Annex 1
Characteristics of GEMPOL model

The model consists of:

1) Indices;
2) Variables;
3) Parameters;
4) Equations.

The indices and parameters are labelled with lower case letters, while the variables are described with upper case letters. The expressions in quotation marks refer to individual elements of particular indices (sets). In addition, the lines over the top of the letters indicate exogeneous variables, while their lack implies endogeneity of variables.

1) **Indices**

Sets

- *i* – set of industries;
- *g* – set of products/commodities;
- *skl* – set of labour types (by skills):
- *m* – set of margin types;
  - *trd* – trade margin;
  - *trn* – transport margin;
- *tx* – set of product tax/subsidy types;
  - *vat* – value added tax (VAT);
  - *exc* – excise tax;
  - *tar* – import tariffs;
  - *oth* – other product taxes[1];
  - *sub* – product subsidies.
- *own* – set of ownership forms (institutional sectors):
  - *prv* – private sector;
  - *pub* – public sector.

Subsets

- *h*(*g*) – margin products (*tde*, *mvs*, *whs*, *trd*, *ltr*, *wtr*);
- *eng*(*g*) – energy products (*col*, *lig*, *oil*, *gas*, *pet*, *ele*, *tde*, *gdt*, *hea*);
- *fue*(*g*) – fossil fuels (*col*, *lig*, *oil*, *gas*, *pet*, *gdt*).

[1] Games-of-chance and lottery tax, sugar levies; receipts of the Fund for Sports and Recreation Protection Activity from advertisement of alcoholic beverages; receipts of the Fund for the Promotion of Creative Activities from the production of copyright-protected goods; receipts of the Fund for Solving Gambling Addiction Problems; fuel surcharge.

Table A1. Products (index *g*) and industries (index *i*) distinguished within the model

	Description	CPA 2008 / / NACE Rev 2.0
agr	Agriculture and hunting	01
frs	Forestry and logging	02
fsh	Fishing and aquaculture	03
col	Hard coal	05
lig	Lignite	05
oil	Crude petroleum	06
gas	Natural gas	06
min	Other mining and quarrying	07–09
foo	Food	10
bev	Beverages	11
tob	Tobacco	12
tex	Textiles	13
app	Wearing apparel	14
lea	Leather and related products	15
woo	Wood, cork, straw and wicker	16
pap	Paper and paper products	17
prt	Printing and recording	18
pet	Coke, refined petroleum	19
chm	Chemicals	20
phm	Pharmaceuticals	21
rub	Rubber and plastic	22
nmm	Other non-metallic minerals	23
mtl	Basic metals	24
fmt	Fabricated metals	25
cmp	Computer, electronic and optical products	26
eeq	Electrical equipment	27
mch	Machinery and equipment n.e.c.	28
mvh	Motor vehicles	29
teq	Other transport equipment	30
fur	Furniture	31
oth	Other manufacturing	32
rin	Repair and installation of machinery and equipment	33
ele	Electricity	35
tde	Transmission, distribution and trade of electricity	35
gdt	Distribution and trade of gas fuels	35
hea	Heat (steam and hot water)	35
wat	Collection, purification and distribution of water	36
was	Waste collection, treatment and disposal activities; materials recovery	38

	Description	CPA 2008 / / NACE Rev 2.0
sew	Sewerage and remediation	37,39
con	Construction	41–43
mvs	Sale and repair of motor vehicles and motorcycles	45
whs	Wholesale trade	46
trd	Retail trade	47
ltr	Land and pipeline transport	49
wtr	Water and air transport	50–51
pst	Warehousing; postal and courier services	52–53
htl	Accommodation	55
res	Food and beverage services	56
pbs	Publishing	58
avp	Motion picture, video and television production, sound recording and music publishing	59
bdc	Programming and broadcasting	60
com	Telecommunication	61
prg	Computer programming and consultancy	62
inf	Information services	63
fin	Financial services	64
ins	Insurance, reinsurance and pension funding	65
aux	Activities auxiliary to financial services and insurance	66
rea	Real estate	68
leg	Legal and accounting services	69
mng	Management consulting services	70
eng	Architectural and engineering services; technical testing and analysis services	71
sci	Scientific research and development	72
adv	Advertising and market research	73
opf	Other professional, scientific and technical services	74
vet	Veterinary services	75
ren	Rental and leasing services	77
emp	Employment services	78
trv	Travel agency, tour operator and other reservation services and related services	79
sec	Security and investigation services	80
bui	Services to buildings and landscape activities	81
off	Office administration, office support and other business support	82
pub	Public administration	84
edu	Education	85
hlt	Human health	86
soc	Social works	87–88
art	Creative, arts and entertainment services	90

cont. table A1

	Description	CPA 2008 / / NACE Rev 2.0
lib	Library, archive, museum services	91
gmb	Gambling and betting	92
spt	Sporting services and amusement and recreation services	93
org	Services furnished by membership organisations	94
rep	Repair of computers and personal and household goods	95
ops	Other personal services	96
prv	Activities of households as employers of domestic personnel	97–98

Source: own elaboration.

Table A2. Product/industry groups used in the aggregation of results

Description	CPA 2008 / NACE Rev 2.0
Agriculture, forestry, fishing	01, 02, 03
Energy	05, 06, 19, 35
Food, beverages, tobacco	10, 11, 12
Textiles, leather, wearing apparel	13, 14, 15
Paper	17, 18
Chemicals	20, 21, 22
Non-metallic minerals	23
Metals	07, 08, 09, 24, 25
Machinery and equipment	26, 27, 28, 29, 30
Other manufacturing	16, 31, 32
Construction	41, 42, 43
Services	36, 37, 38, 39, 45, 46, 47, 49, 50, 51, 52, 53, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 70, 71, 72, 73, 74, 75, 77, 78, 79, 80, 81, 82, 84, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96, 97, 98

Source: own elaboration.

Table A3. Labour types by skill (index *skl*) distinguished within the model

Code	Description	ISCED '97
HS	High-skilled	6 (Second stage of tertiary education) 5 (First stage of tertiary education)
MS	Medium-skilled	4 (Post-secondary non-tertiary education) 3 (Upper secondary education)
LS	Low-skilled	2 (Lower secondary education) 1 (Primary education)

Source: own elaboration based on Timmer et al. [2015].

2) **Variables**

Activities:

- Y_i – production function of industry i;
- AN_g – production function aggregating domestic output, imports (including tariffs) and margin into "net" Armington composite of product g;
- AG_g – production function aggregating "net" Armington composite of product g into "gross" Armington composite of product g excluding VAT;
- AV_g – transformation function of "gross" Armington composite of product g excluding VAT into "gross" Armington composite of product g including VAT;
- DE_g – transformation function of "gross" Armington composite including VAT into domestic demand and exports of product g;
- EX_g – export function of product g;
- IM_g – import function of product g;
- MA_m – production function of margin m;
- CD – consumption function of households;
- GD – consumption function of the government;
- ID_{own} – investment function of institutional sector *own*;
- $LABS_{skl}$ – "production" function of labour supply for skill level *skl*;
- $CAPS_i$ – "production" function of capital stock in industry i – from net prices into gross prices.

Prices:

- PP_g – producer price of domestically produced commodity g;
- PAN_g – "net" Armington composite price of product g;
- PAG_g – "gross" Armington composite price of product g excluding VAT;
- PAV_g – "gross" Armington composite price of product g including VAT;
- PD_g – price of domestically sold product g;
- PE_g – export price of product g;
- PM_g – import price of product g;
- PX – exchange rate;
- PZ_m – price of margin m;
- PL_{skl} – net wage for skill level *skl*;
- PLS_{skl} – gross wage for skill level *skl*;
- PK_i – net capital price in industry i;
- PKS_i – gross capital price in industry i;
- PC – household consumption price (numeraire);
- PG – government consumption price;
- PI_{own} – investment good price for institutional sector *own*;
- PEX_g – excise tax "price" (rate) on product g.

