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Experimental calculation of index in education

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Education in the Czech Republic

Schools in the Czech Republic are divided into public and private providers. Most of schools are public institutions. These schools are mainly founded by local government. Schools are semi-budgetary organizations. (They provide paid services at prices, which usually cannot cover their costs and for that reason they receive subsidies, which are equal to a difference between budgeted receipts and costs. If receipts exceed costs, a semi-budgetary organization is obliged most of the surplus transfer to the budget of its founder.) Local budgets cover their costs from 80 to 90 %. Only 10 schools (from that – 2 high schools: Police academy and Military academy of Czech Republic) are budgetary organizations. These 10 schools are directly attached to state budget. All their costs are covered from state budget. Schools in sector of non-profit institutions are partly financed by subsidies from state budget. In CZNA there are only church schools in the sector of non-profit institutions. Subsidies for church schools were 671 millions Czech Crowns in 2004. Its share is 53 % on non-market production of schools. So, we decided to use calculated price indices of non-market output of education services providing by government sector on non-market output in non-profit institutions sector.

Table 1: Number of schools according to sectors

NACE	Public schools		Private schools	
	S.11001	S. 13	S.11002	S. 15
801	4	7155	50	92
802	8	1073	244	111
803		36	33	16
804	11	443	274	420
80 Education	23	8707	601	639

Table 2: Output of education in million CZK, 2004

	S. 11	S. 13		S. 14	S. 15	
	market	nonmarket	market	market	market	nonmarket
801	385	60 376	5 145	10	92	299
802	2 327	31 264	3 400	36	151	669
803	717	22 778	4 795	0	73	48
804	2 895	4 170	705	5 079	525	243
NACE M	6 324	118 588	14 045	5 125	841	1 259

The biggest non-market output is in the sector of government institutions. Sector of non-profit institutions takes a share on non-market output of education under 2 %. The following table shows splitting of non-market government output into central and local government. The major non-market output is provided by local government institutions. Only high education is in central government.

Table 3: Non-market production in the sector of government institutions (million CZK, 2004)

Non-market production		
	CG	LG
801	3 076	57 300
802	4 844	26 420
803	22 525	253
804	1 268	2 902
NACE M	31 713	86 875

Current method non-market education output

Now we use input method. We sum the costs items and each item is separately estimated in constant prices:

- **matrix of intermediate consumption** in sectors S. 13 and S. 15
Intermediate consumption we estimated in constant prices by consumer price indices.
- **Consumption of fixed capital** is firstly estimated by two methods PIM /perpetual inventory method/ and price-quantity models in constant prices of the base year. And subsequently, the estimates of consumption of fixed capital in current and previous year's prices are acquired from these models by indexing.
- **Compensation of employees** in previous years prices is estimated by index of these compensation on one employer adjusted of labour productivity grow.

Experimental calculation in education

We tried to join cost data with output defined as numbers of pupils, students according to type of education. Previous calculation separates government and non-profit institutions. Now we consider of using price index counted from government data sources on church schools. Reason for this step consists in state subsidies from to church schools. They were higher than half of non-market production in 2004

Main data sources:

- Statistical yearbook of education is published by Institute for information on education
- State financial statement and Budget structure – there are information about public expenditures of local and central government institutions

Institute for information on education publish the statistical yearbook of education, where CZSO used numbers of pupils, students, numbers of classes in this structure /stratification/:

Pre and primary education /CPA 801/:

- kindergartens
- special kindergartens
- primary schools
- special primary schools
- preliminary courses

Secondary education /CPA 802/:

- gymnasiums
- secondary schools
- special secondary schools
- training institutions
- special training institutions

- practice training schools

Higher and university education /CPA 803/:

- higher schools
- universities

Other education /CPA 804/:

- art schools
- language schools

This stratification approximately agrees with international classification ISCED 97. Statistics of education comprise indicators on schools, pupils (students), classes in classification ISCED 97 and also according to type of school (as was remarked above). Costs are published only according to type of school, but they are not published in ISCED 97.

