



***Auctioning CO2 Permits in the Czech Republic:
Expected Sectoral and Overall Economic Effects***

Lubomír Lízal, PhD.
CERGE-EI
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Intro Summary

This paper estimates the effects of auctioning CO2 permits in comparison to the previous allocation system. The EU efforts to curb greenhouse gas emissions, especially CO2, have materialized in the proposed amendment of Directive 2003/87/EC. The existing Emission Trading System (ETS) – which will be in effect till 2012 – should be gradually replaced with a more efficient auction system. We show the redistribution impact is not severe; however, this is just in case of sufficient national level of allocated permits and has a strong impact on the sectoral labor division.

Introduction

- all producers that emit greenhouse gases will be forced to obtain allowance for up to 100% of their output
 - **significant cost increase**
 - **at least 20 % of proceeds being allocated and spend on mitigation and prevention of climate changes**
 - **additional public spending can provide stimulus for the economy**

- Effect of such stimulus depends on
 - **the particular structure of the economy**
 - **the difference between current overall emissions and future need to buy permits**
 - **major difference in this respect will be between countries that “sell” and those that “buy” permits abroad**

Introduction – Stylized Facts

- National Allocation Plan II (which is valid till 2012) as a baseline
 - **Determination of the net position of the Czech Republic**
 - **Assume real average price of allowance of 30€ per ton of CO₂**
 - ***ex-ante* analysis of economic impact**
 - **Models**
 - **CGEM (computable general equilibrium models)**
 - **intraindustry (or input-output, IO) analysis**

Impact Assessment Studies

- Kasimati (2003): Compare Sydney Olympics 2000
 - Andersen (1999), NSW Treasury (1997)
 - IO analysis (define primary impact outside the model) and
 - KPMG Peat Marwick (1993)
 - CGEM (computable general equilibrium models) – stability issues
 - No differences found

- Use I-O model
 - What would be the effect of the immediate change from free allocation to auctions in this year given the current status of the economy?

Initial Economic Impact

- Change from free allocation to auctioning is a “tax” on the industry
 - **Size of the tax depends on**
 - The actual need of permits
 - Auction price

- Macroeconomic effect depends on regionalization
 - **What is the actual position of a country/firm**

Regionalization

- Gain:
 - Flows that originate outside the region and will stay in the region – Czech firm will sell permits abroad.
- Loss:
 - Flows that originate in the region and will leave the region – Czech firm will have to buy permits from abroad.
- Redistribution:
 - Flows that originate in the region and will stay in the region. These are transactions among Czech firms (or with the local government).
 - The redistribution can cause indirect loss or gain – this depends whether the original allocation was close to the equilibrium or not and large reallocations across different industries are required.
- Neutral:
 - World trading, for our model this is just external permit price setting mechanism.

Regionalization

		Target	
		In Region (R)	Import (I)
Source	Autonomous External (a)	Gain (a·R)	Neutral (a·I)
	In Region (r)	Redistribution (r·R)	Loss (r·I)

Primary exogenous shock

- In case of no need of additional permits from abroad (equilibrium national allocation) the primary shock is zero and has only redistributive component.
- In case of the deficit of the permits, which is determined as the difference between the original NAP II and an approved modified NAP II, we have a net transfer abroad in the amount of $30 \cdot 25 \cdot 15 \text{ mil.} = 11.25 \text{ bln. CZK}$.
 - **Such a shock is modeled as decrease of the governmental expenditures (as the permit will be bought from foreign entity and not a domestic government, therefore it is a net decrease in the governmental proceedings in the full amount) of 11.25 bln.**

Permit Allocation

Sector	Number of firms	Tons of CO ₂	Sector	Number of firms	Tons of CO ₂
01- Agriculture	2	80268	27- Basic metals	14	23614941
10- Coal and lignit; peat	3	549993	28- Fabricated metal products	6	742080
12- Uranium	2	130383	29- Machinery and equipment n.e.c.	12	1010777
13- Other ores	1	370253	31- Electr. machinery and app. n.e.c.	3	87344
15- Food products and beverages	20	1084777	34- Motor vehicles, trailers	7	724488
17- Textile	8	412340	35- Other transport equipment	2	47088
19- Leather and shoes	3	329370	36- Furniture, other goods n.e.c.	4	121055
20- Wood	2	41022	40- Electr.ener., gas, steam& water	117	28252895
21- Pulp and paper	12	2416223	60- Land transport	7	569883
23- Coke, refined petroleum products	9	7388401	62- Air transport	1	58008
24- Chemicals, chemical products	9	2396585	72- Computer and related services	1	8550
25- Rubber, plastic products	5	187894	85- Health and social work	10	280534
26- Non-metallic mineral products	59	15914388	93- Other	1	15723
Total			Total	320	86835264

