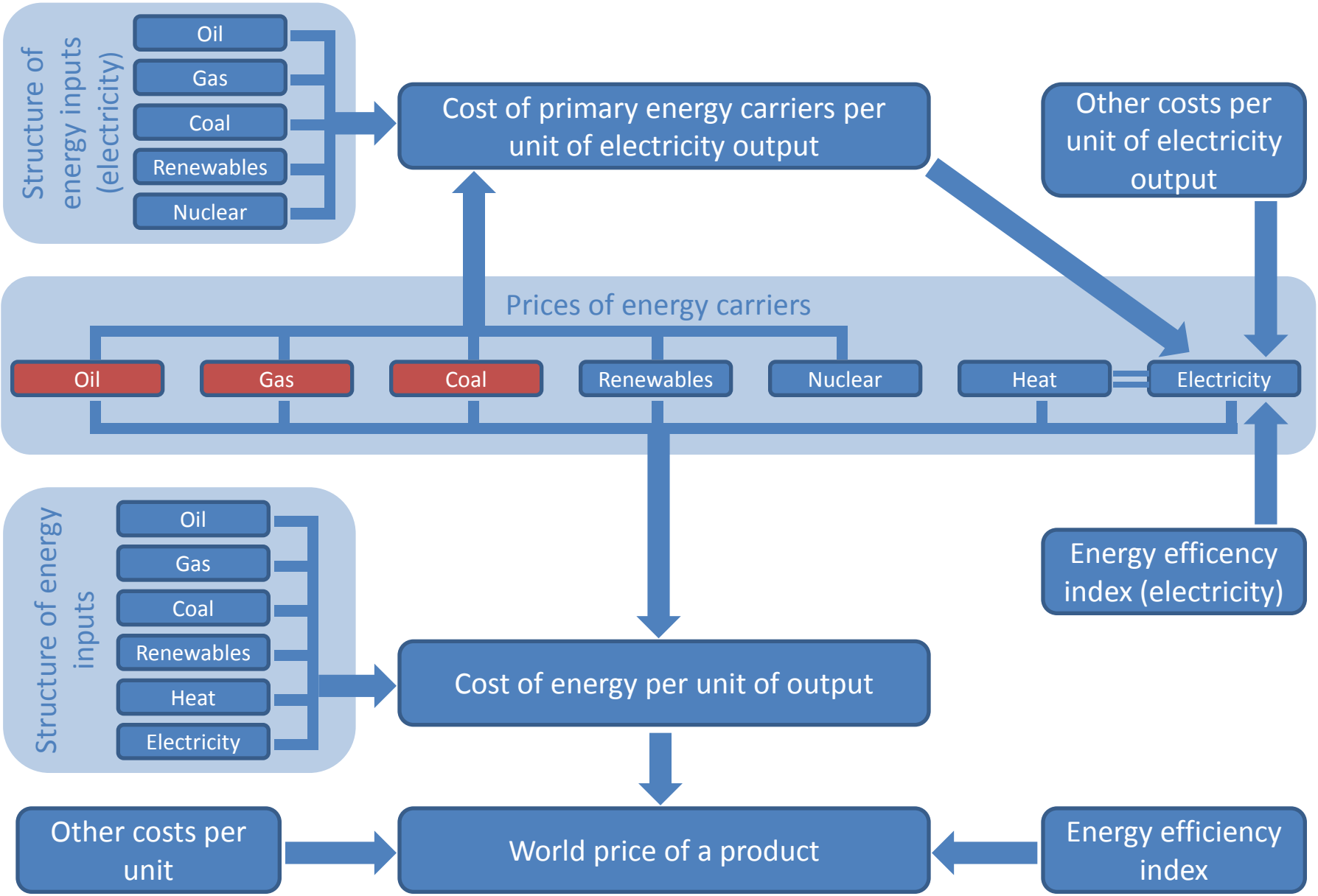
General concept of the model developed for the purpose of the project:

Boratyński J., Plich M., Przybyliński M., 2007, Modeling Economic and Social Impacts of Energy Prices in the Polish Economy, [in:] Plich M., Przybyliński M. (eds.), Recent Developments in INFORUM-type Modeling, University of Łódź.

Foreign trade part:

Przybyliński M., 2008, Prices of energy and foreign trade in the framework of the Polish model IMPEC, [in:] Bardazzi R., Grassini M. (eds.), Structural Changes, International Trade and Multisectoral Modelling, Firenze University Press, pp. 209-220

World price formation in IMPEC



Comments

1. Polish import deflators are treated as world prices of products, seen from the Polish perspective.

2. Lack of technological information:

- Renewable resources
- Heat
- Coke and petroleum products

3. Lack of data on prices:

- Nuclear power
- Renewable resources
- Lignite

4. No inflation loop abroad

World prices of products – import deflators

World price of product *i* is a function of energy cost of an unit of production

$$P_i^M = \left[K_i^N (1-\omega_i) + K_i^E F_i \omega_i\right] \cdot R$$

K_i^E – unit cost of energy for i-th category of products (index)

K_i^N – other costs per unit of output for *i*-th group of products (index)

F_i - technological index showing changes in energy consumption per unit of *i*-th group of products

ω_i – weight, share of energy in costs of production of *i*-th group of products in base year (2000)

R – exchange rate (index)

$$K_i^E = \sum_{s=1}^{S} C_s W_{is}$$

C_s - price of *s*-th energy carrier

W_{is} - share of *s*-th energy carrier in production of *i*-th group of products

World price of electricity

World price of electricity is a function of energy cost of an unit of production

$$C_{ele} = \left[K_{ele}^{N} (1 - \omega_{ele}) + K_{ele}^{E} F_{ele} \omega_{ele} \right]$$

K_{ele}^{E} – unit cost of energy (index)

K_{ele}^{N} – other costs per unit of production (index)

F_i - technological index showing changes in energy consumption per unit

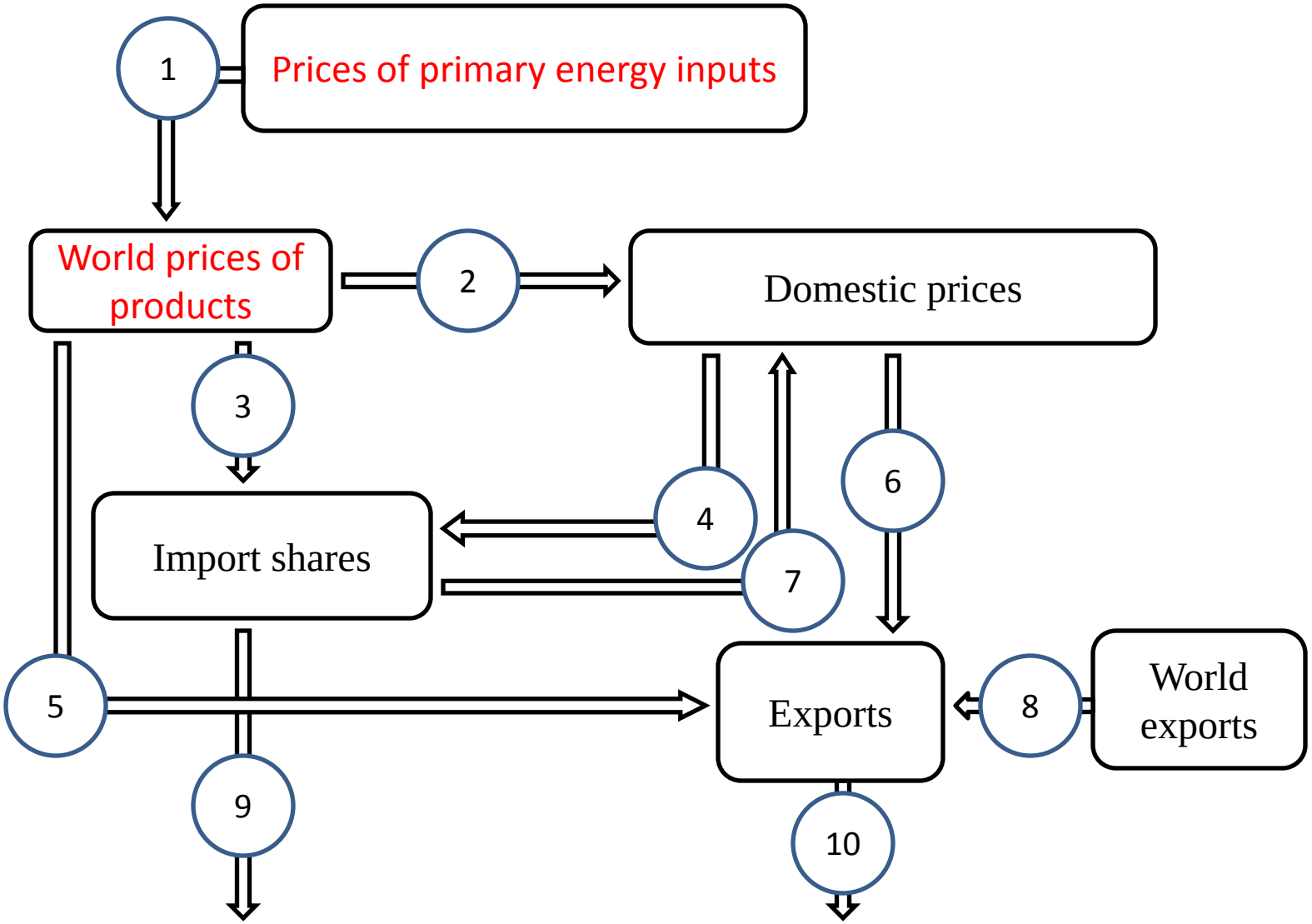
ω_i – weight, share of energy in costs of production in base year (2000)