Example: Gymnasiums four-year – all study years are included into group - 3A
 Gymnasiums six-year – the first two years are included into group – 2A and
 next four years are included into group – 3A.
 Gymnasiums eight-year – the first four years are included into group – 2A (it is
 second degree of elementary education) and next four years are included into
 group – 3A.

We cannot make the same cost stratification according to ISCED 97. So we used data about pupils and classes according to type of school.
 (diagram of education system in the Czech Republic in school year 2004/2005 is shown in annex)

Construction of index on non – market education

Generally CZSO used unit cost method. Estimations of costs at constant prices were calculated via the number of pupils (students) and unit costs per pupil (student) in previous year.

From the total numbers of pupils CZSO excluded students of private and church schools. Exclusion of private education was a logical step – it is market production. Reason for exclusion of the church schools was hidden in a problem with basic data. There were not enough stratified information about costs from the NPISH report and about students in each type of school. There is not available same stratification as in public schools. So we decided to apply a calculated price index from public schools to church schools.

The public costs appear in the calendar year form, the number of pupils / students in the school year form. Non-correspondence between school and calendar year is solving by recalculation with ratio 1/3:2/3 – for present calendar year we take 2/3 of number of pupils of the previous school year and 1/3 of number of pupils of the present school year.

And also the differences between the day-student and other form of study-student were kept, in the relation 1:1/2.

The following steps of measurement of non-market education in sector of government institution apply to pre and primary education, secondary education and other and higher schools.

1. step: Estimate numbers of pupils into calendar year form /cy/ we call as **Standard number pupils** in stratification according to individual types of school

$$2/3 * (\text{number of pupils}_{d, sy(t-1)} + 0,5 * \text{number of pupils}_{o, sy(t-1)}) + 1/3 * (\text{number of pupils}_{d, sy(t)} + 0,5 * \text{number of pupils}_{o, sy(t)})$$

Where: d = daily study
o = other form of study (distance study)
sy = school year
t-1 = previous school year
t = present school year

2. step: Unit costs in calendar year t = Public expenditures in calendar year t / standard number pupils in calendar year t

unit costs	2000	2001	2002	2003	2004
Kindergartens	27 085	29 534	33 283	34 077	35 799
Special kindergartens	49 002	54 621	71 228	65 579	70 115
Primary schools	25 193	29 458	33 430	40 068	43 642
Special primary schools	61 674	73 257	85 112	92 869	103 947
Gymnasiums	32 816	34 731	41 050	42 406	45 581
Secondary schools	48 034	48 718	55 084	57 273	59 351
Special secondary schools	79 925	118 800	127 482	138 121	136 561
Training college	43 418	45 463	53 376	60 538	63 494
Special training college	57 479	62 577	52 899	54 430	61 748
Higher schools		39 582	36 433	38 317	40 572

3. step: Public expenditures in previous year's prices = unit costs in cy t-1 * standard number pupils in t calendar year

Costs in constant price in mil. CZK	2001	2002	2003	2004
Kindergartens	7447	8080	9178	9435
Special kindergartens	284	313	399	354
Primary schools	26216	29745	32575	37510
Special primary schools	2563	2963	3368	3587
Gymnasiums	4006	4263	5150	5333
Secondary schools	8313	8341	9481	10046
Special secondary schools	279	380	406	427
Training college	7190	7655	8875	9964
Special training college	828	941	830	848
Higher schools		669	650	726

4. **step:** quality adjustment – we have decided to choose number of pupils (students) in one class as the coefficient of quality.

