

# Common mistakes in the application of bibliometric information in the Czech Republic

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Knowledge-Research-Education Conference  
*Prague Sep 2011*

# How to achieve excellence in R&D?



Allocation mechanisms and built-in incentives of evaluation methodologies (often based on bibliometric data) determine how scientists spend their time and whether they choose to work in a country, given its overall level of R&D funding.

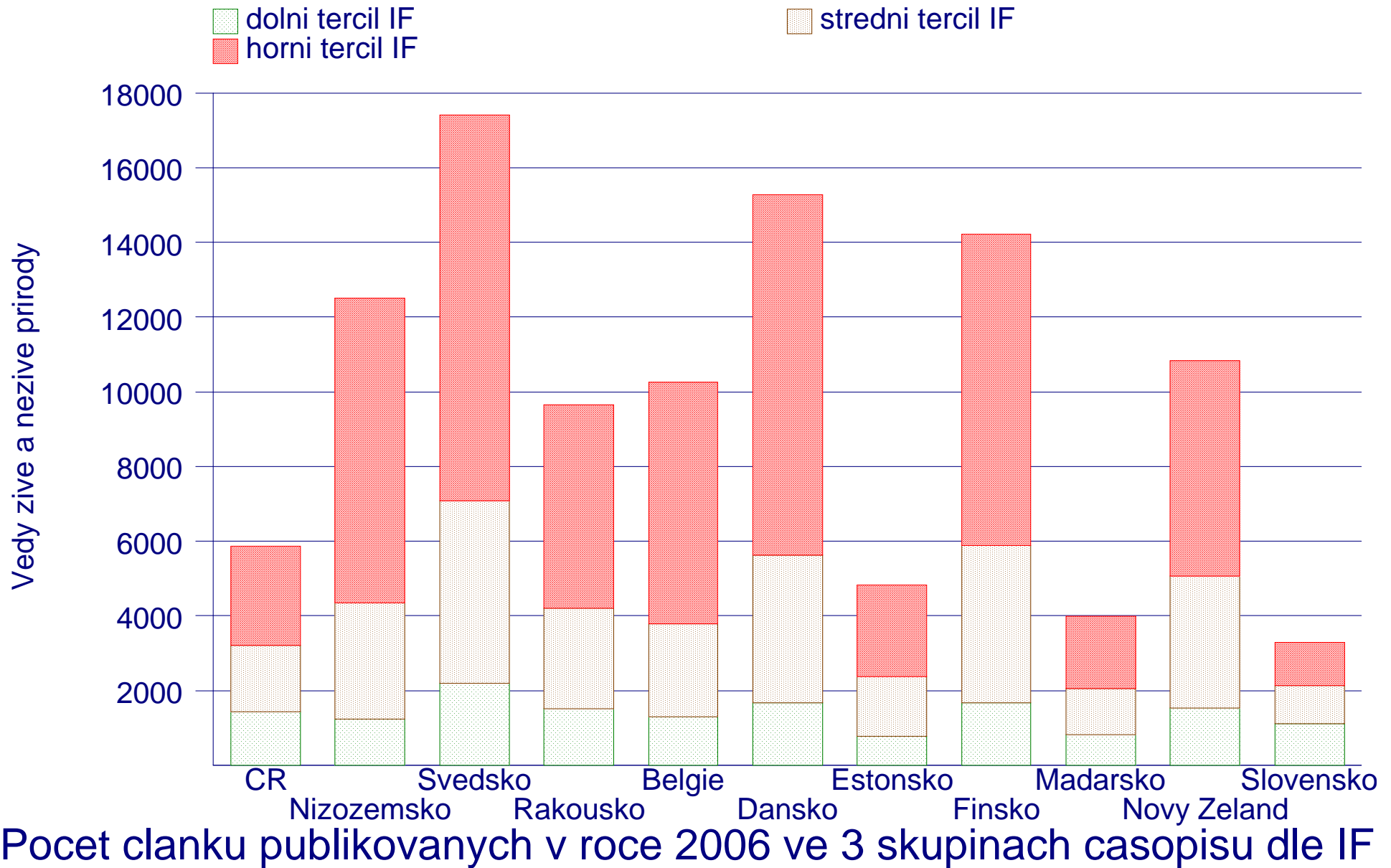
# What is the productivity of Czech science?