Institutional sectors:

- HH – household sector;
- GOV – government sector.

3) **Parameters**

Share parameters:

- $\gamma_{g,i}$ – share of product g in the entire output of industry i;
- $\theta_{g,i}$ – share of the use of product g in total use of non-energy products in industry i;
- θ_{i}^{TOP} – share of the use of non-energy products in the total output of industry i;
- θ_{CD}^{TOP} – share of non-energy product consumption in total household consumption;
- θ_{GD}^{TOP} – share of non-energy product consumption in total government consumption;
- θ_{i}^{KLE} – share of value added in the value added-energy composite in industry i;
- θ_{i}^{VA} – share of capital costs in value added in industry i;
- θ_{i}^{LABL} – share of high-skilled labour costs in the composite of medium- and high-skilled labour in industry i;
- θ_{i}^{LABU} – share of low-skilled labour costs in total labour costs in industry i;
- $\theta_{g,i}^{FUEL}$ – share of fossil fuel g in the total use of fossil fuels in industry i;
- $\theta_{g,CD}^{FUEL}$ – share of fossil fuel g in the total consumption of fossil fuels by households;
- $\theta_{g,GD}^{FUEL}$ – share of fossil fuel g in the total consumption of fossil fuels by the government;
- θ_{i}^{ENER} – share of the electricity-heat composite in total energy use in industry i;
- θ_{CD}^{ENER} – share of the electricity-heat composite in total energy use by households;
- θ_{GD}^{ENER} – share of the electricity-heat composite in total energy use by the government;
- θ_{i}^{EH} – share of electricity within the electricity-heat composite in industry i;
- θ_{CD}^{EH} – share of electricity within the electricity-heat composite for household consumption;
- θ_{GD}^{EH} – share of electricity within the electricity-heat composite for government consumption;
- θ_{i}^{EC} – share of electricity generation within the composite of electricity generation as well as electricity transmission and distribution in industry i;
- θ_{CD}^{EC} – share of electricity generation within the composite of electricity generation as well as electricity transmission and distribution for household consumption;

- θ_{GD}^{EC} – share of electricity generation within the composite of electricity generation as well as electricity transmission and distribution for government consumption;
- $\theta_{g,m}^{MR}$ – share of margin *m* within the "net" Armington composite (including margins) of product *g*;
- θ_{g}^{AR} – share of domestic production within the "net" Armington composite (excluding margins) of product *g*;
- γ_{g}^{DE} – share of domestically sold output in total production of commodity *g*;
- $\theta_{h,m}^{MA}$ – share of product *h* in total costs of margin *m*;
- α_{g}^{CD} – share of non-energy commodity *g* in total consumption of non-energy products by households;
- θ_{g}^{GD} – share of non-energy commodity *g* in total consumption of non-energy products by the government;
- $\theta_{g,own}^{ID}$ – share of product *g* in total investment outlays of institutional sector *own*.

Substitution and transformation elasticities:

- σ_{i}^{TOP} – substitution elasticity between value added-energy composite and non-energy products in industry *i*;
- σ_{CD}^{TOP} – substitution elasticity between energy composite and non-energy products within household consumption;
- σ_{GD}^{TOP} – substitution elasticity between energy composite and non-energy products within government consumption;
- σ_{i}^{VA} – substitution elasticity between capital and labour in industry *i*;
- σ_{i}^{KLE} – substitution elasticity between value added and energy in industry *i*;
- σ_{i}^{LABU} – substitution elasticity between low-skilled labour and composite of medium- and high-skilled labour in industry *i*;
- σ_{i}^{LABL} – substitution elasticity between high- and medium-skilled labour in industry *i*;
- σ_{i}^{ENER} – substitution elasticity between fossil fuels composite and electricity-heat composite in industry *i*;
- σ_{CD}^{ENER} – substitution elasticity between fossil fuels composite and electricity-heat composite within household consumption;
- σ_{GD}^{ENER} – substitution elasticity between fossil fuels composite and electricity-heat composite within government consumption;
- σ_{i}^{FUEL} – substitution elasticity between fossil fuels in industry *i*;
- σ_{CD}^{FUEL} – substitution elasticity between fossil fuels within household consumption;
- σ_{GD}^{FUEL} – substitution elasticity between fossil fuels within government consumption;

- σ^{EH} – substitution elasticity between electricity and heat;
- σ^{EC} – substitution elasticity between generation as well as transmission and distribution of electricity;
- σ_g^{ARMI} – substitution elasticity between domestic production and imports of commodity g;
- η^{DE} – transformation elasticity of "gross" Armington composites including VAT between domestic market and exports.

Other parameters:

- k_shr_{own} – share of institutional sector *own* in total capital stock within the economy.

Taxes:

- itx_i – taxes minus subsidies on/to industry i;
- $gtx_{tx,g}$ – tax/subsidy of type on/to product g;
- ktx – taxes on capital remuneration;
- ltx_{skl} – taxes on labour remuneration by skill level *skl*.

Stocks (fixed in a given year):

- $\overline{LAB_{skl}}$ – labour stock (by skill level *skl*);
- $\overline{CAP_i}$ – capital stock of industry i;
- $\overline{BOP}$ – balance of payments (trade balance);
- $\overline{BENS}$ – social transfers from the government to households;
- $\overline{DEF}$ – budget deficit.

Auxiliary variables:

- $EXCISE(g)$ – index of excise tax on product g;
- $DEMAND\_PRV$ – index of private sector demand;
- $DEMAND\_PUB$ – index of public sector demand.

Table A4. Values of substitution elasticities (σ) for particular industries and products, as well as for households and the government (products/industries in rows, production/consumption function nests in columns)

	TOP	KLE	VA	LABU	LABL	ENER	FUEL	ARMI
agr, frs, fsh	0.76	0.21	0.15	0.14	0.05	0.60	0.70	0.79
col, lig, oil, gas	0.48	0.21	0.00	0.32	0.01	0.15	0.15	0.37
min	0.48	0.21	0.00	0.32	0.01	0.80	0.90	0.37
foo, bev, tob	0.52	0.39	0.44	0.08	0.55	0.80	0.90	0.61
tex	0.62	0.50	0.17	0.06	0.62	0.80	0.90	0.77
app, lea	0.79	0.32	0.05	0.01	0.68	0.80	0.90	0.93
woo	0.67	0.47	0.14	0.00	0.49	0.80	0.90	0.68
pap, prt	0.86	0.32	0.35	0.00	0.41	0.80	0.90	0.81
pet	0.84	0.49	0.19	0.00	0.59	0.20	0.10	1.13

