

2.1 Exercise: NPK input price change with the policy editor

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Background: with and without market model

- Input price changes can be applied in CAPRI for both task:
 - Run scenario with market model
 - Run scenario without market model
- Input prices for mineral fertilizer are exogenous to the model

Economic Background

$$\text{profit} = P_W Q(N) - P_N N(Q)$$

P_W = Price of wheat

P_N = Fertilizer Price of nitrate

Q = Production of wheat

N = Fertilizer Input

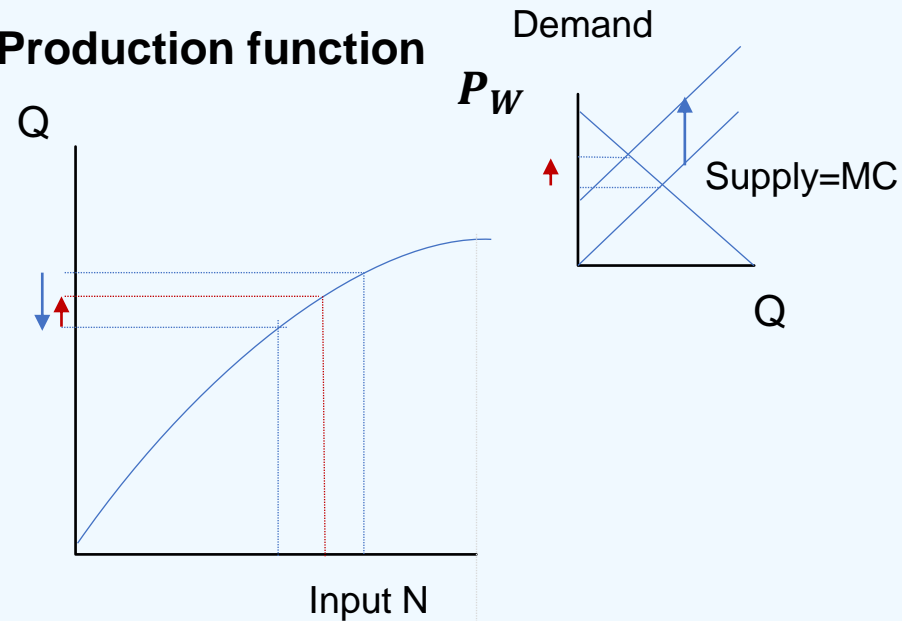
$$\max(\text{profit}) = \frac{\text{profit}}{\partial N}$$

$$P_w \frac{\partial Q}{\partial N} - P_N = 0$$

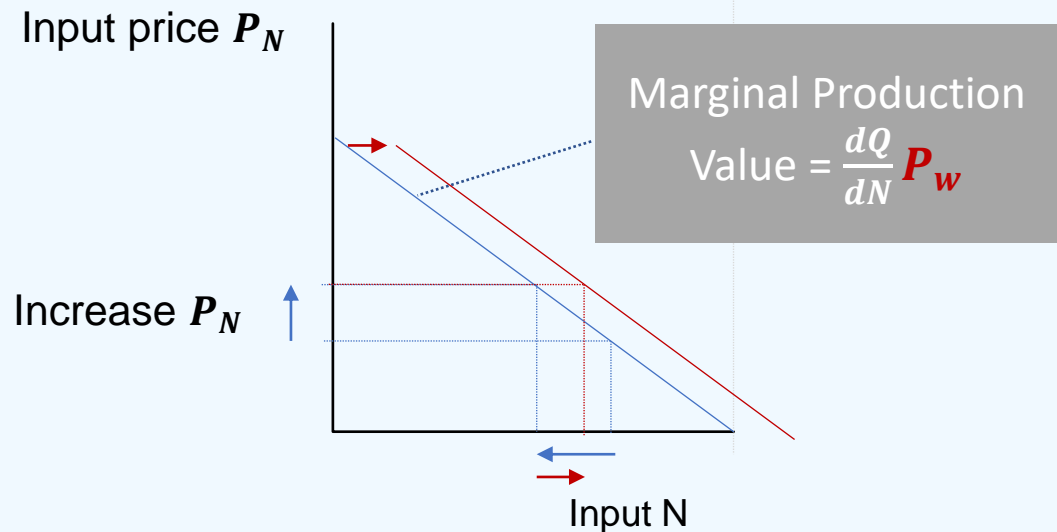
$$P_w \frac{\partial Q}{\partial N} = P_N$$

$$P_w = \frac{\partial N}{\partial Q} P_N$$

Production function



Marginal value product (MVP)