$$K_{ele}^{E} = \sum_{s=1}^{S} C_s W_{ele,s}$$

C_s - price of *s*-th energy carrier

$W_{ele,s}$ - share of *s*-th energy carrier in energy cost

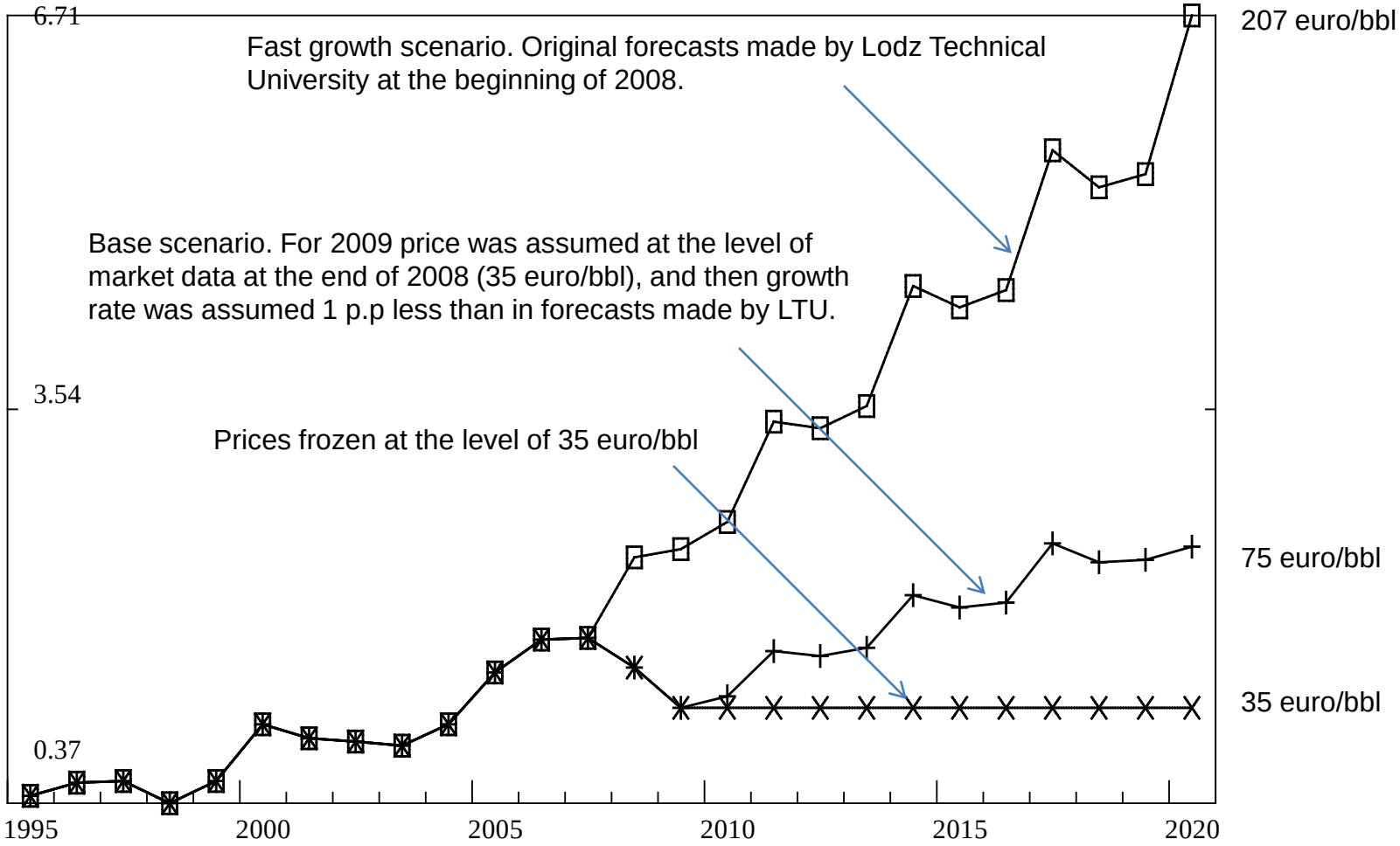
General layout of foreign trade block



Assumptions:

Price of oil

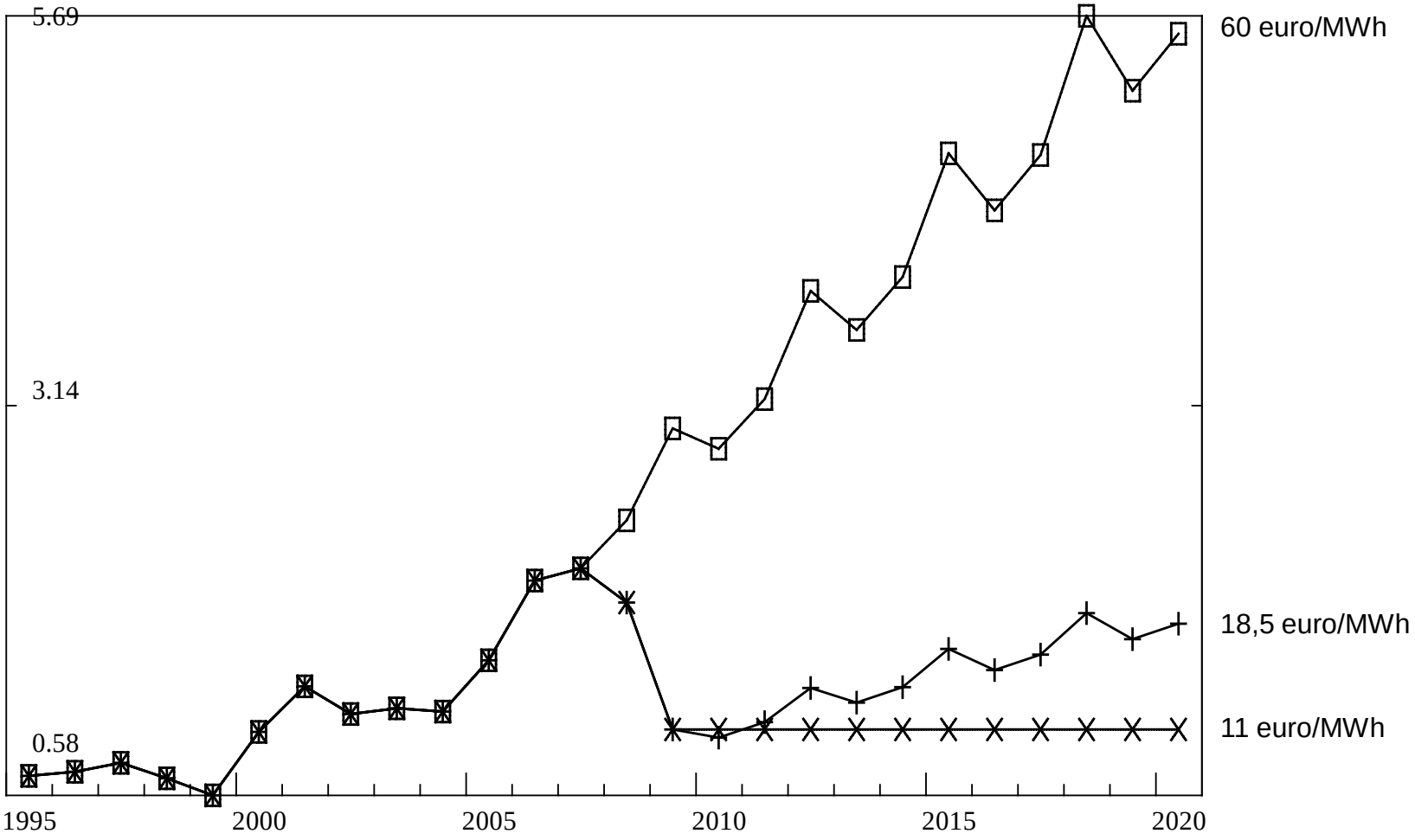
2000=1 (30,9 euro/bbl)