	TOP	KLE	VA	LABU	LABL	ENER	FUEL	ARMI
chm, phm	0.98	0.25	0.43	0.11	0.65	0.80	0.90	0.96
rub	0.84	0.64	0.42	0.00	0.56	0.80	0.90	1.10
nmm	0.98	0.52	0.42	0.04	0.42	0.80	0.90	0.96
mtl, fmt	0.92	0.35	0.14	0.00	0.46	0.80	0.90	0.93
cmp, eeq	0.96	0.79	0.25	0.07	0.42	0.80	0.90	0.40
mch	1.05	0.72	0.41	0.00	0.34	0.80	0.90	0.68
mvh, teq	0.71	0.46	0.18	0.11	0.40	0.80	0.90	1.26
fur, oth, rin	0.91	0.63	0.17	0.12	0.37	0.80	0.90	0.81
ele, tde	0.87	0.08	0.31	0.35	1.25	0.20	0.20	0.61
gdt, hea	0.87	0.08	0.31	0.35	1.25	0.90	0.10	0.61
wat, was, sew	0.87	0.08	0.31	0.35	1.25	0.30	0.40	0.61
con	0.81	0.34	0.18	0.00	0.00	0.80	0.90	0.89
mvs	1.06	0.38	0.38	0.01	0.51	0.30	0.40	0.53
whs	0.91	0.40	0.38	0.00	0.10	0.30	0.40	1.11
trd	0.50	0.36	0.10	0.00	0.23	0.30	0.40	1.04
ltr	0.89	0.04	0.15	0.00	0.00	0.20	0.10	0.31
wtr	0.78	0.34	0.12	0.09	0.00	0.20	0.10	1.22
pst	1.03	0.26	0.05	0.02	0.00	0.30	0.40	0.41
htl, res	1.01	0.43	0.06	0.00	0.09	0.30	0.40	0.55
pbs, avp, bdc, com, prg, inf	0.74	0.19	0.44	0.00	0.01	0.30	0.40	0.75
fin, ins, aux	0.62	0.40	0.18	0.26	0.00	0.30	0.40	0.72
rea	0.65	0.18	0.19	0.14	0.00	0.30	0.40	1.19
leg, mng, eng, sci, adv, opf, vet, ren, emp, trv, sec, bui, off	0.74	0.19	0.44	0.00	0.01	0.30	0.40	0.75
pub	1.01	0.26	0.11	0.00	0.77	0.30	0.40	1.36
edu	0.85	0.00	0.11	0.53	0.29	0.30	0.40	0.91
hlt, soc	1.13	0.30	0.12	0.19	0.25	0.30	0.40	0.78
art, lib, gmb, spt, org, rep, ops, prv	0.93	0.31	0.01	0.20	0.06	0.30	0.40	1.07
Households (CD)	0.93	n/a	n/a	n/a	n/a	0.30	0.40	n/a
Government (GD)	1.00	n/a	n/a	n/a	n/a	0.30	0.40	n/a

Source: Antoszewski et al. [2015], Antoszewski [2019b], McKibbin and Wilcoxen [1999].

4) **Equations**

a) **Zero profit conditions**

Production function of industry i (complementary variable Y_i):

$$\Pi_i = \sum_g \left(1-itx_i\right)\cdot\gamma_{g,i}\cdot PP_g - \Bigg\{\theta_i^{TOP}\cdot\left(\sum_{g\notin eng(g)}\theta_{g,i}\cdot PD_g\right)^{1-\sigma_i^{TOP}} + \left(1-\theta_i^{TOP}\right)\cdot$$

$$\cdot\Bigg[\theta_i^{KLE}\cdot\Bigg[\theta_i^{VA}\cdot PKS_i^{1-\sigma_i^{VA}} + \left(1-\theta_i^{VA}\right)\cdot\Bigg(\theta_i^{LABU}\cdot PLS_{"LS"}^{1-\sigma_i^{LABU}} + \left(1-\theta_i^{LABU}\right)\cdot$$

$$\cdot\left(\theta_i^{LABL}\cdot PLS_{"HS"}^{1-\sigma_i^{LABL}} + \left(1-\theta_i^{LABL}\right)\cdot PLS_{"MS"}^{1-\sigma_i^{LABL}}\right)^{\frac{1-\sigma_i^{LABU}}{1-\sigma_i^{LABL}}}\Bigg)^{\frac{1-\sigma_i^{VA}}{1-\sigma_i^{LABU}}}\Bigg]^{\frac{1-\sigma_i^{KLE}}{1-\sigma_i^{VA}}} + \left(1-\theta_i^{KLE}\right)\cdot$$

$$\cdot\Big[\theta_i^{ENER}\cdot\Big[\theta_i^{EH}\cdot\left(\theta_i^{EC}\cdot PD_{"ele"} + \left(1-\theta_i^{EC}\right)\cdot PD_{"tde"}\right) + \left(1-\theta_i^{EH}\right)\cdot PD_{"hea"}\Big]^{1-\sigma_i^{ENER}} +$$

$$+\left(1-\theta_i^{ENER}\right)\cdot\left(\sum_{g\in fue(g)}\theta_{g,i}^{FUEL}\cdot PD_g^{\,1-\sigma_i^{FUEL}}\right)^{\frac{1-\sigma_i^{ENER}}{1-\sigma_i^{FUEL}}}\Bigg]^{\frac{1-\sigma_i^{KLE}}{1-\sigma_i^{ENER}}}\Bigg]^{\frac{1-\sigma_i^{TOP}}{1-\sigma_i^{KLE}}}\Bigg\}^{\frac{1}{1-\sigma_i^{TOP}}} \le 0 \qquad (1)$$

Production function aggregating domestic output, imports (including tariffs) and margin into "net" Armington composite of product g (complementary variable AN_g):

$$\Pi_g^{AN} = PAN_g - \left(1-\sum_m\theta_{g,m}^{MR\cdot}\right)\cdot\Big[\left(\theta_g^{AR}\cdot PP_g^{\,1-\sigma_g^{AR}} + \left(1-\theta_g^{AR}\right)\cdot\right.$$

$$\left.\cdot\left(\left(1+gtx_{g,"tar"}\right)\cdot PM_g\right)^{1-\sigma_g^{AR}}\right]^{\frac{1}{1-\sigma_g^{AR}}} - \sum_m\theta_{g,m}^{MR\cdot}\cdot PZ_m \le 0 \qquad (2)$$

Production function aggregating "net" Armington composite of product g into "gross" Armington composite of product g excluding VAT (complementary variable AG_g):

$$\Pi_g^{AG} = \left(1 - gtx_{g,"oth"} - gtx_{g,"sub"}\right) \cdot PAG_g - PAN_g - PEX_g \leq 0 \tag{3}$$

Transformation function of "gross" Armington composite of product g excluding VAT into "gross" Armington composite of product g including VAT (complementary variable AV_g):

$$\Pi_g^{AV} = \left(1 - gtx_{g,"vat"}\right) \cdot PAV_g - PAG_g \leq 0 \tag{4}$$

Transformation function of "gross" Armington composite including VAT into domestic demand and exports of product g (complementary variable DE_g):

$$\Pi_g^{DE} = \left(\gamma_g^{DE} \cdot PD_g^{1-\eta^{DE}} + \left(1 - \gamma_g^{DE}\right) \cdot PE_g^{1-\eta^{DE}}\right)^{\frac{1}{1-\eta^{DE}}} - PAV_g \leq 0 \tag{5}$$

Export function of product g (complementary variable E_g):

$$\Pi_g^{E} = PX - PE_g \leq 0 \tag{6}$$

Import function of product g (complementary variable M_g):

$$\Pi_g^{IM} = PM_g - PX \leq 0 \tag{7}$$

Production function of margin m (complementary variable MA_m):

$$\Pi_m^{MA} = PZ_m - \sum_h \theta_{h,m}^{MA} \cdot PD_h \leq 0 \tag{8}$$

Consumption function of households (complementary variable CD):

$$\begin{aligned} \Pi^{CD} = PC - \Bigg\{ & \theta_{CD}^{TOP} \cdot \left(\sum_{g \in eng(g)} PD_g^{\alpha_g^{CD}} \right)^{1-\sigma_{CD}^{TOP}} + \left(1 - \theta_{CD}^{TOP}\right) \cdot \Bigg[\theta_{CD}^{ENER} \cdot \Big[\theta_{CD}^{EH} \cdot \left(\theta_{CD}^{EC} \cdot PD_{"ele"} + \right. \right. \\ & \left. \left. + \left(1 - \theta_{CD}^{EC}\right) \cdot PD_{"tde"} \right) + \left(1 - \theta_{CD}^{EH}\right) \cdot PD_{"hea"} \Big]^{1-\sigma_{CD}^{ENER}} + \left(1 - \theta_{CD}^{ENER}\right) \cdot \\ & \cdot \left(\sum_{g \in fue(g)} \theta_{g,CD}^{FUEL} \cdot PD_g^{1-\sigma_{CD}^{FUEL}} \right)^{\frac{1-\sigma_{CD}^{ENER}}{1-\sigma_{CD}^{FUEL}}} \Bigg]^{\frac{1-\sigma_{CD}^{TOP}}{1-\sigma_{CD}^{ENER}}} \Bigg\}^{\frac{1}{1-\sigma_{CD}^{TOP}}} \leq 0 \end{aligned} \tag{9}$$