- NOBODY KNOWS (output trend to be divided by inputs)
- We do not even know which fields are more productive
- Wrong bibliometric data is used to finance Czech R&D&I

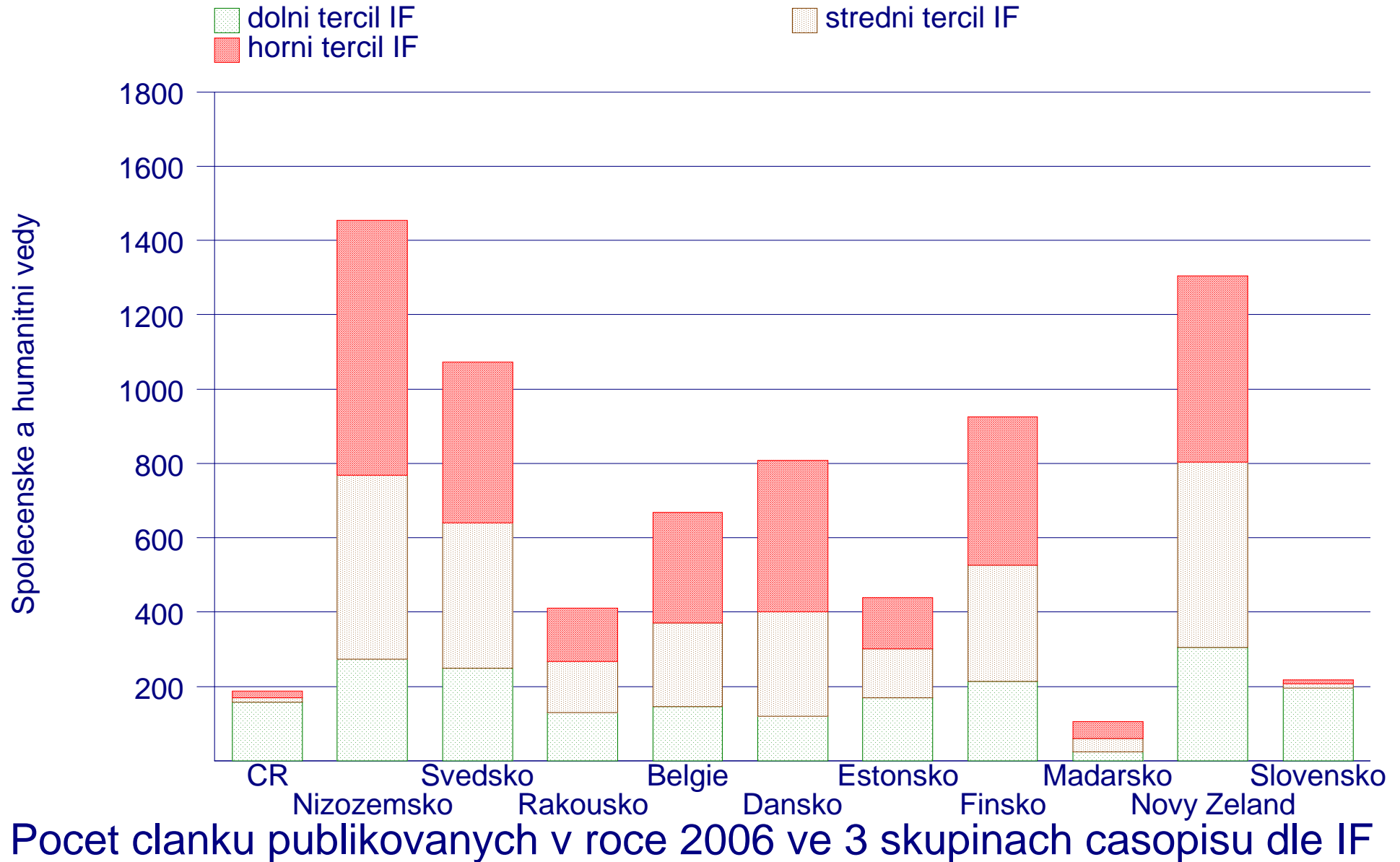
Data:

- 2011 CWTS measures of outputs, not scaled by inputs
- Other local analyses misleading and/or non-informative:
  - Analysis of R&D&I by the R&D&I Council -2010
  - Field comparison of Thomson Reuters indicators 2010
  - Field priority setting analysis, Technology Center 2011
  - R&D&I Council's Evaluation Methodology (2010-2015?)
- I will substantiate these claims and offer some examples.
- But first, some own calculations based on WoS IF data (IF not ideal, but available for comparably sized countries)