Assumptions:

Price of natural gas

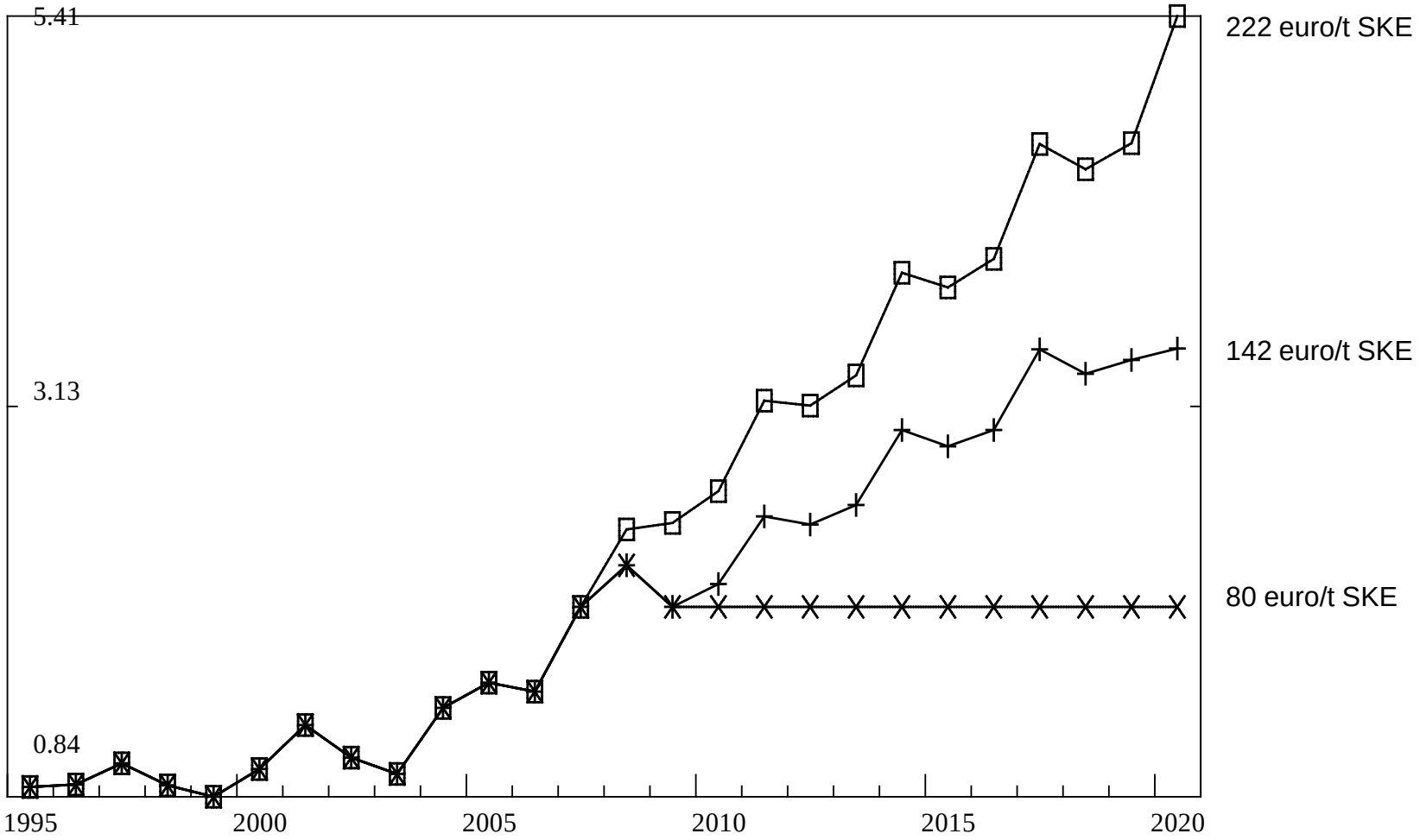
2000=1 (10,84 euro/MWh)



Assumptions:

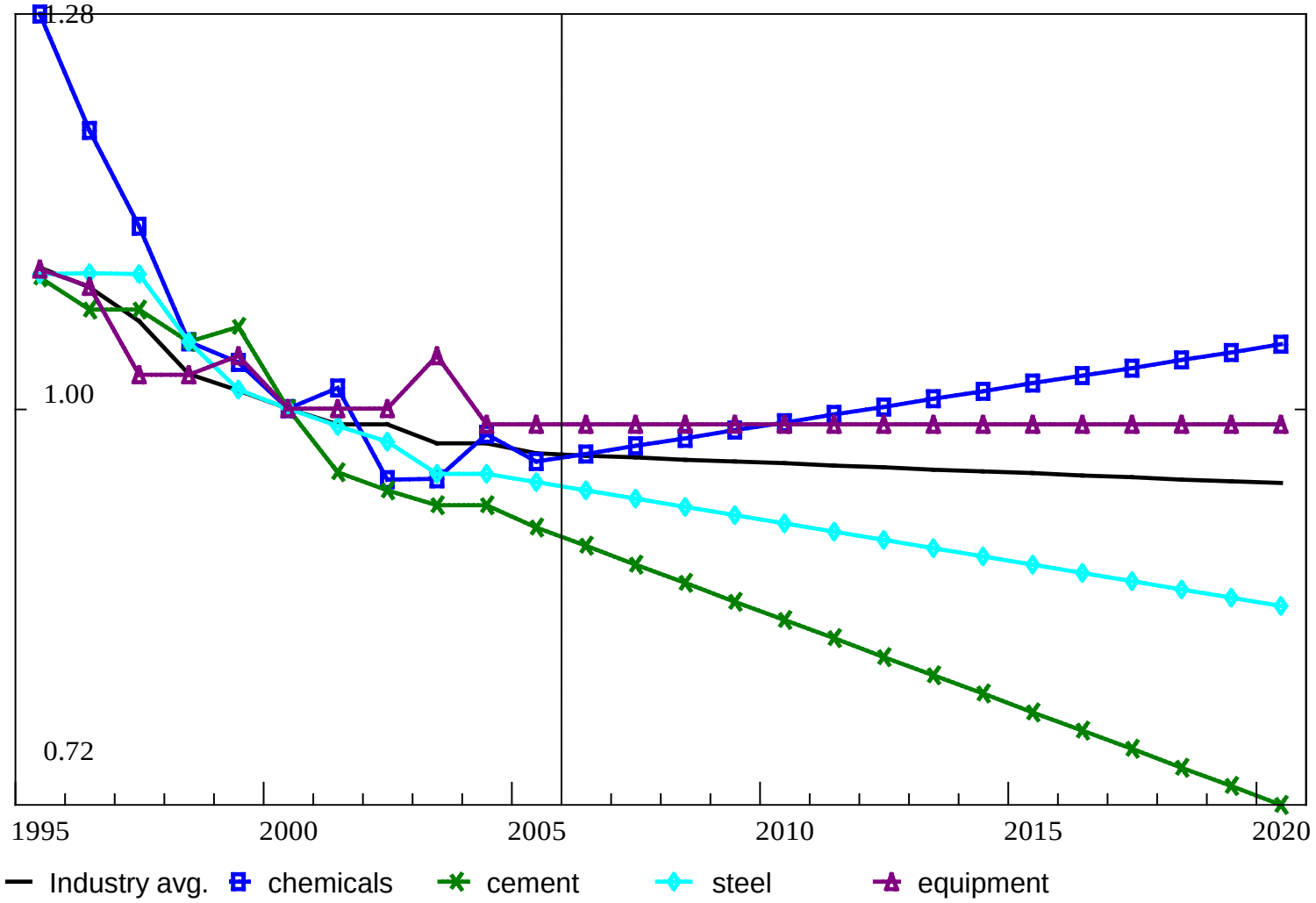
Price of coal

2000=1 (30,9 euro/t SKE)