Primary “Tax” Impact, Permit=30Euro

Sector	Mil CZK	Sector	Mil CZK
01- Agriculture	60	27- Basic metals	17711
10- Coal and lignit; peat	412	28- Fabricated metal products	557
12- Uranium	98	29- Machinery and equipment n.e.c.	758
13- Other ores	278	31- Electr. machinery and app. n.e.c.	66
15- Food products and beverages	814	34- Motor vehicles, trailers	543
17- Textile	309	35- Other transport equipment	35
19- Leather and shoes	247	36- Furniture, other goods n.e.c.	91
20- Wood	31	40- Electr.ener., gas, steam& water	21190
21- Pulp and paper	1812	60- Land transport	427
23- Coke, refined petroleum products	5541	62- Air transport	44
24- Chemicals, chemical products	1797	72- Computer and related services	6
25- Rubber, plastic products	141	85- Health and social work	210
26- Non-metallic mineral products	11936	93- Other	12
Total (redistribution – government)			65126

Intersectoral analysis of economic impact

- See Miller (1998)

	Interindustry Sales (Z)	Final Demand Expenditures (f)	Total (x)
Sectors according NACE[1]	$\begin{matrix} z_{11} & z_{12} & \dots & z_{1n} \\ z_{21} & z_{22} & \dots & z_{2n} \\ \vdots & \vdots & & \vdots \\ z_{n1} & z_{n2} & \dots & z_{nn} \end{matrix}$	$\begin{matrix} c_1 & i_1 & g_1 & e_1 \\ c_2 & i_2 & g_2 & e_2 \\ \vdots & \vdots & \vdots & \vdots \\ c_n & i_n & g_n & e_n \end{matrix}$	$\begin{matrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{matrix}$
Value Added Components Imports	$\begin{matrix} l_1 & l_2 & \dots & l_n \\ ov_1 & ov_2 & \dots & ov_n \\ m_1 & m_2 & \dots & m_n \end{matrix}$	<p><i>Transaction between the payment sectors (inc. imports) and final demand</i></p>	$\begin{matrix} L \\ OV \\ M \end{matrix}$
Total (x)	$x_1 \quad x_2 \quad \dots \quad x_n$	$C \quad I \quad G \quad E$	

EU Entry - Summary II

$$x = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \quad i = \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix} \quad f = \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_n \end{bmatrix} \quad I = \begin{bmatrix} 1 & 0 & \dots & 0 \\ 0 & 1 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & 1 \end{bmatrix}$$

$$x = Zi + f \quad x = Ax + f \quad Z = \begin{bmatrix} a_{11}x_1 & a_{12}x_2 & \dots & a_{1n}x_n \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1}x_1 & a_{n2}x_2 & \dots & a_{nn}x_n \end{bmatrix}$$
$$Ix - Ax = f \quad (I - A)x = f$$

$$x^* = (I - A)^{-1} f^*$$

Indirect Impact Calculation

$$x^* = (I - A)^{-1} f^*$$

Matrix B , defined as $B = (I - A)^{-1}$ is the well-known *Leontief Inverse matrix* or *total requirement matrix* or *direct and indirect requirements matrix*.

In changes from original situation (benchmark levels):

$$\Delta x = (I - A)^{-1} \Delta f$$

Indirect Impact Results

		Primary impact	Induced change in turnover	Ind. change. in turnover with incr. of gov. exp.
	Total	65,126.45	-127,451.86	-14,887.46

		Sectoral Labor Multiplier	Induced change in employment	Ind. change in employment w. incr. of gov. exp.
	Total	n.a.	-53675	46555