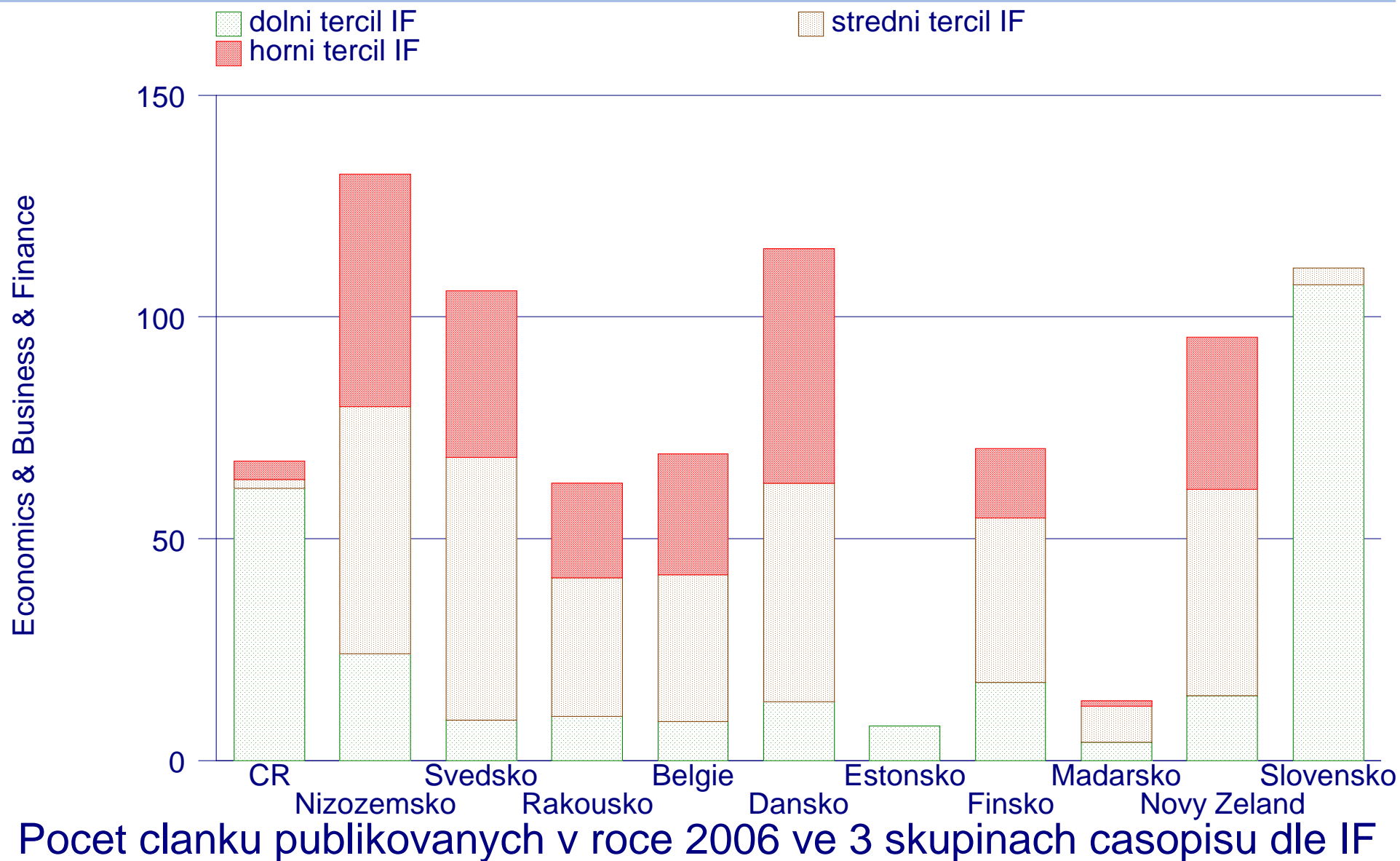
# Natural Sciences, article counts by terciles of IF, scaled to Czech population