Consumption function of the government (complementary variable *GD*):

$$\Pi^{GD} = PG - \left\{ \theta_{GD}^{TOP} \cdot \left(\sum_{g \in eng(g)} \theta_g^{GD} \cdot PD_g \right)^{1-\sigma_{GD}^{TOP}} + (1-\theta_{GD}^{TOP}) \cdot \right.$$

$$\cdot \left[\theta_{GD}^{ENER} \cdot \left[\theta_{GD}^{EH} \cdot \left(\theta_{GD}^{EC} \cdot PD_{"ele"} + \left(1-\theta_{GD}^{EC}\right) \cdot PD_{"tde"} \right) + \left(1-\theta_{GD}^{EH}\right) \cdot PD_{"hea"} \right]^{1-\sigma_{GD}^{ENER}} + \right.$$

$$\left. \left. + \left(1-\theta_{GD}^{ENER}\right) \cdot \left(\sum_{g \in fue(g)} \theta_{g,GD}^{FUEL} \cdot PD_g^{\,1-\sigma_{GD}^{FUEL}} \right)^{\frac{1-\sigma_{GD}^{ENER}}{1-\sigma_{GD}^{FUEL}}} \right]^{\frac{1-\sigma_{GD}^{TOP}}{1-\sigma_{GD}^{ENER}}} \right\}^{\frac{1}{1-\sigma_{GD}^{TOP}}} \leq 0 \qquad (10)$$

Investment function of institutional sector *own* (complementary variable ID_{own}):

$$\Pi_{own}^{ID} = PI_{own} - \sum_g \theta_{g,own}^{ID} \cdot PD_g \leq 0 \qquad (11)$$

"Production" function of labour supply for skill level *skl* (complementary variable $LABS_{skl}$):

$$\Pi_{skl}^{LABS} = PLS_{skl} - (1+ltx) \cdot PL_{skl} \leq 0 \qquad (12)$$

"Production" function of capital stock in industry *i* – from net prices into gross prices (complementary variable $CAPS_i$):

$$\Pi_i^{CAPS} = PKS_i - (1+ktx) \cdot PK_i \leq 0 \qquad (13)$$

b) **Market clearing conditions**

Balance of domestic production of commodity *g* (complementary variable PP_g):

$$\sum_i \frac{\partial \Pi_i^Y}{\partial PP_g} \cdot Y_i = \frac{\partial \Pi_g^{AN}}{\partial PP_g} \cdot AN_g \qquad (14)$$

Production balance of domestically sold commodity *g* (complementary variable PD_g):

$$\frac{\partial \Pi_g^{DE}}{\partial PD_g} \cdot DE_g = \sum_i \frac{\partial \Pi_i^Y}{\partial PD_g} \cdot Y_i + \frac{\partial \Pi^{CD}}{\partial PD_g} \cdot CD + \frac{\partial \Pi^{GD}}{\partial PD_g} \cdot GD \; + \\ + \sum_{own} \frac{\partial \Pi_{own}^{ID}}{\partial PD_g} \cdot ID_{own} + \sum_m \frac{\partial \Pi_m^{MA}}{\partial PD_g} \cdot MA_m \tag{15}$$

"Net" Armington composite balance of product g (complementary variable PAN_g):

$$\frac{\partial \Pi_g^{AN}}{\partial PAN_g} \cdot AN_g = \frac{\partial \Pi_g^{AG}}{\partial PAN_g} \cdot AG_g \tag{16}$$

"Gross" Armington composite balance of product g excluding VAT (complementary variable PAG_g):

$$\frac{\partial \Pi_g^{AG}}{\partial PAG_g} \cdot AG_g = \frac{\partial \Pi_g^{AV}}{\partial PAG_g} \cdot AV_g \tag{17}$$

"Gross" Armington composite balance of product g including VAT (complementary variable PAV_g):

$$\frac{\partial \Pi_g^{AV}}{\partial PAV_g} \cdot AV_g = \frac{\partial \Pi_g^{DE}}{\partial PAV_g} \cdot DE_g \tag{18}$$

Export balance of product g (complementary variable PE_g):

$$\frac{\partial \Pi_g^{DE}}{\partial PE_g} \cdot DE_g = EX_g \tag{19}$$

Import balance of product g (complementary variable PM_g):

$$IM_g = \frac{\partial \Pi_g^{AN}}{\partial PM_g} \cdot AN_g \tag{20}$$

Balance of payments (complementary variable PX):

$$\sum_g EX_g = \overline{BOP} + \sum_g IM_g \tag{21}$$

Balance of margin m (complementary variable PZ_m):

$$\frac{\partial \Pi^{MA}}{\partial PZ_m} \cdot MA_m = \sum_g \frac{\partial \Pi_g^{AN}}{\partial PZ_m} \cdot AN_g \tag{22}$$

Balance of labour supply of skill level *skl* in net prices (complementary variable PL_{skl}):

$$\overline{LAB_{skl}} = \frac{\partial \Pi_{skl}^{LABS}}{\partial PL_{skl}} \cdot LABS_{skl} \tag{23}$$

Balance of labour supply of skill level *skl* in gross prices (complementary variable PLS_{skl}):

$$\frac{\partial \Pi_{skl}^{LABS}}{\partial PLS_{skl}} \cdot LABS_{skl} = \sum_i \frac{\partial \Pi_i^Y}{\partial PLS_{skl}} \cdot Y_i \tag{24}$$

Capital stock balance in industry *i* in net prices (complementary variable PK_i):

$$\overline{CAP_i} = \frac{\partial \Pi_i^{CAPS}}{\partial PK_i} \cdot CAPS_i \tag{25}$$

Capital stock balance in industry *i* in gross prices (complementary variable PKS_i):

$$\frac{\partial \Pi_i^{CAPS}}{\partial PKS_i} \cdot CAPS_i = \frac{\partial \Pi_i^Y}{\partial PKS_i} \cdot Y_i \tag{26}$$

Balance of household consumption (complementary variable *PC*):

$$\frac{\partial \Pi^{CD}}{\partial PC} CD = HH \tag{27}$$

Balance of government consumption (complementary variable *PG*):

$$\frac{\partial \Pi^{GD}}{\partial PG} GD = GOV \tag{28}$$

Balance of investment good for institutional sector *own* (complementary variable PKS_{own}):

$$\frac{\partial \Pi_{"prv"}^{ID}}{\partial PI_{"prv"}} ID_{"prv"} = HH \tag{29}$$

$$\frac{\partial \Pi_{"pub"}^{ID}}{\partial PI_{"pub"}} ID_{"pub"} = GOV \tag{30}$$

c) **Income balance conditions**

Households:

$$HH = \sum_{skl} PL_{skl} \cdot \overline{LAB_{skl}} + \sum_{i} k\_shr_{"prv"} \cdot PK_i \cdot \overline{CAP_i} + PX \cdot \overline{BOP} + \\ + PC \cdot \overline{BENS} - PC \cdot \overline{DEF} \tag{31}$$