Table 3: Indirect Impact, in mil. CZK, Permit Price at 30 Euro

Sector, NACE	Primary impact	Induced change in turnover	Ind. change. in turnover with incr. of gov. exp.
Total	65,126.45	-127,451.86	-14,887.46
01 Agriculture	60.20	-374.21	388.76
02 Forestry	0.00	-320.72	-175.87
05 Fishing	0.00	-1.00	2.81
10 Coal and lignit; peat	412.49	-3,148.65	-2,868.45
11 Crude petroleum and natural gas	0.00	-8,826.99	-7,900.35
12 Uranium	97.79	-97.79	-97.79
13 Metal ores	277.69	-1,281.79	-1,263.15
14 Other mining products	0.00	-697.09	-578.56
15 Food products and beverages	813.58	-1,283.54	-225.37
16 Tobacco products	0.00	-1.65	5.34
17 Textiles	309.26	-561.93	-369.93
18 Wearing apparel; furs	0.00	-63.77	170.63
19 Leather	247.03	-329.53	-295.96
20 Wood and products of wood	30.77	-904.55	-475.86
21 Pulp,paper and paper products	1,812.17	-3,155.68	-2,590.29
22 Pprinted matter,recorded media	0.00	-295.91	814.58
23 Coke,refined petroleum products	5,541.30	-8,117.64	-6,810.90
24 Chemicals,chemical products	1,797.44	-3,461.23	1,438.07
25 Rubber,plastic products	140.92	-1,179.59	-624.19
26 Non-metallic mineral products	11,935.79	-14,904.93	-14,446.82
27 Basic metals	17,711.21	-23,772.29	-23,356.03
28 Fabricated metal products	556.56	-2,721.90	-2,219.85
29 Machinery and equipment n.e.c.	758.08	-1,707.05	-1,331.91
30 Office machinery,computers	0.00	-46.22	390.98
31 Electr. machinery and app. n.e.c.	65.51	-1,128.75	-794.84
32 Radio,tv apparatus	0.00	-75.14	225.99
33 Medical,precision and optic. instr.	0.00	-182.57	809.39
34 Motor vehicles,trailers	543.37	-993.49	-720.11
35 Other transport equipment	35.32	-159.32	599.46
36 Furniture,other goods n.e.c.	90.79	-188.94	164.86
37 Recovered secondary raw mat.	0.00	-1,009.08	-987.16

Sector, NACE	Primary impact	Induced change in turnover	Ind. change. in turnover with incr. of gov. exp.
40 Electr.ener.,gas,steam&hot water	21,189.67	-27,805.70	-25,749.43
41 Distribution services of water	0.00	-224.01	70.01
45 Construction work	0.00	-1,064.12	2,945.58
50 Trade and repair serv.of mot.veh.	0.00	-595.94	43.02
51 Wholesale	0.00	-2,766.35	274.40
52 Retail trade,repair serv.	0.00	-608.10	-119.99
55 Hotels,restaurants	0.00	-286.27	1,050.38
60 Land transport	427.41	-3,572.05	-1,727.00
61 Water transport	0.00	-53.91	35.59
62 Air transport	43.51	-158.23	357.59
63 Travel agency services	0.00	-1,633.90	8,230.79
64 Post. telecommunication services	0.00	-683.67	1,509.36
65 Financial intermediation services	0.00	-955.30	1,032.97
66 Insurance and pension fund serv.	0.00	-470.24	-122.05
67 Serv.auxiliary to fin.intermed.	0.00	-147.40	-3.79
70 Real estate services	0.00	-750.87	1,260.34
71 Renting services	0.00	-193.82	-26.94
72 Computer and related services	6.41	-352.88	693.67
73 Research and development	0.00	-71.79	720.41
74 Other business services	0.00	-3,057.84	3,974.74
75 Public admin.,defence serv.	0.00	-149.04	21,693.90
80 Education	0.00	-79.17	12,573.49
85 Health and social work	210.40	-233.63	13,945.67
90 Sewage,refuse disposal services	0.00	-385.44	1,354.52
91 Membership organisation services	0.00	-9.40	1,452.22
92 Recreation,cult.and sporting serv.	0.00	-127.35	2,557.51
93 Other	11.79	-22.50	208.10