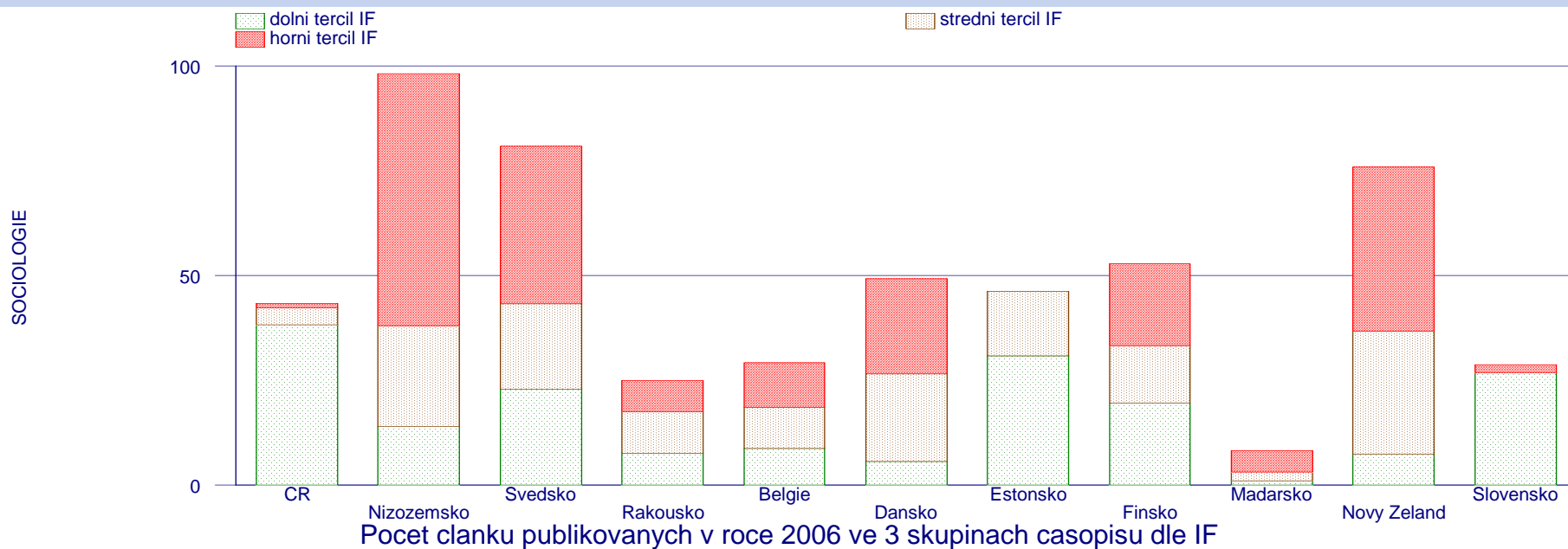
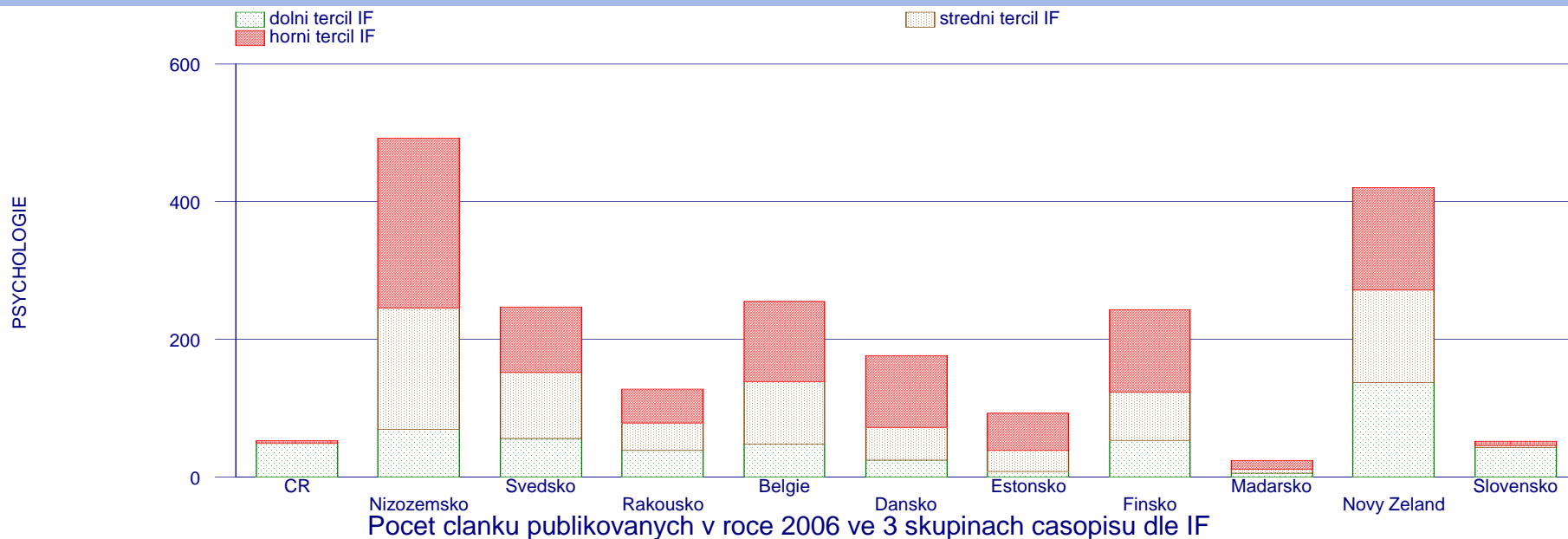
# Social sciences and humanities