Coefficient of quality = number of pupils in one class					
Size of class		Index of quality			
2003	21,46	⇒	0,997277	⇒	1,002723
2004	21,40				
Teaching of year 2004 is better than teaching of year 2003 over 0,27 %					
Unit costs		Number of pupils			
2003	40 068	2003	974 407		
2004	43 642	2004	936 155		
Primary education in mil. CZK (2004)					
current prices		40 856			
constant prices without adjustment		37 510			
constant prices with adjustment		37 612			

Number of pupils in school years (without tertiary education)

School years	1999_2000	2000_2001	2001_2002	2002_2003	2003_2004	2004_2005
Kindergartens	286196	276038	272752	275189	276869	276871
Special kindergartens	6027	5805	5747	5682	5440	5316
Primary schools	1065167	1050364	1021053	987077	949067	910332
Special primary schools	43544	41961	40747	39839	39026	37814
Gymnasiums	113889	122589	121724	125525	126017	126005
Secondary schools	153270	178552	175349	175073	178410	182398
Special secondary schools	4552	3652	3185	3222	3101	3078
Training college	165113	168696	173837	171524	171042	169119
Special training college	13079	14260	14698	15718	15619	15492

From available data we could count number of pupils in one class.

School years	1999_2000	2000_2001	2001_2002	2002_2003	2003_2004	2004_2005
Kindergartens	22	22	22	23	23	23
Special kindergartens	11	11	11	11	10	11
Primary schools	22	22	22	22	21	21
Special primary schools	9	9	9	9	9	9
Gymnasiums	29	29	29	29	29	29
Secondary schools	29	28	29	29	29	29
Special secondary schools	11	10	10	10	10	10
Training college	25	26	26	26	26	26
Special training college	11	12	12	12	11	11

In the period under consideration, there were not big changes in number of pupils per class. We see no reason for recalculation of quality adjustment data in this case (size of classroom). We see these changes so small to lead to change the quality of teaching.

We can accept the size of classroom, differenced by type of school as enough quality adjusted until big changes in the size of classroom. There is supposed, that the quality of teaching is not different when the number of pupils rise from 22 to 23 students per classroom. The quality adjustment trend is also limited from above, defined as human potential. Finally, we decided not to take into account the changes in class size for they were not significant. So this calculation of quality adjustment is only an exploratory calculation, which we do not take into account the estimation of non-market output of education services in constant prices.

In the Czech republic there is available results from international research PISA for year 2000. This research was aimed to pupils born in calendar year 1984. These pupils were in the ninth class of primary schools and in the first class of secondary schools. There was also survey among student in the third class of secondary schools. This research related to reading, mathematical and scientific literacy. We would like to cooperate with Institute for information on education and look for how to use these results.

Higher and high education

From year 2000 Institute for information on education published information about universities – costs and number of students in stratification by universities. The unit costs are calculated for each university, weighted sum as index for university education. Procedure supposed homogeneity costs in the frame of one university, which is correct only in the case of university with one specialisation. We have no data about students per field of study, also costs are not stratified, and information about each university is a way, how to give information about the output of university education so detailed as possible.

Data for each university in the Czech republic

Universities in the Czech republic	Number of students - standard	Unit costs	Costs in constant prices of previous year (mil. CZK)
Univerzita Karlova v Praze	41 722	124 248	5 144
Jihočeská univerzita v Českých Budějovicích	7 491	96 122	692
Univerzita Jana Evangelisty Purkyně v Ústí nad Labem	6 648	59 222	367
Masarykova univerzita v Brně	26 304	82 505	2 077
Univerzita Palackého v Olomouci	13 758	92 356	1 259
Veterinární a farmaceutická univerzita Brno	2 046	304 252	604
Ostravská univerzita v Ostravě	6 351	65 886	391
Univerzita Hradec Králové	5 109	56 767	262
České vysoké učení technické v Praze	21 712	130 445	2 635
Vysoká škola chemicko-technologická v Praze	3 056	279 273	885
Západočeská univerzita v Plzni	14 387	71 324	945
Technická univerzita v Liberci	6 760	80 887	526
Univerzita Pardubice	5 844	92 032	529
Vysoké učení technické v Brně	16 914	111 678	1 904
Vysoká škola báňská - Technická univerzita Ostrava	16 139	84 082	1 301
Univerzita Tomáše Bati ve Zlíně	5 164	80 413	447
Vysoká škola ekonomická v Praze	14 982	60 842	917
Česká zemědělská univerzita v Praze	10 224	126 721	1 286
Mendelova zemědělská a lesnická univerzita v Brně	6 764	158 640	1 149
Akademie múzických umění v Praze	1 220	246 308	264
Akademie výtvarných umění v Praze	278	316 235	55

Vysoká škola umělecko-průmyslová v Praze	427	215 848	76
Janáčkova akademie múzických umění v Brně	573	241 717	124
TOTAL	233 874		23 837

There are also higher schools that have the same procedure of calculation as primary or secondary schools.