Important code parts

```
$setglobal SCENDES Fertilzer Prices increasing due to CO2 tax
*
*   Baseline scenario
*
$include ..\gams\scen\base_scenarios\CAP_2014_2020.gms
*
*   Category : Price shocks
*
DATA (RMSSUP, "UVAG", "NITF", "ChangeFactor") = 1.80;
DATA (RMSSUP, "UVAG", "POTF", "ChangeFactor") = 1.80;
DATA (RMSSUP, "UVAG", "PHOF", "ChangeFactor") = 1.80;
```

```
".\gams\capmod\inflation_and_trend_interpolation.gms"
*
*   ----- take over price changes from scenario definition
*
DATA (MS, "UVAG", IO, "Y")   $ DATA (MS, "UVAG", IO, "AbsoluteLevel")   = DATA (MS, "UVAG", IO, "AbsoluteLevel");
DATA (MS, "UVAG", IO, "Y")   $ DATA (MS, "UVAG", IO, "AbsoluteChange")   = DATA (MS, "UVAG", IO, "Y") +
DATA (MS, "UVAG", IO, "AbsoluteChange");

DATA (MS, "UVAG", IO, "Y")   $ DATA (MS, "UVAG", IO, "ChangeFactor")     = DATA (MS, "UVAG", IO, "Y") *
DATA (MS, "UVAG", IO, "ChangeFactor");

DATA (MS, "UVAG", IO, "Y")   $ DATA (MS, "UVAG", IO, "PercentageChange") = DATA (MS, "UVAG", IO, "Y") * (1. +
DATA (MS, "UVAG", IO, "PercentageChange")/100);
```

The objective function

```
"..\gams\supply\Supply_model.gms"
*-----
OBJEQF_.. v_obje =E= SUM(RUNR,
*          --- revenues - variable costs
*          v_linObjPart(RUNR) - v_sumOfPmpTermsLevls(RUNR
*          --- contribution of PMP terms for feeding
*          + v_sumOfPmpTermsFeed(RUNR)
*          - v_pmpCostLandMarket(RUNR)
*
*          - v_landSupCost(RUNR)
*          );
*-----
*
*          + sales valued with expected prices
*          - purchases of inputs valued with expected prices
*          - sum cost of variable inputs excluding feed, young animals
*          + sum of premiums
LINEAR_(RUNR).. v_linObjPart(RUNR) =E=
*          --- sales/purchases valued by "unit value" price
*          from gross Economic Accounts for Agriculture
*
*          SUM(RUNR,OMOBJE(RUNR,OM_OBJE),
*          v_netPutQuant(RUNR,OM_OBJE) * ( SUM(R_RAGG(RUNR,MSACT),
*          (%data%(MSACT,"UVAG",OM_OBJE,"Y"))
*
*
*          --- activity levels multiplied with
*          variable costs (excluding feed and animals), negative values
*          premiums for specific alternatives
*          premiums defined in policy data set
+ SUM((MPACT,A) $ p_techFact(RUNR,MPACT,"LEVL",A),
*          v_actLevl(RUNR,MPACT,A) * (p_linObjCont(RUNR,MPACT,A)
*          +%data%(RUNR,MPACT,"PRME","Y") * (1+p_techFact(RUNR,MPACT,"PRME",A))))
*
*
*
;
```

Important code parts

```
"..\gams\sets.gms"  
  
SET FNUT_ROWS "Mineral fertilizing inputs" /  
  NITF  "Nitrogen in fertiliser"  
  PHOF  "Phospate in fertiliser [P2O5]"  
  POTF  "Potassium in fertiliser [K2O]"  
  /;  
  
SET OM_OBJE(ROWS) "Goods in objective of supply model" /  
  SWHE , DWHE , RYEM , BARL , OATS , MAIZ , OCER , PARI,  
  RAPE , SUNF , SOYA , OLIV,  
  PULS , POTA,  SUGB , TEXT, TOBA,  
  TOMA , OVEG,  APPL , OFRU, CITR, TAGR,  TABO,  TWIN  
  COMI ,  
  BEEF , PORK , SGMI , SGMT , EGGS , POUM ,  
  
SET.OYANI ROWS,  
SET.FNUT_ROWS  
  
**** use of bulk feedingstuff  
  
FCER , FPRO , FENE , FMIL , FOTH /;
```