The government:

$$GOV = \sum_{i} k\_shr_{"pub"} \cdot PK_i \cdot \overline{CAP_i} + \sum_{i}\sum_{g} itx_i \cdot PP_g \frac{\partial \Pi_i^Y}{\partial PP_g} \cdot Y_i + \\ + \sum_{g} gtx_{"tar",g} \cdot PM_g \frac{\partial \Pi_g^{AN}}{\partial PM_g} \cdot AN_g + \sum_{g} PEX_g \cdot \frac{\partial \Pi_g^{AG}}{\partial PAN_g} \cdot AG_g + \\ + \sum_{g} gtx_{"oth",g} \cdot PAG_g \frac{\partial \Pi_g^{AG}}{\partial PAG_g} \cdot AG_g + \sum_{g} gtx_{"sub",g} \cdot PAG_g \frac{\partial \Pi_g^{AG}}{\partial PAG_g} \cdot AG_g + \\ + \sum_{g} gtx_{"vat",g} \cdot PAV_g \frac{\partial \Pi_g^{AV}}{\partial PAV_g} \cdot AV_g + \sum_{skl} ltx_{skl} \cdot PL_{skl} \frac{\partial \Pi_{skl}^{LABS}}{\partial PL_{skl}} \cdot LABS_{skl} + \\ + \sum_{i} ktx \cdot PK_i \frac{\partial \Pi_i^{CAPS}}{\partial PK_i} \cdot CAPS_i - PC \cdot \overline{BENS} + PC \cdot \overline{DEF} \tag{32}$$

d) **Auxiliary equations**

Determination mechanism for excise tax rate on product g (complementary variable $EXCISE_g$):

$$PEX_g = gtx_{"exc",g} \cdot PC \tag{33}$$

Determination mechanism for private sector investment volume (complementary variable *DEMAND_PRV*):

$$DEMAND\_PRV = CD \tag{34}$$

Determination mechanism for public sector investment volume (complementary variable *DEMAND_PUB*):

$$DEMAND\_PUB = GD \tag{35}$$

e) **Dynamic equations**

Real net rental rate of capital in industry i in year t:

$$PR_{i,t} = PK_{i,t} - \delta_i \tag{36}$$

Average real net rental rate of capital in the economy in year *t*:

$$APR_t = \sum_i \left(\frac{K_{i,t}}{\sum_i K_{i,t}} \cdot PR_{i,t} \right) = \sum_i \left(\frac{K_{i,t}}{\sum_i K_{i,t}} \cdot PK_{i,t} \right) - \sum_i \left(\frac{K_{i,t}}{\sum_i K_{i,t}} \cdot \delta_i \right) \tag{37}$$

Base-year share of industry *i* in total capital stock:

$$\overline{\xi}_i = \frac{K_{i,"2010"}}{\sum_i K_{i,"2010"}} \tag{38}$$

Share of total investment outlays addressed to industry *i* in year *t*:

$$\xi_{i,t} = \frac{\overline{\xi}_i \times \frac{PR_{i,t}}{APR_t}}{\sum_i \overline{\xi}_i \times \frac{PR_{i,t}}{APR_t}} \tag{39}$$

Investment outlays addressed to industry *i* in year *t*:

$$I_{i,t} = \xi_{i,t} \cdot I_i^* \tag{40}$$

Gross growth rate of capital stock in industry *i* in between year *t* and *t+1*:

$$K\_GR_{i,t+1} = \frac{K_{i,t+1}}{K_{i,t}} = \frac{(1-\delta_i) \cdot K_{i,t} + I_{i,t}}{K_{i,t}} = \frac{I_{i,t}}{K_{i,t}} - \delta_i \tag{41}$$

Level of capital stock in industry *i* in year *t* + 5:

$$K_{i,t+5} = K\_GR_{i,t}^5 \cdot K_{i,t} \tag{42}$$

Table A5. Per annum depreciation rates of capital by industry

agr	4.7%	pet	6.4%	gdt	4.9%	com	12.0%	sec	12.0%
frs	4.7%	chm	6.2%	hea	4.9%	prg	12.0%	bui	12.0%
fsh	4.7%	phm	6.2%	wat	4.9%	inf	12.0%	off	12.0%
col	5.3%	rub	6.6%	was	4.9%	fin	12.1%	pub	3.2%
lig	5.3%	nmm	6.6%	sew	4.9%	ins	12.1%	edu	3.7%
oil	5.3%	mtl	5.7%	con	5.4%	aux	12.1%	hlt	7.1%
gas	5.3%	fmt	5.7%	mvs	4.1%	rea	1.3%	soc	7.1%
min	5.3%	cmp	7.6%	whs	4.5%	leg	12.0%	art	7.7%
foo	5.9%	eeq	7.6%	trd	4.3%	mng	12.0%	lib	7.7%
bev	5.9%	mch	7.1%	ltr	6.0%	eng	12.0%	gmb	7.7%

tob	5.9%	mvh	9.0%	wtr	12.0%	sci	12.0%	spt	7.7%
tex	5.9%	teq	9.0%	pst	6.0%	adv	12.0%	org	7.7%
app	5.9%	fur	6.0%	htl	4.0%	opf	12.0%	rep	7.7%
lea	5.9%	oth	6.0%	res	4.0%	vet	12.0%	ops	7.7%
woo	6.1%	rin	6.0%	pbs	12.0%	ren	12.0%	prv	7.7%
pap	6.6%	ele	4.9%	avp	12.0%	emp	12.0%		
prt	6.6%	tde	4.9%	bdc	12.0%	trv	12.0%		

Source: own elaboration based on Timmer et al. [2015].

Table A6. Labour supply in the economy. by skill level (billions of working hours)

	2010	2015	2020	2025	2030	2035	2040	2045	2050
HS	2.5	2.5	2.4	2.4	2.3	2.3	2.2	2.1	2.0
MS	18.9	19.0	18.6	18.2	17.9	17.5	17.0	16.2	15.3
LS	7.2	7.2	7.1	6.9	6.8	6.7	6.5	6.2	5.8

Source: own elaboration based on European Commission [2015].

Table A7. Total capital stock in the economy (2010 PLN bn) – baseline scenario

2010	2015	2020	2025	2030	2035	2040	2045	2050
2,341	2,662	3,101	3,464	3,852	4,249	4,633	5,014	5,399

Source: own elaboration.

Table A8. Factors productivity (2010 = 1)

	2010	2015	2020	2025	2030	2035	2040	2045	2050
Labour	1.00	1.18	1.41	1.67	1.90	2.11	2.34	2.59	2.85
Capital	1.00	1.08	1.19	1.32	1.43	1.52	1.62	1.73	1.84

Source: own elaboration based on European Commission [2015].

Table A9. Index of energy intensity changes in particular sectors of the economy – central scenario

	2015	2020	2025	2030	2035	2040	2045	2050
agr, frs, fsh	1.00	0.94	0.90	0.86	0.82	0.80	0.77	0.76
col, lig, oil, gas, min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
foo, bev, tob	1.00	0.93	0.88	0.82	0.69	0.64	0.61	0.60
tex, app, lea	1.00	0.92	0.87	0.85	0.81	0.77	0.75	0.73
woo	1.00	0.93	0.94	0.89	0.83	0.79	0.77	0.72
pap, prt	1.00	0.88	0.70	0.57	0.45	0.35	0.31	0.29
pet	1.00	0.93	0.94	0.89	0.83	0.79	0.77	0.72
chm, phm, rub	1.00	0.86	0.78	0.66	0.56	0.54	0.53	0.52

cont. table A9

	2015	2020	2025	2030	2035	2040	2045	2050
nmm	1.00	0.94	0.87	0.77	0.73	0.70	0.68	0.63
mtl, fmt	1.00	0.92	0.77	0.63	0.57	0.56	0.54	0.53
cmp, eeq, mch, mvh, teq, fur, oth, rin	1.00	0.93	0.94	0.89	0.83	0.79	0.77	0.72
ele, tde, gdt, hea	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
wat, was, sew	1.00	0.93	0.94	0.89	0.83	0.79	0.77	0.72
con	1.00	0.97	0.91	0.87	0.83	0.79	0.77	0.74
mvs, whs, trd	1.00	0.92	0.80	0.73	0.67	0.64	0.60	0.59
ltr, wtr	1.00	0.91	0.83	0.75	0.72	0.69	0.66	0.63
pst, htl, res, pbs, avp, bdc, com, prg, inf, fin, ins, aux, rea, leg, mng, eng, sci, adv, opf, vet, ren, emp, trv, sec, bui, off, pub, edu, hlt, soc, art, lib, gmb, spt, org, rep, ops, prv	1.00	0.92	0.80	0.73	0.67	0.64	0.60	0.59
Households (CD)	1.00	0.90	0.80	0.72	0.66	0.61	0.59	0.58
Government (GD)	1.00	0.90	0.80	0.72	0.66	0.61	0.59	0.58

Source: own elaboration based on European Commission [2016].