Assumptions:

Energy efficiency index ODEX



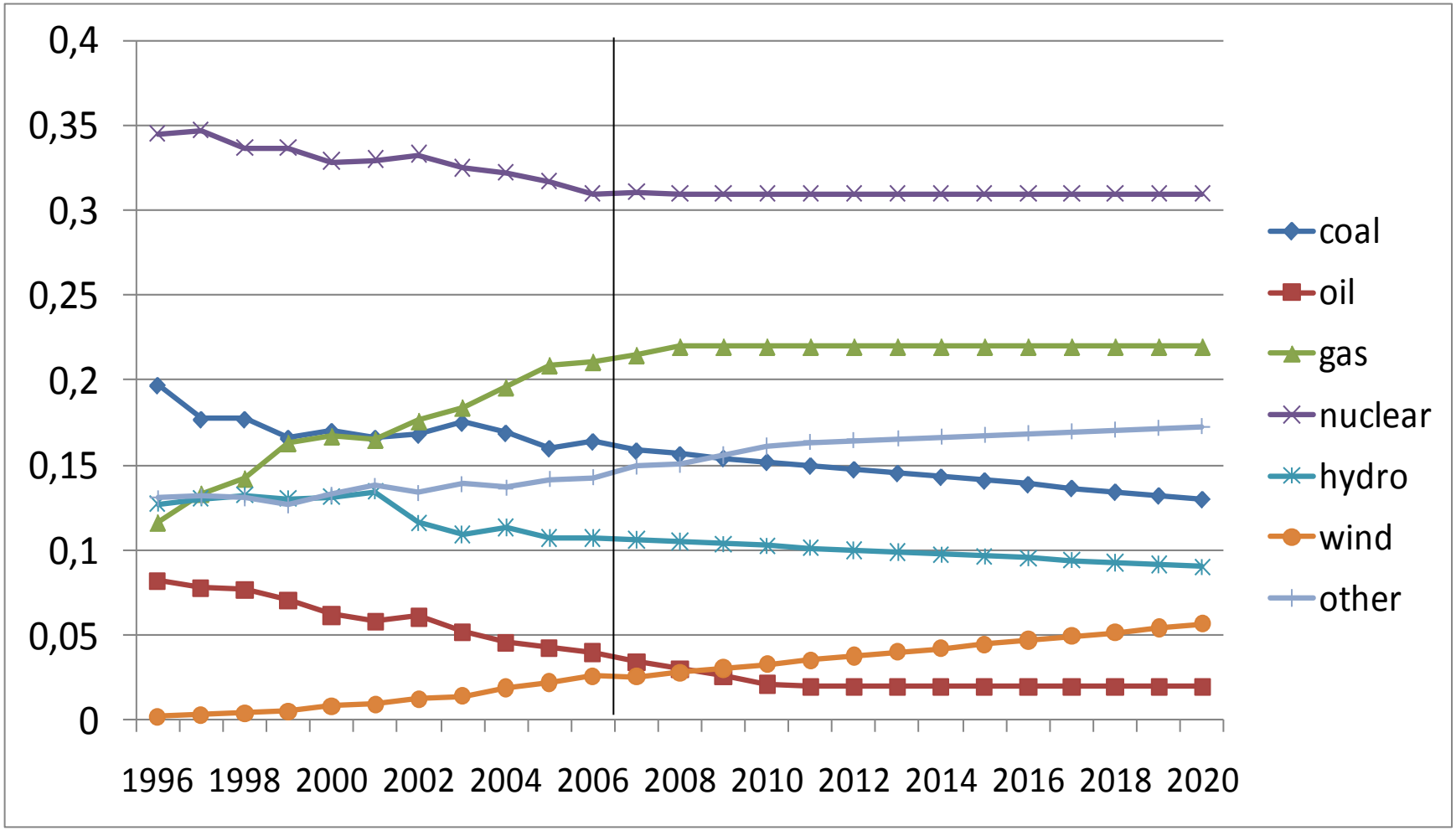
Share of energy in output in 2000

average for 18 EU countries, based on SIOT published by EUROSTAT

1	Products of agriculture, hunting and related services	2,98%	19	Fabricated metal products, except machinery and equipment	1,68%	37	Water transport services	8,38%
2	Products of forestry, logging and related services	1,42%	20	Machinery and equipment n.e.c.	1,15%	38	Supporting and auxiliary transport services; travel agency services	1,60%
3	Fish and other fish products; services of incidental fishing	7,27%	21	Office machinery and computers	0,54%	39	Post and telecommunications services	1,14%
4	Coal and lignite; peat	14,01%	22	Electrical machinery and apparatus n.e.c.	1,20%	40	Financial intermediation services, except insurance and pension funding services	0,47%
5	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	6,42%	23	Radio, television and communication equipment and apparatus	0,74%	41	Insurance and pension funding services, except compulsory social security services	0,41%
6	Food products and beverages	1,75%	24	Medical, precision and optical instruments, watches and clocks	0,78%	42	Services auxiliary to financial intermediation	0,72%
7	Tobacco products	0,63%	25	Motor vehicles, trailers and semi-trailers	0,95%	43	Real estate services	0,42%
8	Textiles	3,01%	26	Other transport equipment	1,01%	44	Renting of machinery and equipment without operator and of personal and household goods	1,58%
9	Wearing apparel; furs	0,98%	27	Furniture; other manufactured goods n.e.c.	1,20%	45	Computer and related services	0,72%
10	Leather and leather products	1,07%	28	Recovered secondary raw materials	2,65%	46	Research and development services	1,19%
11	Wood and of products of wood and cork (except furniture); articles of straw and plaiting materials	1,98%	29	Electrical energy, gas, steam and hot water	37,18%	47	Other business services	0,82%
12	Pulp, paper and paper products	4,49%	30	Collected and purified water, distribution services of water	5,45%	48	Public administration and defence services; compulsory social security services	1,33%
13	Printed matter and recorded media	1,04%	31	Construction work	0,99%	49	Education services	1,24%
14	Coke, refined petroleum products and nuclear fuels	71,09%	32	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	1,46%	50	Health and social work services	1,10%
15	Chemicals and chemical products	7,11%	33	Wholesale trade and commission trade, except of motor vehicles and motorcycles	1,75%	51	Sewage and refuse disposal services, sanitation and similar services	1,69%
16	Rubber and plastic products	2,43%	34	Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods	2,01%	52	Membership organisation services n.e.c.	1,45%
17	Other non-metallic mineral products	5,61%	35	Hotels and restaurants services	1,92%	53	Recreational, cultural and sporting services	1,28%
18	Basic metals	6,19%	36	Land transport; transport via pipelines services	6,22%	54	Other services	1,59%

Assumptions:

Structure of primary energy used for electricity production

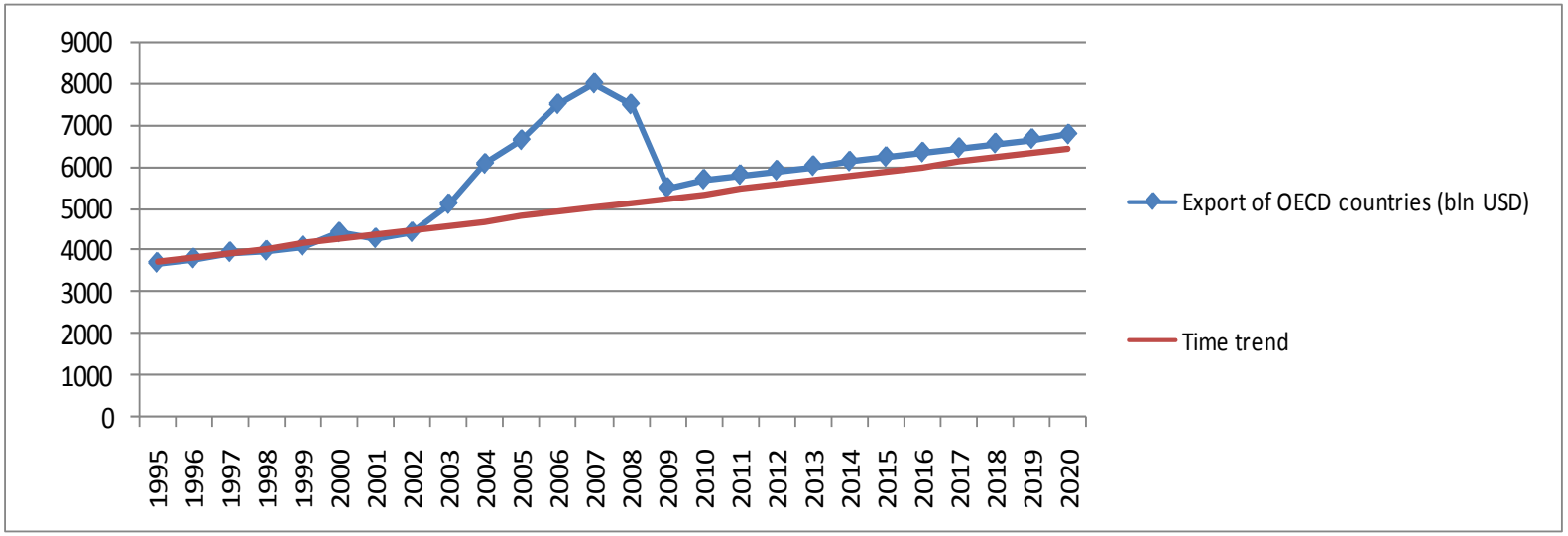


Source: EUROSTAT, Electricity generation by origin

Assumptions:

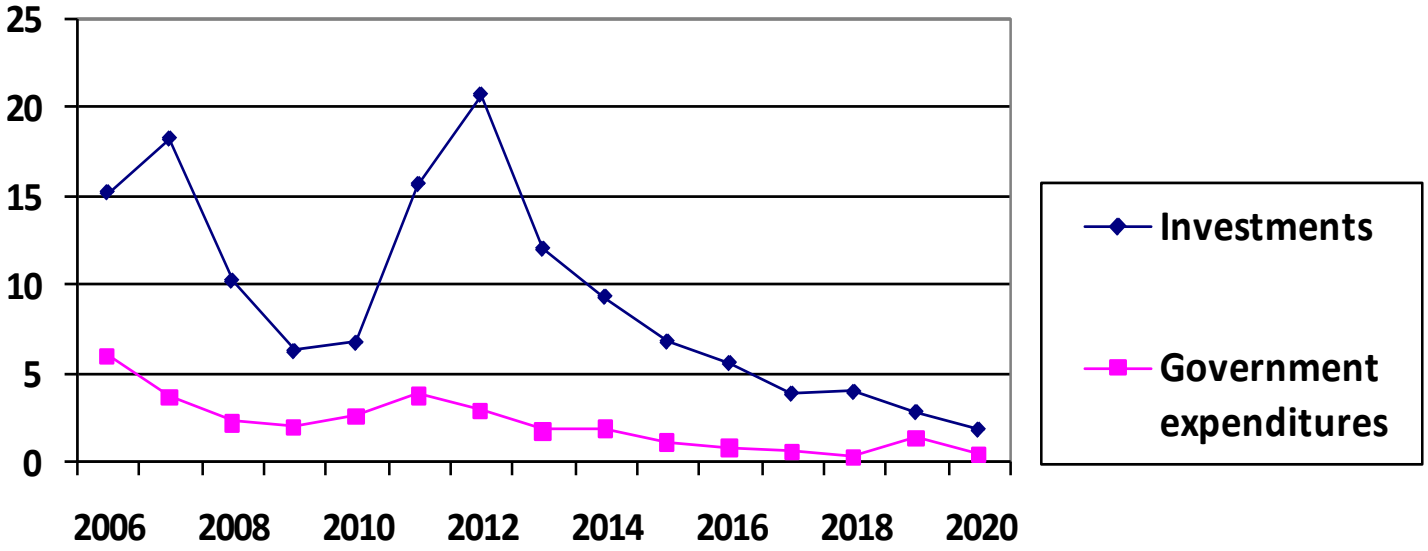
Other assumptions

- Fixed „real” weights
- Prices of other carriers following oil, gas, coal
- Non-energy unit costs extrapolated with time trends
- Exchange rate 4,50 PLN/Euro
- Exports of OECD countries as a demand factor in export equations (http://puck.sourceoecd.org/pdf/factbook2008/302008011e-03-01-02.pdf) . This means no demand effect abroad!



Assumptions:

Macroeconomic assumptions



Multiplier analysis 1
Rise of world price of oil by 50%

Import prices rise for all products, but not much. For coke and petroleum products this effect is 7,9% and electrical energy 2,5%. Other products don't change their prices more than 0,8%.

This effect is stronger in case of domestic prices. Relations of import versus domestic prices go down by 1,6 to 6,4%. This result seems to be contrary to common opinion that Polish economy is based on coal, so rise in prices of other carriers should improve its competitiveness. Oil, however, is not a substitute for coal. Prices of Polish goods are more sensitive for changes in prices of oil because the economy consumes more energy per unit of production than EU average.

Because of unfavourable change in price relations exports of all groups of products fall, and total export falls by 1,9% (external demand was assumed constant).

For the same reason, total import goes up, but only by 0,4%. Price effect is, however, reduced here by demand effect. In approximately half of the product groups import falls.

Multiplier analysis 1b
Rise of world price of natural gas by 50%

- No significant changes

Multiplier analysis 1c
Rise of world price of coal by 50%

- No significant changes

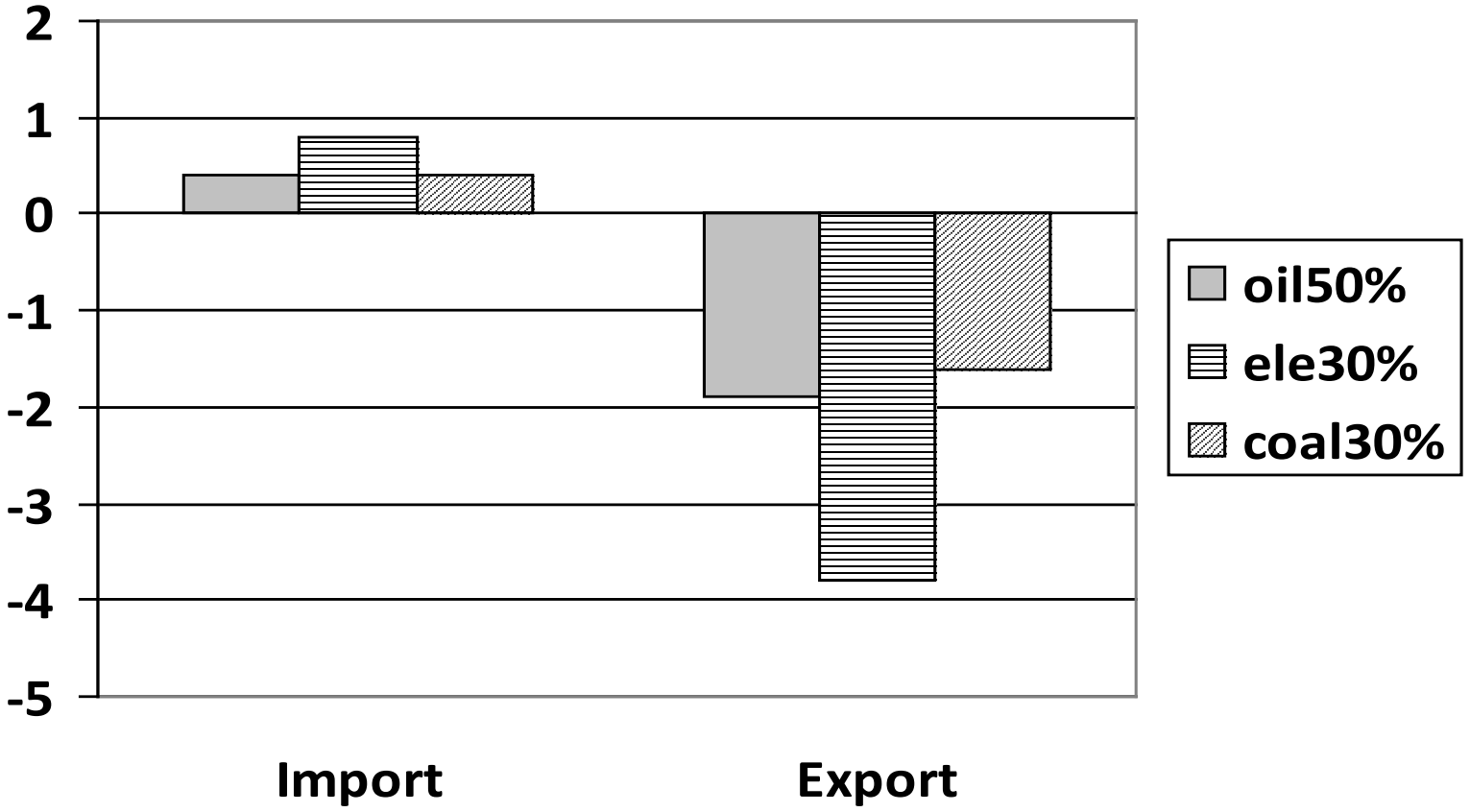
Multiplier analysis 2
Rise of domestic coal price by 30%