Expectations

- Yield
- Supply
- Price
- Mineral fertilizer use
- Income

Breakout session

- We split randomly the group in groups of 3 participants
- You have 30 min
 - run the scenario
 - fill out the quiz provided in the ppt
 - provide 1-2 slide additional results in the area of
 - Income, production, environmental indicators, trade
- Please indicate one member of the group to present the group work at the end in about 2-5 min

Exercise 2.8. input price shock for fertilizer

- Introduce a price change of +80% for mineral fertilizer
- Find, modify and save the code snippet from the policy editor for “higher fertilizer prices”
- Store the scenario from the wiki (or next slide) into the userScenc folder and run the model
- Proof that the price shock was correctly translated into the model for the run **without market model** for Germany
- Fill the cloze at the end of the presentation using the results for with market model from the zip file, where we assumed that fertilizer prices increase in all countries of the EU

Scenario in GAMS

```
$setglobal SCENDES Fertilizer Prices increaseing due to CO2 tax  
$include ..\gams\scen\base_scenarios\CAP_2014_2020.gms  
  
DATA (RMSSUP, "UVAG", "NITF", "ChangeFactor") = 1.80;  
DATA (RMSSUP, "UVAG", "POTF", "ChangeFactor") = 1.80;  
DATA (RMSSUP, "UVAG", "PHOF", "ChangeFactor") = 1.80;
```

Relevant tables in the exploiter

- For supply, hectare and heard size, income and yield by activity see **farm->Supply Details**
- For total price changes see -> table **Prices**
- For Nitrate change see -> table environment->Nutrient balances -> **Gross nutrient budgets**

Cloze for Exercise 2.8 for Germany

- Check that fertilizer prices are increased by 80% in both runs, with and without the market model.

Without and with the market model **in bracket**:

- The change in supply for soft wheat is ___%(___ %) and for hectare ___%/___%). The price change for soft wheat is ___%(___%).
- In sum, the change in mineral fertilizer for nitrate in Germany is ___%(___%). Is manure production increasing/decreasing?
- Production (supply) of pulses in/decrease by ___%(___%), cattle herd sizes in/decrease?
- Farm income decreased by ___%(___%). Why?

Cloze for Exercise 2.8 for Germany

- Check that fertilizer prices are increased in both runs, with and without the market model, are 80%.

Without and with the market model **in bracket**:

- The change in supply for soft wheat is -21%(-3%) and for hectare -18%(-4%). The price change for soft wheat is 0%(+12%).
- In sum, the change in mineral fertilizer for nitrate in Germany is -18%(-7%). Is manure production increasing/~~decreasing~~?
- Production (supply) of pulses in/~~decrease~~ by 20%(3%), cattle herd sizes in/~~decrease~~?
- Farm income decrease by 11%(12%)

View Handling Windows Options

Prices [0]

Region: Germany DE000000 Year: 2030 2030

	cap_after_2014_refdefaultA C:\p\test2\test2\output\results\capmod\res_2_1730cap_after_2014_refdefaultA.gdx	userScens_Higher_input_price_2_7_DEdefaultA C:\p\test2\test2\output\tr	userScens_Higher_input_price_2_7_MMOndefaultA C:\p\test2\test2\outp
	Producer Price [Euro/t] UVAG	Producer Price [Euro/t] UVAG	Producer Price [Euro/t] UVAG
Fertiliser FERC	1025.25	1845.07 79.96%	1847.54 80.20%
Nitrate (N) NITF	1106.65	1991.98 80.00%	1991.98 80.00%
Phosphate (P2O5) PHOF	1552.04	2793.67 80.00%	2793.67 80.00%
Potassium (K2O) POTF	664.96	1196.93 80.00%	1196.93 80.00%

Prices [2]