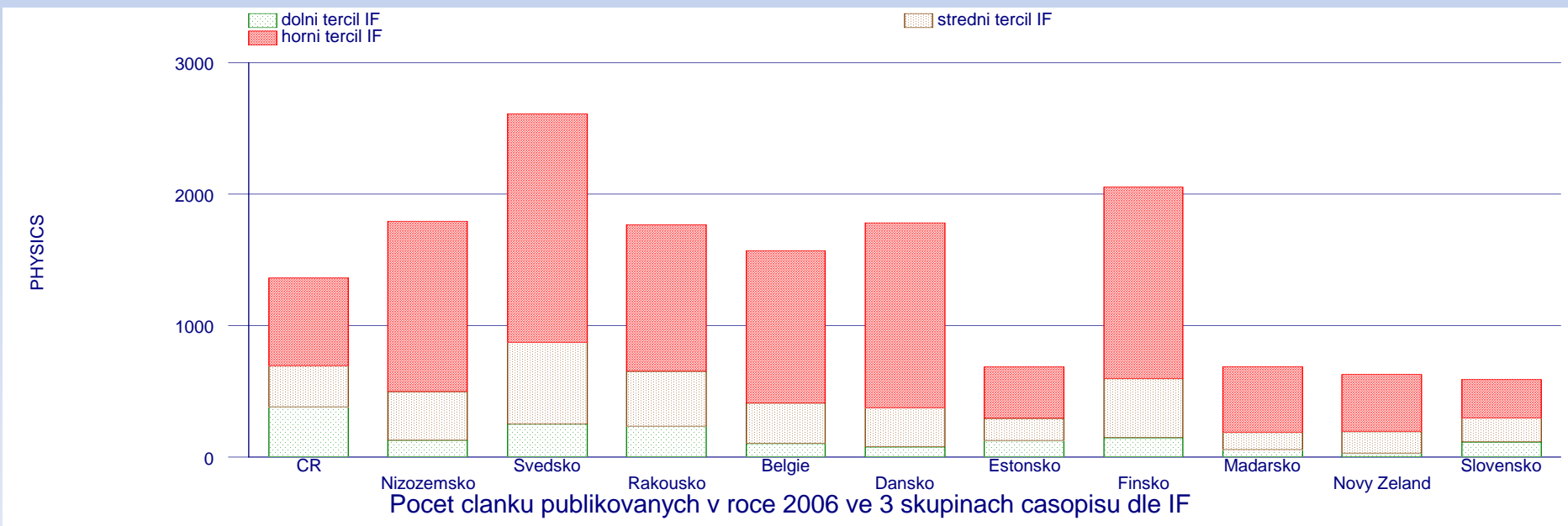
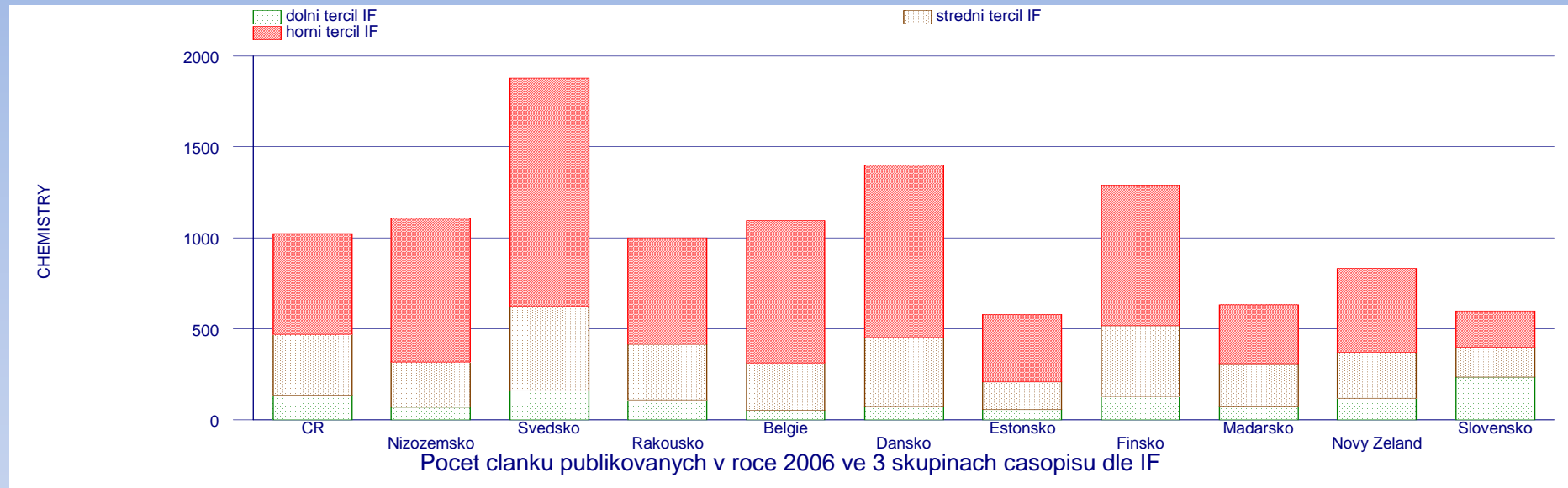
# Economics and Business and Finance