Table 4: Indirect Employment Impact, Permit Price at 30 Euro

Sector, NACE	Sectoral Labor Multiplier	Induced change in employment	Ind. change in employment w. incr. of gov. exp.
Total	n.a.	-53675	46555
01 Agriculture	0.933	-349	363
02 Forestry	0.661	-212	-116
05 Fishing	1.721	-2	5
10 Coal and lignit; peat	0.598	-1884	-1716
11 Crude petroleum and natural gas	0.195	-1720	-1539
12 Uranium	2.065	-202	-202
13 Metal ores	8.900	-11408	-11243
14 Other mining products	0.882	-615	-510
15 Food products and beverages	0.373	-479	-84
16 Tobacco products	0.096	0	1
17 Textiles	0.901	-506	-333
18 Wearing apparel; furs	1.056	-67	180
19 Leather	0.675	-222	-200
20 Wood and products of wood	0.685	-620	-326
21 Pulp,paper and paper products	0.411	-1297	-1065
22 Pprinted matter,recorded media	0.540	-160	440
23 Coke,refined petroleum products	0.035	-288	-241
24 Chemicals,chemical products	0.257	-891	370
25 Rubber,plastic products	0.340	-401	-212
26 Non-metallic mineral products	0.414	-6165	-5976
27 Basic metals	0.285	-6768	-6649
28 Fabricated metal products	0.605	-1647	-1344
29 Machinery and equipment n.e.c.	0.382	-653	-509
30 Office machinery,computers	0.125	-6	49
31 Electr. machinery and app. n.e.c.	0.353	-399	-281
32 Radio,tv apparatus	0.216	-16	49
33 Medical,precision and optic. instr.	0.406	-74	328
34 Motor vehicles,trailers	0.249	-247	-179
35 Other transport equipment	0.441	-70	264
36 Furniture,other goods n.e.c.	0.759	-143	125
37 Recovered secondary raw mat.	0.345	-348	-341

Sector, NACE	Sectoral Labor Multiplier	Induced change in employment	Ind. change in employment w. incr. of gov. exp.
40 Electr.ener.,gas,steam&hot water	0.184	-5110	-4732
41 Distribution services of water	0.472	-106	33
45 Construction work	0.576	-613	1697
50 Trade and repair serv.of mot.veh.	0.812	-484	35
51 Wholesale	0.366	-1012	100
52 Retail trade,repair serv.	1.504	-915	-180
55 Hotels,restaurants	1.360	-389	1428
60 Land transport	0.796	-2844	-1375
61 Water transport	2.936	-158	104
62 Air transport	0.306	-48	109
63 Travel agency services	0.145	-237	1193
64 Post. telecommunication services	0.417	-285	630
65 Financial intermediation services	0.351	-336	363
66 Insurance and pension fund serv.	0.508	-239	-62
67 Serv.auxiliary to fin.intermed.	0.345	-51	-1
70 Real estate services	0.092	-69	116
71 Renting services	0.237	-46	-6
72 Computer and related services	0.483	-170	335
73 Research and development	1.378	-99	993
74 Other business services	0.494	-1511	1964
75 Public admin.,defence serv.	1.269	-189	27532
80 Education	1.646	-130	20696
85 Health and social work	1.639	-383	22853
90 Sewage,refuse disposal services	0.657	-253	890
91 Membership organisation services	0.335	-3	486
92 Recreation,cult.and sporting serv.	0.731	-93	1869
93 Other	1.823	-41	379

Conclusions

- As the presented analysis of a change from a free allocation of greenhouse gas permits to permit auctions suggests, the primary impact on the monitored and regulated CO₂ sources is equivalent to a new tax in the overall amount of 65 bln. CZK in the average scenario (one permit is for 30 Euro in 2008 prices)
 - **we suppose that the original NAP II fully covers the needs of the firms for the permits).**
 - **In the case of permit shortage, as can be the case of the modified NAP II, the median price permit implies net transfer abroad in the amount of 11.25bln. CZK and the redistribution effect is only 65bln CZK while the implicit tax level of all the sectors is 76 bln. CZK per year.**

Conclusions

- Primary impact was used as an input to the input-output analysis which produced the secondary (implied) impacts.
 - **The induced change of a primary impact of a size 65 bln. CZK without redistribution of the collected fees back to economy presents a reduction of the overall turnover of the economy of 127 bln. CZK;**
 - **in the case of full redistribution of the fees back to the economy (autonomous scenario) is the implied change of a turnover just -15 bln. CZK, however, we see an important increase of the size of the governmental sector spending (see Table 3 in the paper).**
- We recommend to reduce a general tax (or social security contribution) to keep the fiscal effect of the permit auctions neutral. Otherwise we would see a bloating state employment and a decrease of employment in the private sector.