Annex 2
Detailed simulations results

Table A10. Detailed macroeconomic results – part I

Real macroeconomic aggregates (percentage change vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Central	GDP	1.39	2.56	3.65	4.53	5.12	5.44	5.68
	Private consumption	2.19	4.04	5.82	7.33	8.40	9.04	9.52
	Public consumption	0.33	0.46	0.55	0.58	0.54	0.46	0.41
	Investment	1.58	2.88	4.13	5.19	5.93	6.36	6.69
	Output	0.40	0.52	0.61	0.63	0.58	0.51	0.51
	Exports	0.04	0.18	0.08	–0.07	–0.21	–0.27	–0.33
	Imports	0.05	0.20	0.08	–0.08	–0.23	–0.30	–0.36
	Capital stock	0.00	0.62	1.45	2.41	3.36	4.21	4.91
	Intermediate energy use	–4.02	–7.68	–11.06	–13.93	–15.68	–16.76	–17.60
	Final energy use	3.94	6.91	10.98	14.77	17.42	18.97	20.60
	Total energy use	–2.95	–5.69	–8.01	–9.88	–10.93	–11.55	–11.94
	Rebound effect (% of expected reduction)	72.69	72.73	71.90	71.30	71.79	71.99	71.75

Real macroeconomic aggregates (percentage change vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Low intensity	GDP	2.06	3.72	5.21	6.38	7.13	7.53	7.80
	Private consumption	3.24	5.91	8.42	10.50	11.97	12.84	13.50
	Public consumption	0.48	0.65	0.75	0.76	0.69	0.56	0.47
	Investment	2.34	4.20	5.96	7.41	8.43	9.01	9.45
	Output	0.58	0.72	0.80	0.79	0.70	0.60	0.60
	Exports	0.06	0.25	0.08	–0.14	–0.32	–0.41	–0.48
	Imports	0.07	0.27	0.08	–0.15	–0.35	–0.45	–0.53
	Capital stock	0.00	0.92	2.14	3.51	4.84	6.04	7.00
	Intermediate energy use	–5.95	–11.25	–16.02	–19.93	–22.24	–23.63	–24.71
	Final energy use	5.85	10.06	15.77	20.96	24.54	26.57	28.81
	Total energy use	–4.37	–8.35	–11.61	–14.16	–15.52	–16.31	–16.78
	Rebound effect (% of expected reduction)	72.26	71.79	70.64	69.82	70.18	70.31	70.11
High intensity	GDP	0.71	1.32	1.92	2.43	2.77	2.97	3.12
	Private consumption	1.11	2.07	3.02	3.85	4.44	4.80	5.08
	Public consumption	0.17	0.24	0.30	0.33	0.33	0.29	0.26
	Investment	0.80	1.48	2.15	2.73	3.15	3.39	3.58
	Output	0.21	0.28	0.36	0.39	0.37	0.34	0.34
	Exports	0.02	0.10	0.06	–0.02	–0.09	–0.13	–0.16
	Imports	0.02	0.11	0.06	–0.02	–0.10	–0.14	–0.18
	Capital stock	0.00	0.31	0.74	1.24	1.75	2.21	2.60
	Intermediate energy use	–2.03	–3.92	–5.72	–7.28	–8.26	–8.88	–9.37
	Final energy use	1.99	3.56	5.72	7.78	9.26	10.15	11.04
	Total energy use	–1.49	–2.90	–4.13	–5.15	–5.74	–6.10	–6.34
	Rebound effect (% of expected reduction)	73.13	73.71	73.25	72.93	73.57	73.85	73.59
Low elasticities	GDP	1.26	2.25	3.15	3.87	4.34	4.59	4.78
	Private consumption	2.02	3.52	4.91	6.01	6.75	7.15	7.47
	Public consumption	0.06	0.08	0.09	0.08	0.06	0.02	–0.01
	Investment	1.43	2.47	3.44	4.20	4.71	4.98	5.20
	Output	0.14	0.02	–0.10	–0.26	–0.40	–0.52	–0.57
	Exports	–0.26	–0.33	–0.59	–0.84	–1.03	–1.13	–1.24
	Imports	–0.28	–0.36	–0.64	–0.92	–1.13	–1.24	–1.35
	Capital stock	0.00	0.61	1.30	2.08	2.80	3.43	3.94
	Intermediate energy use	–5.95	–10.84	–15.93	–20.38	–23.27	–25.00	–26.40
	Final energy use	–0.63	–2.48	–3.37	–4.15	–5.10	–5.68	–5.30
	Total energy use	–5.25	–9.74	–14.26	–18.21	–20.82	–22.38	–23.51
	Rebound effect (% of expected reduction)	51.42	53.34	49.97	47.11	46.26	45.70	44.37

cont. table A10

Real macroeconomic aggregates (percentage change vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
High elasticities	GDP	1.53	2.83	4.08	5.11	5.79	6.16	6.41
	Private consumption	2.24	4.27	6.28	8.06	9.36	10.17	10.77
	Public consumption	0.63	0.94	1.19	1.33	1.34	1.24	1.16
	Investment	1.69	3.14	4.59	5.86	6.78	7.32	7.73
	Output	0.62	0.90	1.16	1.30	1.29	1.23	1.25
	Exports	0.29	0.61	0.64	0.57	0.45	0.39	0.36
	Imports	0.32	0.66	0.70	0.62	0.50	0.43	0.39
	Capital stock	0.00	0.65	1.58	2.66	3.76	4.76	5.59
	Intermediate energy use	–2.16	–4.91	–7.02	–8.82	–9.93	–10.82	–11.44
	Final energy use	7.62	13.84	21.02	27.47	32.19	34.69	36.60
	Total energy use	–0.83	–2.28	–2.97	–3.44	–3.53	–3.73	–3.77
	Rebound effect (% of expected reduction)	92.32	89.05	89.58	90.02	90.90	90.96	91.07

Source: own elaboration.

Table A11. Detailed macroeconomic results – part II

Energy-related expenditures (change vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Central	Private – share (pp.)	–0.08	–0.16	–0.23	–0.30	–0.35	–0.38	–0.39
	Public – share (pp.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Private – value (%)	1.18	2.02	2.83	3.47	3.85	4.08	4.32
	Public – value (%)	1.15	1.75	2.49	3.16	3.62	3.87	4.10
Low energy intensity	Private – share (pp.)	–0.12	–0.24	–0.35	–0.44	–0.51	–0.55	–0.57
	Public – share (pp.)	0.00	0.00	0.00	0.00	0.00	–0.01	–0.01
	Private – value (%)	1.72	2.87	3.90	4.67	5.11	5.36	5.65
	Public – value (%)	1.68	2.52	3.52	4.42	5.07	5.42	5.75
High energy intensity	Private – share (pp.)	–0.04	–0.08	–0.12	–0.15	–0.18	–0.19	–0.20
	Public – share (pp.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Private – value (%)	0.61	1.07	1.54	1.94	2.19	2.34	2.50
	Public – value (%)	0.59	0.92	1.33	1.70	1.96	2.09	2.21
Low elasticities	Private – share (pp.)	–1.35	–2.02	–2.56	–2.99	–3.30	–3.48	–3.59
	Public – share (pp.)	–0.02	–0.03	–0.03	–0.04	–0.04	–0.04	–0.04
	Private – value (%)	–7.53	–14.56	–20.61	–25.57	–29.23	–31.40	–32.68
	Public – value (%)	–9.03	–17.17	–23.62	–28.64	–32.12	–34.11	–35.22
High elasticities	Private – share (pp.)	0.84	1.27	1.69	2.06	2.35	2.52	2.61
	Public – share (pp.)	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	Private – value (%)	7.23	14.28	21.36	27.74	32.74	35.71	37.49
	Public – value (%)	8.59	17.33	26.41	35.18	42.39	47.02	49.98

Source: own elaboration.