# Psychology, Sociology



# Chemistry and Physics



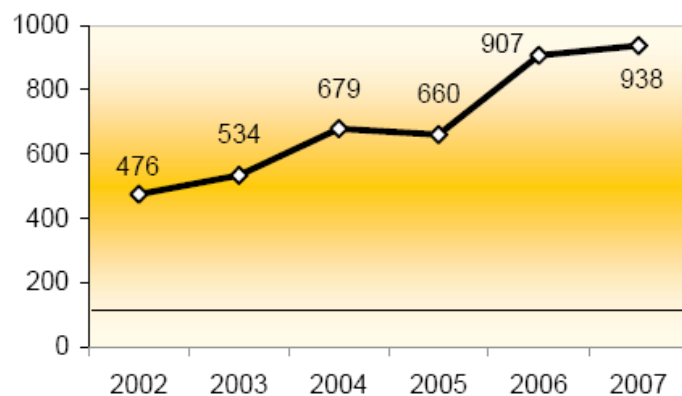


# Existing Czech official analyses

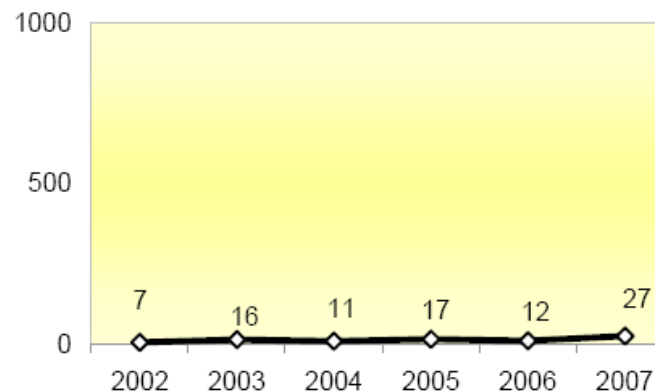
1. Annual R&D&I “Analysis”: RCIO indices, no normalization by inputs or output counts
  2. R&D&I ‘points’ to distribute ~10bln CZK p.a.
  3. Thomson Reuters bibliometric analysis: no address harmonization, no field normalization
  4. Technology Center field priority analysis
  5. CWTS: WoS field-normalized citation impacts based on address harmonization, OP-funded
- 1-4 commissioned by the Czech R&D&I Council