World prices are not changed. Domestic prices rise by 1% to 4% except electricity (8,6%). Relation of import versus domestic prices goes down about 4% in total.
Export is of coal is reduced by 7,2%, and motor vehicles by 4,2%, and other transport equipment by 5,4%. In few other groups this effect exceeds 1%, and the total is 1,9%.
As a consequence, export goes down by 4%, and import rises by 0,8%.

Multiplier analysis 3
Rise of domestic electricity price by 30%

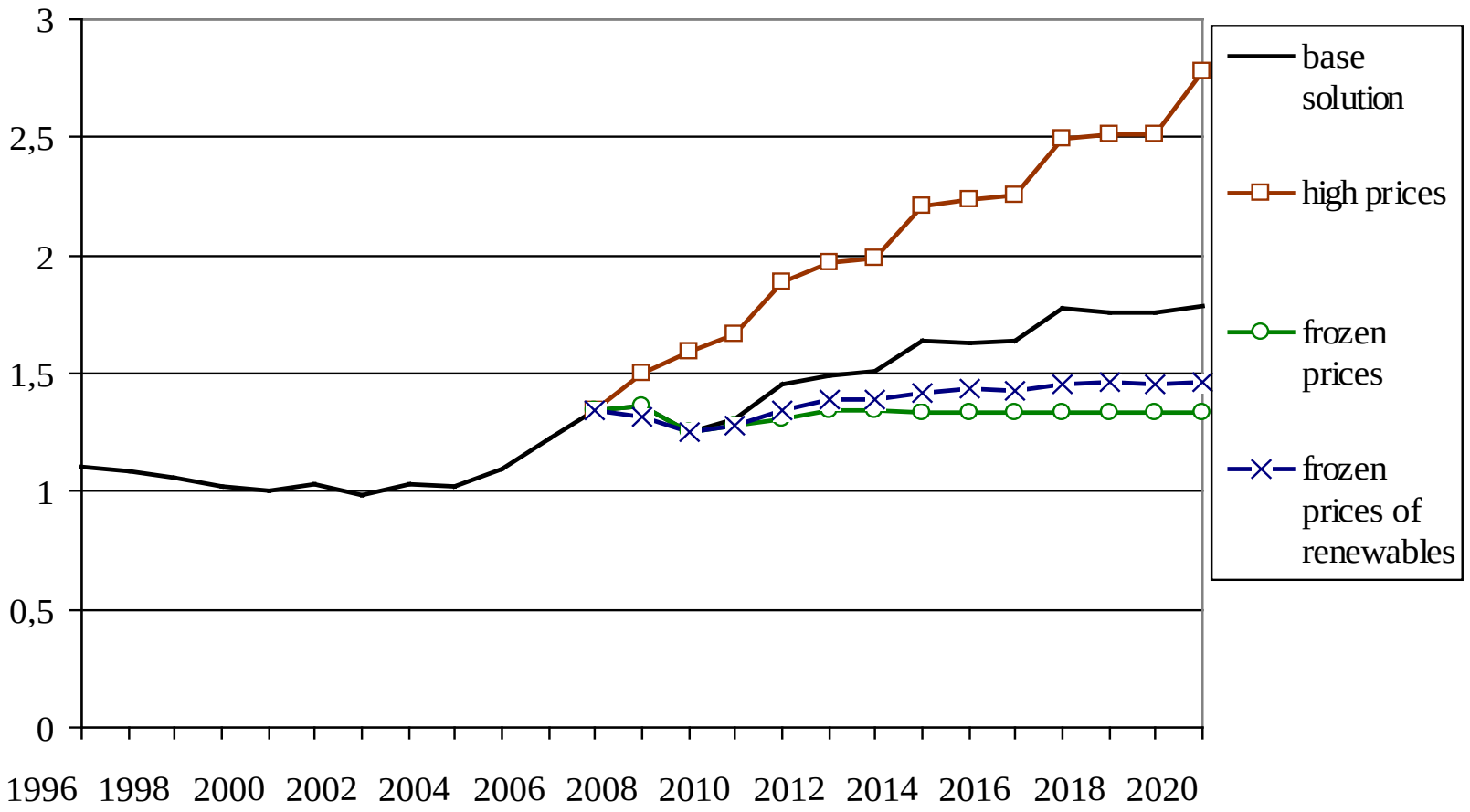
Almost all effects are almost three times higher than those of multiplier analysis 2. There are no significant deviations from this rule.

Multiplier analysis 1,2,3 deviations from base in %



Results:

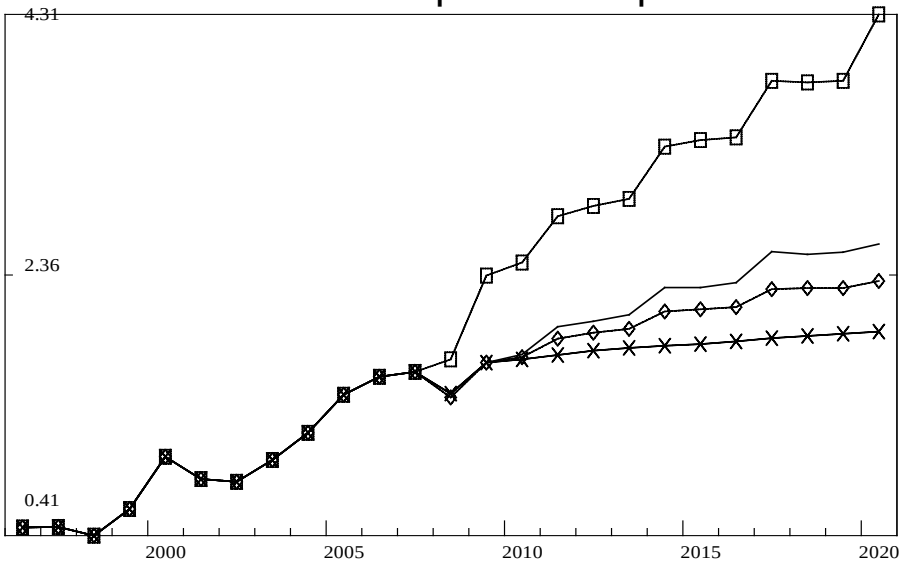
World prices of electricity 2000=1



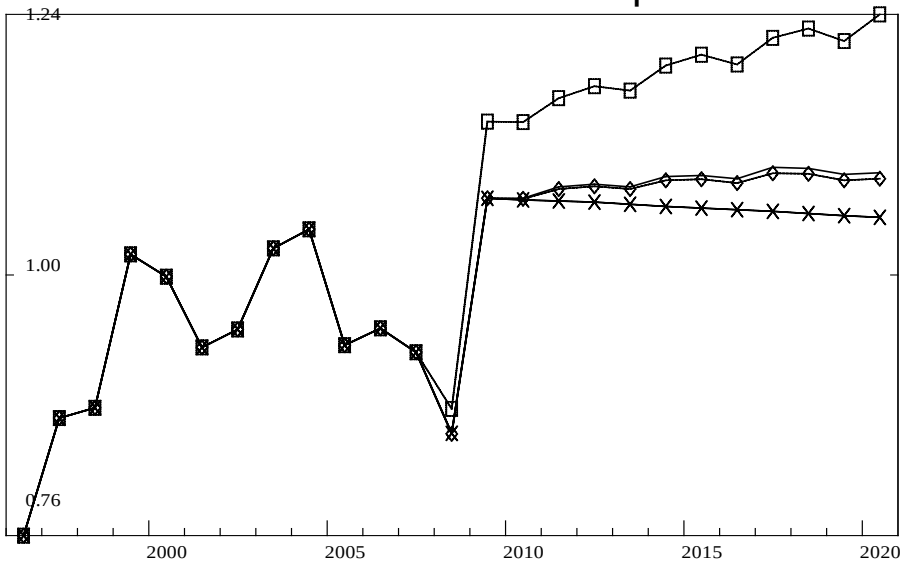
Results:

Polish import deflators 2000=1

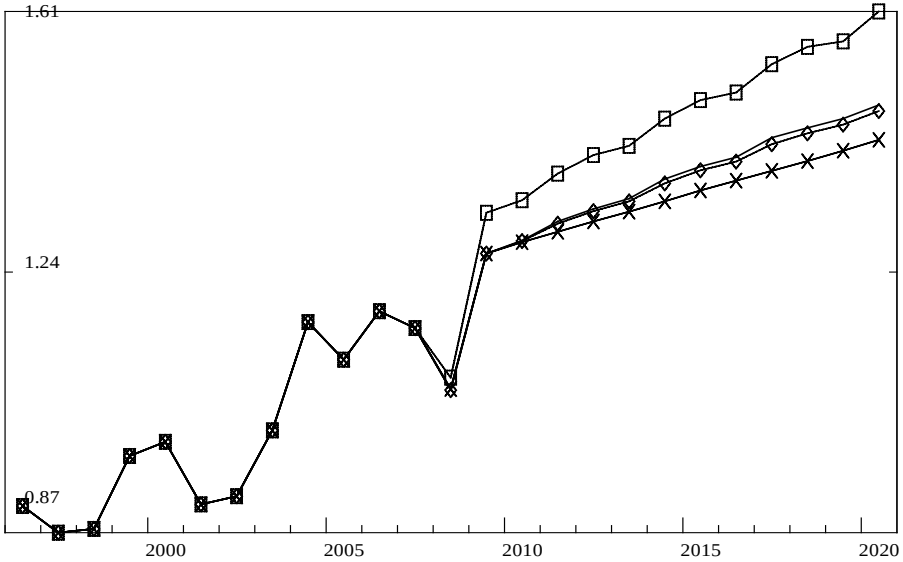
Coke and refined petroleum products



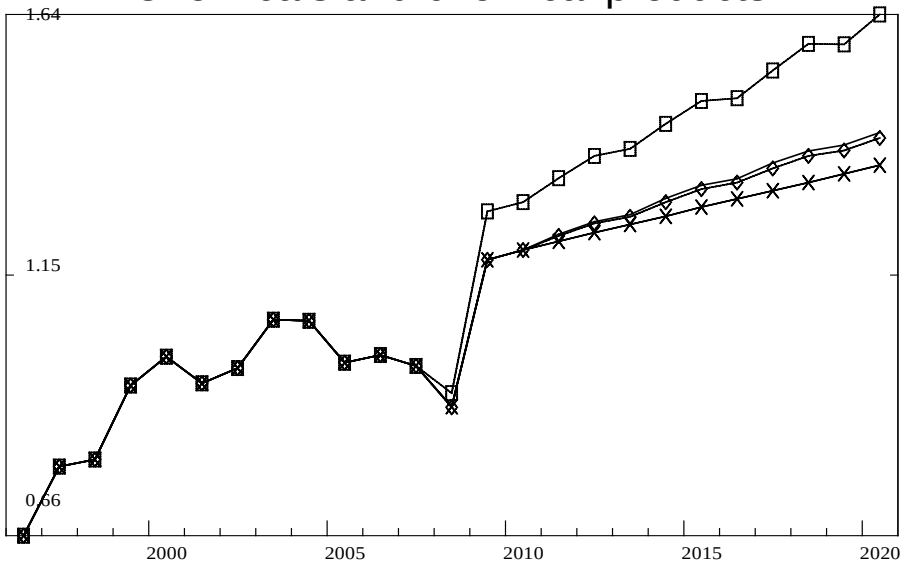
Other non-metallic mineral products



Basic metals



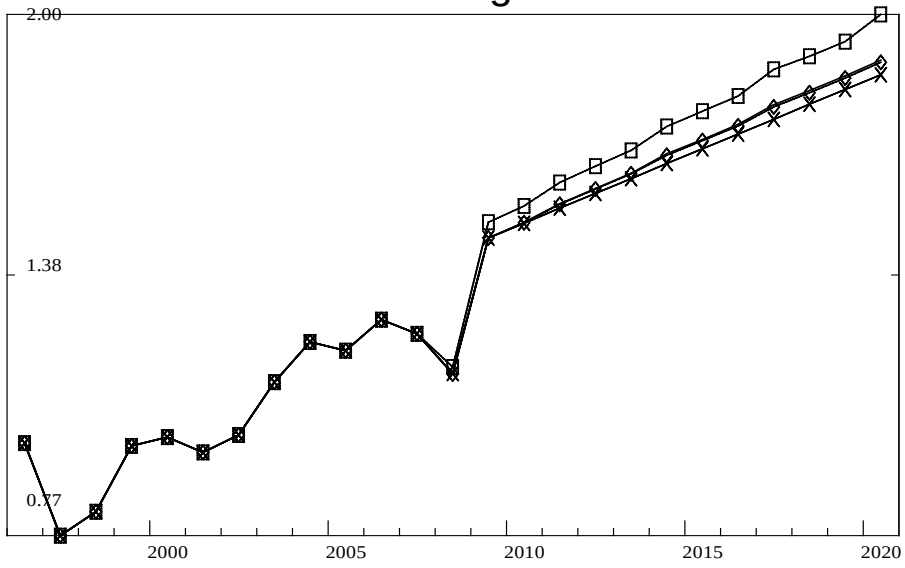
Chemicals and chemical products



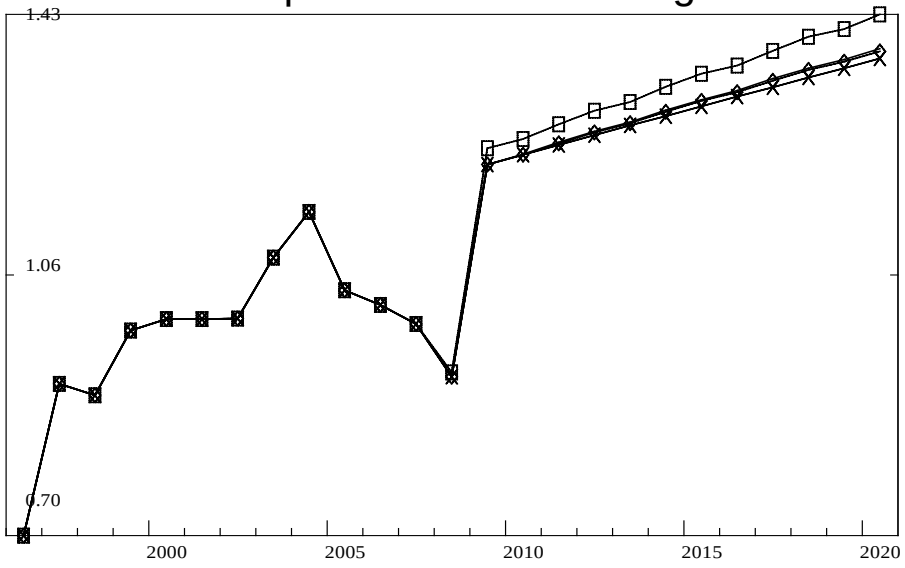
Results:

Polish import deflators 2000=1

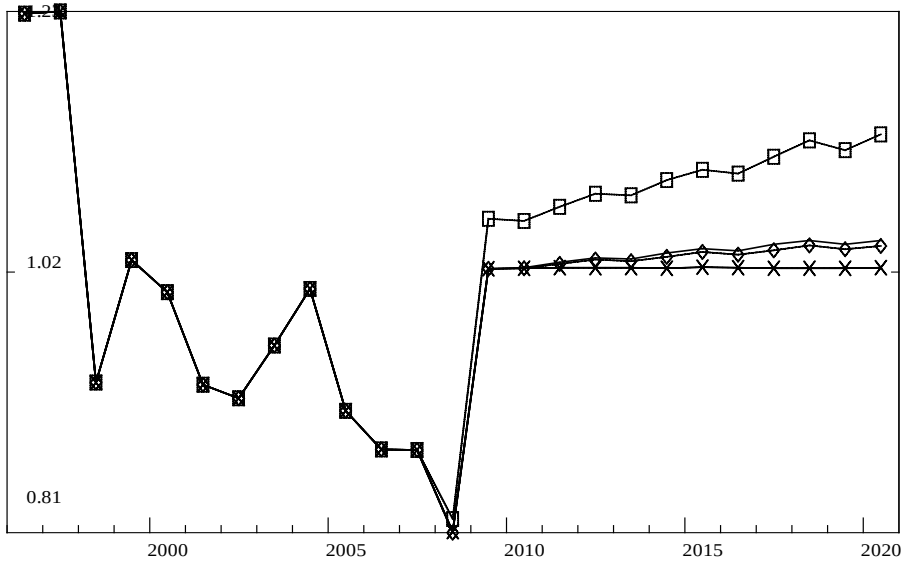
Products of agriculture



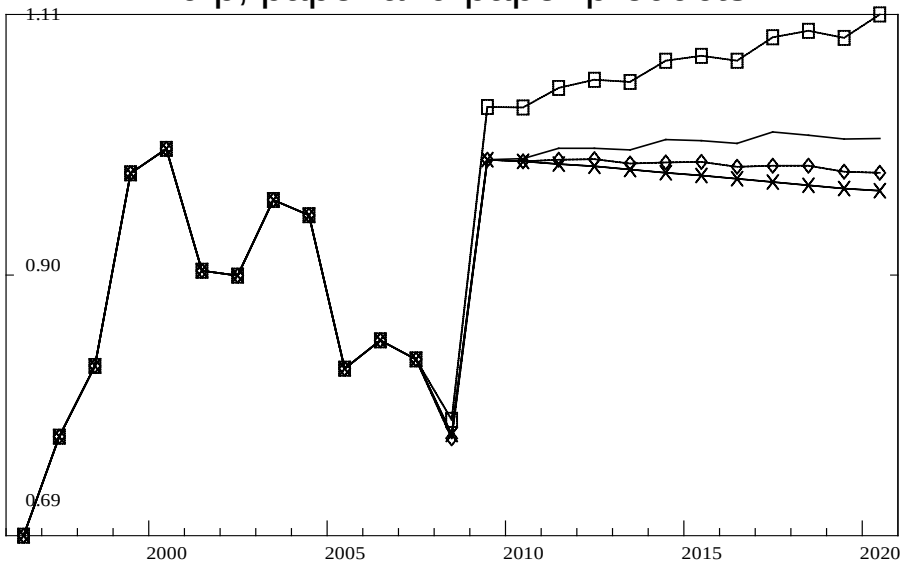
Food products and beverages



Textiles



Pulp, paper and paper products



Results:

Fast growing prices
– average deviations from growth rates

		IMP	EXP			IMP	EXP
1	Products of agriculture, hunting and related services	-0,2	-0,0	16	Rubber and plastic products	-0,2	-0,1
2	Products of forestry, logging and related services	-0,1	-0,0	17	Other non-metallic mineral products	-0,1	0,0
3	Fish and other fish products; services of incidental fishing	-0,5	-0,0	18	Basic metals	-0,4	-0,0
4	Coal and lignite; peat	-17,2	0,4	19	Fabricated metal products, except machinery and equipment	0,1	-0,0
5	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	-0,2	0,4	20	Machinery and equipment n.e.c.	-0,0	-0,2
6	Food products and beverages	-0,1	-0,3	21	Office machinery and computers	-0,0	-0,0
7	Tobacco products	-0,2	-0,2	22	Electrical machinery and apparatus n.e.c.	-0,2	-0,0
8	Textiles	-0,2	-0,0	23	Radio, television and communication equipment and apparatus	-0,0	-0,0
9	Wearing apparel; furs	0,2	-0,1	24	Medical, precision and optical instruments, watches and clocks	-0,1	-0,0
10	Leather and leather products	-0,3	-0,4	25	Motor vehicles, trailers and semi-trailers	-0,3	-0,9
11	Wood and of products of wood and cork (except furniture); articles of straw and plaiting materials	-0,1	-0,1	26	Other transport equipment	-0,3	-0,9
12	Pulp, paper and paper products	-0,1	0,0	27	Furniture; other manufactured goods n.e.c.	-0,2	-0,3
13	Printed matter and recorded media	-0,1	-0,1	29	Electrical energy, gas, steam and hot water	0,4	-0,0
14	Coke, refined petroleum products and nuclear fuels	-0,6	0,1		Services	-0,1	-0,0
15	Chemicals and chemical products	-0,1	-0,0		Total	-0,1	-0,4

Results:

Frozen prices

– average deviations from growth rates

		IMP	EXP			IMP	EXP
1	Products of agriculture, hunting and related services	0,1	0,1	16	Rubber and plastic products	0,1	0,1
2	Products of forestry, logging and related services	0,0	0,0	17	Other non-metallic mineral products	0,1	0,1
3	Fish and other fish products; services of incidental fishing	0,4	0,0	18	Basic metals	0,3	0,0
4	Coal and lignite; peat	24,1	-1,2	19	Fabricated metal products, except machinery and equipment	-0,5	0,0
5	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying	0,3	-1,5	20	Machinery and equipment n.e.c.	-0,1	0,2
6	Food products and beverages	-0,1	0,3	21	Office machinery and computers	-0,0	0,0
7	Tobacco products	-0,0	0,2	22	Electrical machinery and apparatus n.e.c.	0,0	0,0
8	Textiles	0,2	0,1	23	Radio, television and communication equipment and apparatus	-0,0	0,0
9	Wearing apparel; furs	-0,2	0,1	24	Medical, precision and optical instruments, watches and clocks	-0,1	0,0
10	Leather and leather products	0,2	0,4	25	Motor vehicles, trailers and semi-trailers	-0,0	0,9
11	Wood and of products of wood and cork (except furniture); articles of straw and plaiting materials	-0,1	0,2	26	Other transport equipment	0,3	1,1
12	Pulp, paper and paper products	0,1	0,0	27	Furniture; other manufactured goods n.e.c.	0,2	0,4
13	Printed matter and recorded media	0,0	0,1	29	Electrical energy, gas, steam and hot water	-0,4	0,0
14	Coke, refined petroleum products and nuclear fuels	0,4	-0,0		Services	0,1	0,0
15	Chemicals and chemical products	0,1	0,1		Total	0,0	0,4

Conclusions

- Because of relatively high energy intensity of Polish economy, the increase in world prices of energy carriers weakens its competitiveness, but the effect is rather modest.
- Significant influence could be noticed only for rapid movements of oil prices. In other words, world prices of energy carriers are transferred to the Polish economy via products of oil refination rather than electricity.
- Much stronger efects could be noticed for increase in domestic prices of electricity caused by factors other than primary energy carriers.
- The previous conclusion will become more important paralelly to the development of renewable resurces of energy. At this moment, the share of these kinds of resources is quite small.