Table A12. Detailed macroeconomic results – part III

Real wages (percentage change vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Central	High-skilled labour	2.45	3.93	4.99	5.72	6.02	6.02	6.01
	Medium-skilled labour	2.45	3.94	5.08	5.84	6.14	6.15	6.15
	Low-skilled labour	2.89	5.41	7.15	8.54	9.10	9.19	9.05
Low energy intensity	High-skilled labour	3.63	5.73	7.18	8.15	8.57	8.58	8.57
	Medium-skilled labour	3.62	5.75	7.29	8.29	8.70	8.72	8.72
	Low-skilled labour	4.30	7.98	10.43	12.32	13.07	13.19	12.97
High energy intensity	High-skilled labour	1.24	2.03	2.61	3.04	3.23	3.23	3.23
	Medium-skilled labour	1.24	2.04	2.68	3.13	3.31	3.33	3.34
	Low-skilled labour	1.46	2.75	3.69	4.47	4.80	4.86	4.80
Low elasticities	High-skilled labour	2.06	2.48	2.62	2.35	2.00	1.64	1.43
	Medium-skilled labour	1.91	2.10	2.02	1.54	1.03	0.63	0.43
	Low-skilled labour	4.06	7.05	8.60	9.64	9.80	9.58	9.20
High elasticities	High-skilled labour	2.59	4.39	5.81	6.93	7.55	7.71	7.74
	Medium-skilled labour	2.60	4.47	6.02	7.24	7.90	8.08	8.12
	Low-skilled labour	2.44	4.68	6.40	7.91	8.71	8.95	8.86

Source: own elaboration.

Table A13. Detailed sectoral results – central scenario

Output by industry group (percentage change vs. BAU)							
	2020	2025	2030	2035	2040	2045	2050
Agriculture, forestry, fishing	0.40	0.57	0.61	0.63	0.57	0.53	0.52
Energy	–0.88	–3.47	–4.21	–4.59	–4.52	–4.62	–4.28
Food, beverages, tobacco	0.45	0.82	0.95	1.26	1.28	1.21	1.14
Textiles	0.15	0.53	0.50	0.57	0.66	0.69	0.68
Paper	0.42	0.72	0.62	0.59	0.53	0.41	0.32
Chemicals	1.28	1.53	1.82	1.91	1.50	1.32	1.17
Non-metallic minerals	0.88	1.50	2.26	2.45	2.58	2.58	2.90
Metals	0.74	2.50	3.30	3.17	2.70	2.64	2.58
Machinery and equipment	0.19	0.63	0.74	0.74	0.73	0.71	0.67
Other manufacturing	0.24	0.42	0.57	0.69	0.80	0.81	0.83
Construction	1.11	1.77	2.38	2.75	2.90	2.89	2.91
Services	0.35	0.44	0.45	0.43	0.36	0.29	0.27
Exports by product group (percentage change vs. BAU)							
	2020	2025	2030	2035	2040	2045	2050
Agriculture, forestry, fishing	–0.50	–0.98	–1.72	–2.32	–2.70	–2.89	–3.09
Energy	2.03	0.26	2.20	4.79	7.31	8.46	10.25
Food, beverages, tobacco	–0.45	–0.59	–1.22	–1.40	–1.72	–2.02	–2.39

cont. table A13

Exports by product group (percentage change vs. BAU)							
	2020	2025	2030	2035	2040	2045	2050
Textiles	–0.21	0.00	–0.24	–0.35	–0.30	–0.23	–0.26
Paper	0.03	0.29	–0.09	–0.24	–0.28	–0.37	–0.49
Chemicals	0.92	0.90	0.99	0.99	0.65	0.52	0.43
Non-metallic minerals	0.33	0.69	1.32	1.18	1.27	1.31	1.84
Metals	0.66	2.73	3.64	3.39	2.77	2.73	2.69
Machinery and equipment	–0.07	0.30	0.24	0.12	0.06	0.03	–0.05
Other manufacturing	–0.40	–0.59	–0.88	–1.06	–1.10	–1.16	–1.24
Construction	–0.55	–1.47	–2.89	–4.55	–6.04	–7.31	–8.28
Services	–0.52	–1.09	–1.86	–2.41	–2.68	–2.82	–2.97
Imports by product group (percentage change vs. BAU)							
	2020	2025	2030	2035	2040	2045	2050
Agriculture, forestry, fishing	1.14	1.96	2.69	3.33	3.63	3.76	3.93
Energy	–5.78	–9.55	–14.03	–17.62	–20.13	–21.55	–22.92
Food, beverages, tobacco	1.04	1.82	2.55	3.20	3.59	3.84	4.11
Textiles	0.67	1.39	1.94	2.40	2.80	3.10	3.37
Paper	0.47	0.53	0.40	0.18	–0.11	–0.36	–0.53
Chemicals	0.56	0.97	1.14	1.15	1.09	1.05	1.07
Non-metallic minerals	1.31	2.04	2.41	2.85	2.90	2.81	2.52
Metals	0.52	1.26	1.39	1.20	0.93	0.78	0.61
Machinery and equipment	0.72	1.43	1.95	2.34	2.61	2.80	2.95
Other manufacturing	0.99	1.77	2.49	3.03	3.38	3.58	3.79
Construction	2.53	4.60	7.11	9.50	11.34	12.68	13.81
Services	1.14	1.65	2.21	2.53	2.65	2.71	2.89

Source: own elaboration.

Table A14. Detailed fiscal results – part I

Budget revenues and expenditures (percentage change vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Central	VAT	0.83	1.50	2.10	2.70	3.23	3.58	3.77
	Excise	–0.13	–1.57	–1.96	–2.00	–1.96	–2.11	–1.97
	Import duties	0.73	1.82	2.33	2.84	3.31	3.60	3.62
	Other product taxes	–0.71	–1.41	–2.22	–2.74	–3.12	–3.41	–3.70
	Product subsidies	1.60	3.09	4.26	5.36	6.06	6.40	6.57
	Taxes on labour	2.46	3.99	5.11	5.88	6.20	6.21	6.19
	Taxes on capital	2.57	5.03	7.44	9.58	11.21	12.28	13.09
	Producer taxes	1.35	2.37	3.36	4.23	4.92	5.34	5.63
	Producer subsidies	1.56	3.08	4.24	5.34	6.10	6.49	6.68