Other education

There are art schools and state language schools in other education (CPA 804). Estimate in previous year's prices is based on unit costs. We have data about number of teachers, and we calculation number students per one teacher – this ratio has not changed since 2000. In other education there are 23 students per one teacher.

- 5. step:** index = SUMA of public expenditures in current prices in t calendar year/
SUMA of public expenditures in previous year's prices

Paasche price index for education

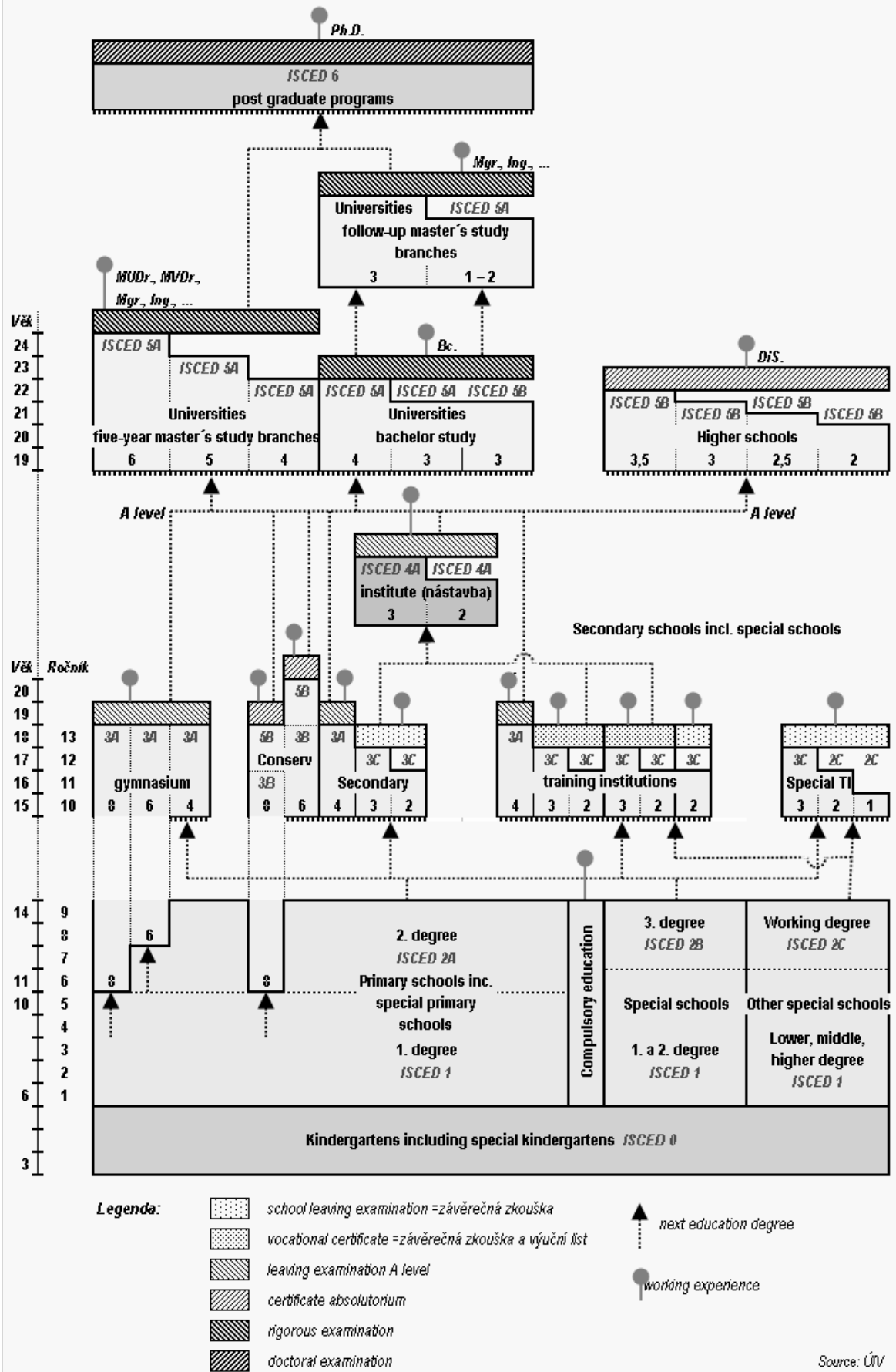
CPA/Years	2001	2002	2003	2004
801 Pre and primary education	115,4	113,7	115,3	108,4
802 Secondary education	104,4	114,3	107,3	105,1
803 Higher and university		103,7	98,6	103,4
804 Other education	116,1	112,5	110,4	113,8