# 1. R&D&I Council “Analysis”: RCIO

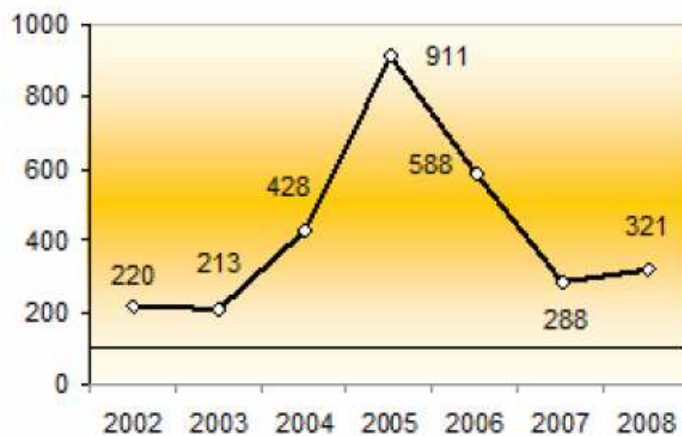
Všeobecné a interní lékařství–RCIO



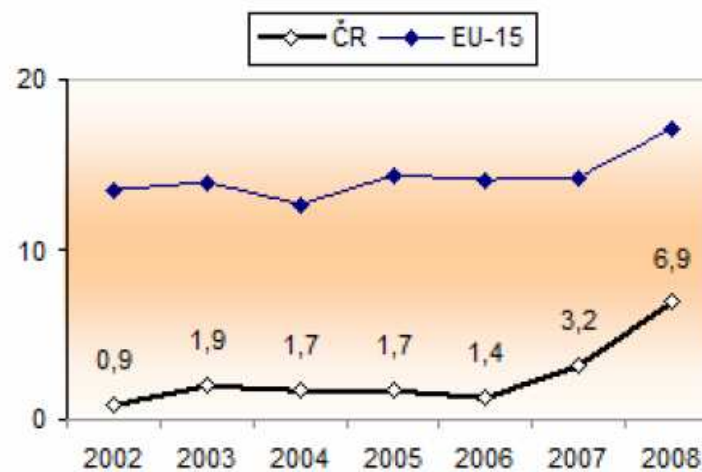
počty publikací



Všeobecné a interní lékařství-RCIO

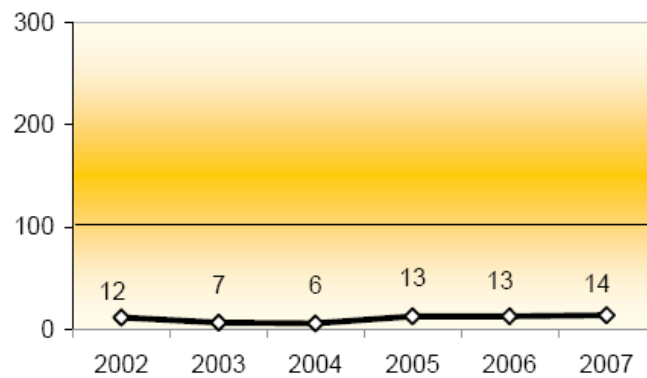


Počet publikací na 1 milion obyvatel

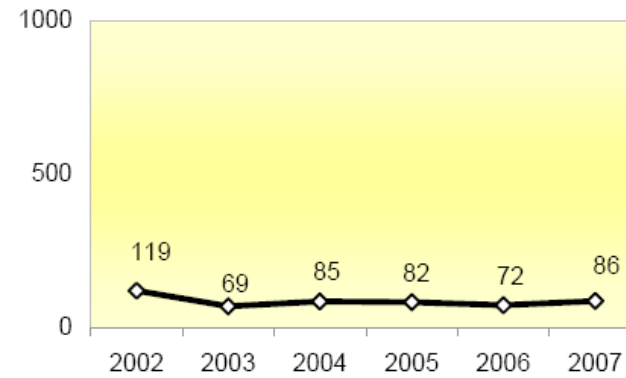


# 1. R&D&I Council “Analysis”: RCIO

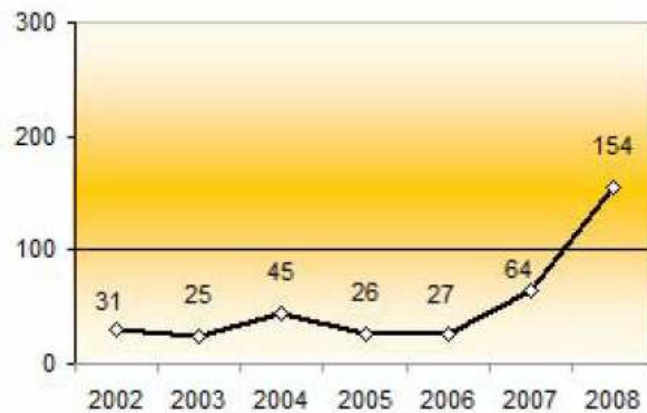
Ekonomie-RCIO



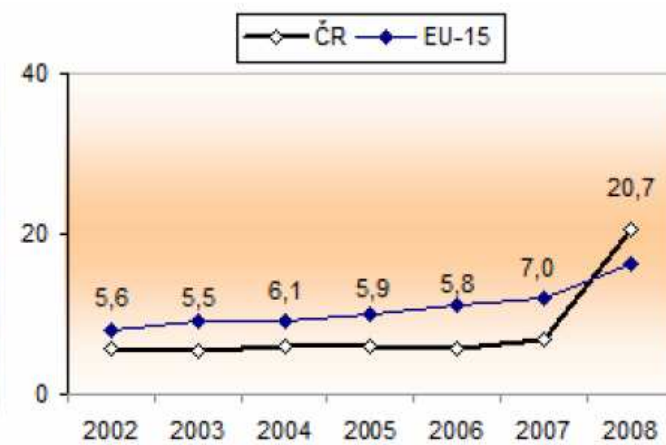
počty publikací



Ekonomické vědy-RCIO



Počet publikací na 1 milion obyvatel



# 1. RCIO misuse, cont.

- Relative citation indices (field-normalized citations per paper) tend to be high where only few researchers from a large field publish in IF journals even though almost all should.
- In Czech lands, normalizing by number of researchers problematic since we do not know the physical number of researchers (only FTE). Also 'national' journals distort citations (more on this issue below).

# 1. RCIO misuse, cont.

- Lesson: present relative citation measures only jointly with measures of total output per unit of input (at least per researcher).
- This will stop the confusing comparison between productive fields with large output at average RCIO from unproductive fields with tiny highly selected output with high RCIO.

## 2. The 2009 'point' table

Result types		I- NERR specializations	II – other specializations	
J <sub>imp</sub>	article in impacted magazine <sup>1)</sup>	<b>10 to 305 <sup>2)</sup></b>		
	article in prestigious impacted magazine (Nature, Science, Proc.Natl. Acad. Sci.) <sup>3)</sup>			
J <sub>neimp</sub>	article in non-impacted magazine	world-renowned database <sup>4)</sup>	<b>12</b>	<b>8</b>
		list of critiqued periodicals <sup>4)</sup>	<b>10</b>	<b>4</b>
B	scholarly book	world language <sup>5)</sup>	<b>40</b>	<b>40</b>
		other languages		<b>20</b>
D	article in proceedings <sup>6)</sup>	<b>8</b>		
P	patent	European or international patent (EPO, WIPO), patent of USA and Japan	<b>500</b>	
		Czech or national patent used on the basis of a valid license contract	<b>200</b>	
		other patents <sup>7)</sup>	<b>40</b>	
Z	pilot plant, confirmed technology, species, breed	<b>100</b>		
F	usable sample	<b>40</b>		
	industrial sample	<b>40</b>		
G	prototype, functional sample	<b>40</b>		
H	Applied results	<b>40</b>		
N, L	certified methodologies and procedures, specialized maps with scholarly content	<b>40</b>		
R	software	<b>40</b>		
V	research report containing classified information	<b>50</b>		
1)	NERR includes specializations (according to R&D IS codebook: AA – Philosophy and Religion, AB – History, AC – Archaeology, Anthropology, and Ethnology, AD – Politology and Political Science, AE – Administration – AG, Legal Science, AI – Linguistic Science, AJ – Literature, Mass media, and Audiovisuals, AL – Art, Architecture, and Cultural Heritage, AM – Education and Schools.)			
2)	publications indicated in the following database Web of Science of the company Thomson Reuters: Science Citation Index Expanded (SCI-EXPANDED) – 1945 – present; Social Science Citation Index (SSCI) – 1980 – present; Arts & Humanities Citation Index (A&HCI) – 1980 – present; Index Chemicus (IC) – 1993 – present; Current Chemical Reactions (CCR-EXPANDED) – 1986 – present			
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## 2. Fatal flaws of Czech “point” system