Budget revenues and expenditures (percentage change vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Low intensity	VAT	1.26	2.30	3.29	4.29	5.17	5.75	6.10
	Excise	–0.19	–2.32	–2.85	–2.88	–2.76	–2.92	–2.64
	Import duties	1.11	2.76	3.62	4.43	5.14	5.58	5.62
	Other product taxes	–1.01	–1.95	–2.93	–3.46	–3.80	–4.03	–4.28
	Product subsidies	2.39	4.58	6.28	7.82	8.78	9.26	9.50
	Taxes on labour	3.65	5.82	7.36	8.38	8.80	8.82	8.81
	Taxes on capital	3.82	7.44	10.93	14.02	16.37	17.92	19.10
	Producer taxes	2.03	3.57	5.06	6.41	7.50	8.19	8.66
	Producer subsidies	2.32	4.57	6.26	7.82	8.85	9.39	9.64
High intensity	VAT	0.41	0.73	1.00	1.26	1.49	1.64	1.71
	Excise	–0.06	–0.80	–1.00	–1.03	–1.02	–1.12	–1.06
	Import duties	0.36	0.89	1.12	1.35	1.58	1.72	1.73
	Other product taxes	–0.37	–0.76	–1.26	–1.61	–1.90	–2.12	–2.35
	Product subsidies	0.81	1.57	2.17	2.76	3.14	3.33	3.43
	Taxes on labour	1.25	2.06	2.69	3.14	3.33	3.34	3.34
	Taxes on capital	1.29	2.55	3.80	4.93	5.78	6.34	6.77
	Producer taxes	0.68	1.19	1.67	2.09	2.41	2.61	2.74
	Producer subsidies	0.78	1.56	2.15	2.74	3.15	3.37	3.48
Low elasticities	VAT	–0.10	–0.30	–0.48	–0.64	–0.71	–0.75	–0.82
	Excise	–1.24	–3.61	–5.13	–6.25	–7.05	–7.70	–7.98
	Import duties	0.16	0.71	0.70	0.62	0.59	0.58	0.41
	Other product taxes	–2.18	–4.23	–6.38	–8.10	–9.40	–10.24	–10.92
	Product subsidies	1.83	3.38	4.48	5.36	5.87	6.10	6.21
	Taxes on labour	2.05	2.45	2.52	2.18	1.77	1.40	1.19
	Taxes on capital	2.36	4.27	5.98	7.35	8.31	8.90	9.39
	Producer taxes	0.62	0.85	1.10	1.25	1.36	1.39	1.41
	Producer subsidies	1.94	3.79	5.20	6.38	7.15	7.56	7.77
High elasticities	VAT	1.46	2.79	4.06	5.32	6.37	7.03	7.43
	Excise	0.91	0.20	0.75	1.55	2.24	2.43	2.86
	Import duties	0.98	2.29	2.97	3.70	4.40	4.81	4.87
	Other product taxes	0.49	0.88	1.25	1.85	2.37	2.63	2.73
	Product subsidies	1.32	2.58	3.57	4.60	5.30	5.66	5.85
	Taxes on labour	2.59	4.44	5.94	7.13	7.78	7.95	7.98
	Taxes on capital	2.65	5.41	8.21	10.84	12.94	14.35	15.37
	Producer taxes	1.83	3.41	4.97	6.44	7.60	8.34	8.83
	Producer subsidies	1.27	2.53	3.45	4.42	5.13	5.51	5.69

Source: own elaboration.

Table A15. Detailed fiscal results – part II

Budget revenues and expenditures (change in bn PLN vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Central	Public capital remuneration	8.64	23.15	44.29	71.50	103.30	138.00	176.92
	VAT	1.31	2.91	4.96	7.60	10.84	14.27	17.81
	Excise	–0.08	–1.13	–1.52	–1.66	–1.72	–1.96	–1.92
	Import duties	0.02	0.06	0.09	0.13	0.19	0.24	0.29
	Other product taxes	–0.10	–0.24	–0.46	–0.67	–0.91	–1.19	–1.53
	Product subsidies	0.11	0.28	0.47	0.70	0.94	1.18	1.43
	Taxes on labour	5.45	8.97	12.06	14.70	17.11	19.91	24.08
	Taxes on capital	1.93	5.17	9.89	15.97	23.07	30.82	39.51
	Producer taxes	0.26	0.57	0.97	1.45	2.00	2.59	3.22
	Producer subsidies	0.22	0.54	0.91	1.37	1.87	2.38	2.89
	Consumption expenditures	14.62	32.11	56.85	87.45	122.50	160.09	203.81
	Investment expenditures	2.47	6.15	11.29	18.35	26.98	36.72	47.45
Low intensity	Public capital remuneration	12.86	34.24	65.12	104.59	150.85	201.41	258.09
	VAT	1.99	4.47	7.76	12.05	17.32	22.94	28.81
	Excise	–0.12	–1.67	–2.22	–2.39	–2.42	–2.71	–2.58
	Import duties	0.03	0.09	0.14	0.21	0.29	0.38	0.45
	Other product taxes	–0.14	–0.33	–0.60	–0.85	–1.11	–1.41	–1.78
	Product subsidies	0.17	0.41	0.69	1.03	1.37	1.71	2.07
	Taxes on labour	8.08	13.08	17.34	20.93	24.31	28.31	34.25
	Taxes on capital	2.87	7.65	14.54	23.36	33.69	44.98	57.64
	Producer taxes	0.40	0.85	1.46	2.20	3.05	3.96	4.95
	Producer subsidies	0.32	0.80	1.34	2.01	2.72	3.44	4.18
	Consumption expenditures	21.76	47.41	83.37	127.60	178.57	233.31	296.80
	Investment expenditures	3.69	9.22	17.04	27.80	41.09	56.22	73.04
High intensity	Public capital remuneration	4.35	11.74	22.63	36.76	53.27	71.28	91.51
	VAT	0.65	1.42	2.36	3.55	5.00	6.52	8.07
	Excise	–0.04	–0.58	–0.78	–0.85	–0.89	–1.04	–1.04
	Import duties	0.01	0.03	0.04	0.06	0.09	0.12	0.14
	Other product taxes	–0.05	–0.13	–0.26	–0.39	–0.56	–0.74	–0.97
	Product subsidies	0.06	0.14	0.24	0.36	0.49	0.62	0.75
	Taxes on labour	2.76	4.62	6.33	7.84	9.19	10.72	13.00
	Taxes on capital	0.97	2.62	5.05	8.21	11.90	15.92	20.44
	Producer taxes	0.13	0.28	0.48	0.72	0.98	1.26	1.57
	Producer subsidies	0.11	0.27	0.46	0.70	0.97	1.24	1.51
	Consumption expenditures	7.37	16.33	29.16	45.14	63.38	82.93	105.73
	Investment expenditures	1.24	3.08	5.62	9.10	13.33	18.05	23.20

Budget revenues and expenditures (change in bn PLN vs. BAU)								
		2020	2025	2030	2035	2040	2045	2050
Low elasticities	Public capital remuneration	9.52	23.02	40.76	61.47	84.54	109.41	138.10
	VAT	–0.15	–0.58	–1.13	–1.83	–2.41	–3.06	–3.99
	Excise	–0.82	–2.62	–4.02	–5.20	–6.23	–7.22	–7.90
	Import duties	0.00	0.02	0.03	0.03	0.04	0.04	0.04
	Other product taxes	–0.31	–0.74	–1.35	–2.05	–2.84	–3.71	–4.72
	Product subsidies	0.14	0.32	0.51	0.73	0.96	1.19	1.43
	Taxes on labour	2.60	2.48	2.34	1.95	1.68	1.60	1.82
	Taxes on capital	2.13	5.14	9.10	13.73	18.88	24.44	30.84
	Producer taxes	0.12	0.21	0.32	0.43	0.56	0.68	0.83
	Producer subsidies	0.28	0.68	1.15	1.69	2.27	2.88	3.53
	Consumption expenditures	10.76	20.88	34.90	51.07	69.16	88.28	111.20
	Investment expenditures	1.77	4.20	7.48	11.43	16.11	21.39	27.35
High elasticities	Public capital remuneration	8.06	22.59	44.86	74.95	111.40	151.93	197.36
	VAT	2.27	5.34	9.39	14.63	20.83	27.28	33.99
	Excise	0.58	0.14	0.58	1.27	1.94	2.22	2.74
	Import duties	0.02	0.07	0.11	0.17	0.23	0.30	0.37
	Other product taxes	0.06	0.14	0.25	0.44	0.67	0.89	1.09
	Product subsidies	0.09	0.22	0.37	0.58	0.79	0.99	1.20
	Taxes on labour	6.75	12.59	18.42	24.16	29.55	34.81	41.12
	Taxes on capital	1.80	5.04	10.02	16.74	24.88	33.93	44.08
	Producer taxes	0.35	0.80	1.41	2.17	3.03	3.94	4.92
	Producer subsidies	0.17	0.43	0.71	1.09	1.51	1.93	2.34
	Consumption expenditures	16.57	38.31	69.89	110.13	156.89	206.92	264.10
	Investment expenditures	3.17	7.82	14.35	23.60	35.14	48.06	62.02

Source: own elaboration.