Laspeyres volume index for education

CPA/Years	2001	2002	2003	2004
801	97,8	97,5	97,4	97,0
802	105,9	100,3	100,3	100,3
803		109,9	107,0	107,4
804	99,1	99,0	99,1	98,6

ANNEX

Diagram of education systém in the Czech Republic in school year 2004/2005



Education

Type of school	Public expenditure (current price), mil. CZK			Number of pupils		Unit costs per pupil			Public expenditure (previous year prices)		Paasche price index		Laspeyres volume index	
	2002	2003	2004	2003	2004	2002	2003	2004	2003	2004	2003	2004	2003	2004
Kindergartens	9 105	9 397	9 912	275 749	276 870	33 283	34 077	35 799	9178	9435	102,4	105,1	100,8	100,4
Special kindergartens	408	367	379	5 601	5 399	71 228	65 579	70 115	399	354	92,1	106,9	97,8	96,4
Primary schools	33 755	39 043	40 856	974 407	936 155	33 430	40 068	43 642	32575	37510	119,9	108,9	96,5	96,1
Special primary schools	3 442	3 675	4 015	39 568	38 622	85 112	92 869	103 947	3368	3587	109,1	111,9	97,8	97,6
Gymnasiums	5 039	5 320	5 733	125 448	125 766	41 050	42 406	45 581	5150	5333	103,3	107,5	102,2	100,3
Secondary schools	9 431	9 858	10 410	172 124	175 403	55 084	57 273	59 351	9481	10046	104,0	103,6	100,5	101,9
Special secondary schools	408	439	422	3 182	3 093	127 482	138 121	136 561	406	427	108,3	98,9	99,5	97,2
Training college	8 987	10 066	10 451	166 273	164 591	53 376	60 538	63 494	8875	9964	113,4	104,9	98,8	99,0
Special training college	795	854	962	15 685	15 577	52 899	54 430	61 748	830	848	102,9	113,4	104,3	99,3
Higher schools	616	684	769	17 852	18 944	36 433	38 317	40 572	650	726	105,2	105,9	105,6	106,1

Public expenditures in current and constant price are in million CZK.

Paasche price index

index for education without adjustment				
CPA/Years	2001	2002	2003	2004
801	115,4	113,7	115,3	108,4
802	104,4	114,3	107,3	105,1
803		100,4	99,4	102,6
804	116,1	112,5	110,4	113,8
index for education with adjustment				
801	114,6	112,8	114,7	108,3
802	104,8	114,5	107,5	105,5

Laspeyres volume index

index for education without adjustment				
CPA/Years	2001	2002	2003	2004
801	97,8	97,5	97,4	97,0
802	105,9	100,3	100,3	100,3
803		109,9	107,0	107,4
804	99,1	99,0	99,1	98,6
index for education with adjustment				
801	98,5	98,3	97,9	97,0
802	105,5	100,1	100,1	99,9