Region: Germany Year: 2030

	cap_after_2014_refdefaultA	userScens_Higher_input_price 2 7 DEdefaultA Producer Price [Euro/t]	userScens_Higher_input price 2 7 MMon Producer Price [Euro/t]
Soft wheat	187.76	187.76 -0.00%	210.74 12.24%

View Handling Windows Options

Gross Nutrient (NPK) budgets (GNB) [2]

Region: Germany | Total or per ha: In sum | Year: 2030 | Percentage diff. to Scen: cap_after_2014_refdefaultA

	userScens_Higher_input_price_2_7_DEdefaultA			userScens_Higher_input_price_2_7_MMOndefaultA		
	Nitrate (N)	Phosphate (P2O5)	Potassium (K2O)	Nitrate (N)	Phosphate (P2O5)	Potassium (K2O)
Input with mineral fertilizers [1000t or kg/ha N,P2O5,K2O]	1274.51 -17.89%	145.31 -44.29%	250.10 -43.10%	1439.99 -7.23%	216.85 -16.86%	353.56 -19.56%
Input with manure (excretion) [1000t or kg/ha N,P2O5,K2O]	1212.83 2.48%	755.21 2.46%	1378.38 2.77%	1189.48 0.51%	741.43 0.59%	1353.36 0.91%
Manure Import [1000t or kg/ha N,P2O5,K2O]	140.71 -0.00%	87.36 0.00%	120.15 0.00%	152.54 8.40%	92.18 5.52%	119.46 -0.58%
Manure Export [1000t or kg/ha N,P2O5,K2O]	151.47 0.00%	92.30 0.00%	120.15 0.00%	152.54 0.71%	92.18 -0.13%	119.46 -0.58%
Net Manure Trade [1000t or kg/ha N,P2O5,K2O]	10.75 0.00%	4.94 0.00%	0.00 -96.10%	-0.00 -100.00%	0.00 -100.00%	0.00 -98.70%
Input with crop residues [1000t or kg/ha N,P2O5,K2O]	1005.55 -8.20%	435.57 -9.03%	1161.82 -10.33%	1034.31 -5.57%	453.18 -5.35%	1220.63 -5.79%
Biological nitrogen fixation [1000t or kg per ha N]	159.42 2.68%			149.91 -3.45%		
Atmospheric nitrogen deposition [1000t or kg per ha N]	172.46 -3.37%			177.00 -0.83%		
Nutrient export with crop products [1000t or kg per ha N,P2O5,K2O]	2853.02 -8.80%	1284.75 -8.73%	2491.15 -8.46%	3016.53 -3.58%	1364.35 -3.07%	2615.93 -3.88%
Surplus total [1000t or kg per ha N]	961.00 -6.30%	46.41 -27.71%	299.16 -15.71%	974.18 -5.02%	47.11 -26.62%	311.62 -12.20%

CAPRI TS 2024

View Handling Windows Options

Supply details [2]

Region: Germany | Year: 2030 | Percentage diff. to Scen: cap_after_2014_refdefaultA

	userScens_Higher_input_price_2_7_DEdefaultA	userScens_Higher_input_price_2_7_MMOndefaultA	View type
Supply [1000 t, 1000 ha or Mio Const EU]			Table
All cattle activities	16543.63 1.63%	16368.00 0.55%	
Other animals	13750.95 2.15%	13450.22 -0.08%	

Welfare overview [3]

Region: Germany | Year: 2030 | Percentage diff. to Scen: cap_after_2014_refdefaultA

	cap_after_2014_refdefaultA	userScens_Higher_input_price_2_7_DEdefaultA	userScens_Higher_input_price_2_7_MMOndefaultA
Agricultural income [Mio Euro]	30546.46	27223.88 -10.88%	26849.93 -12.10%
Output crops [Mio Euro]	33934.66	32859.42 -3.17%	36609.68 7.88%
Output animals [Mio Euro]	44927.05	45552.21 1.39%	44817.22 -0.24%
EAA Input [Mio Euro]	47070.21	52254.62 11.01%	53975.26 14.67%
Crop specific Input [Mio Euro]	9135.29	13510.92 47.90%	14246.95 55.96%
Animal specific Input [Mio Euro]	20499.10	21937.55 7.02%	22482.98 9.68%
Other Input [Mio Euro]	17435.82	16806.15 -3.61%	17245.34 -1.09%