- A. Arbitrary allocations across fields, between basic science and applied/innovation work
- B. Use of IF in all fields, with little normalization (to costs, salaries, frequency of publications)
- C. Automatic financing of easy-to-produce output = powerful incentives against quality research, esp. in fields with low frequency of IF or no IF; incentives applied to micro units

OP-funded International Audit of Czech R&D:

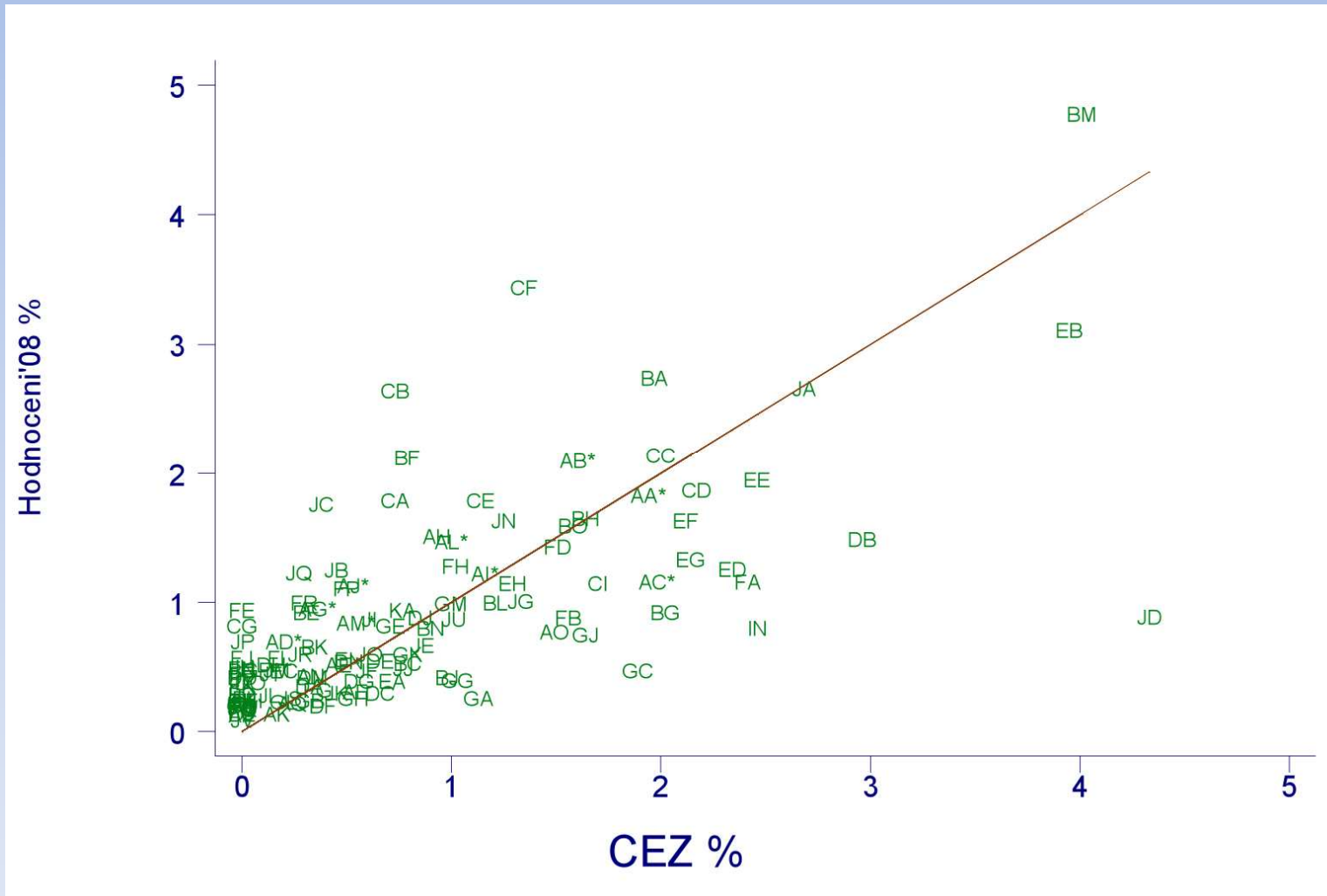
“Discontinue the extreme system immediately”

## 2.A Arbitrary allocations

- The only R&D financing system in the world based solely on counting (not reading) outputs
- The point parameters per type of output are set and adjusted arbitrarily, resulting in arbitrary division of funding between
  - a.basic/applied research,
  - b.old/new field funding shares,
  - c.new/even newer field funding shares...



# Old/new shares of science fields on total institutional funding budget

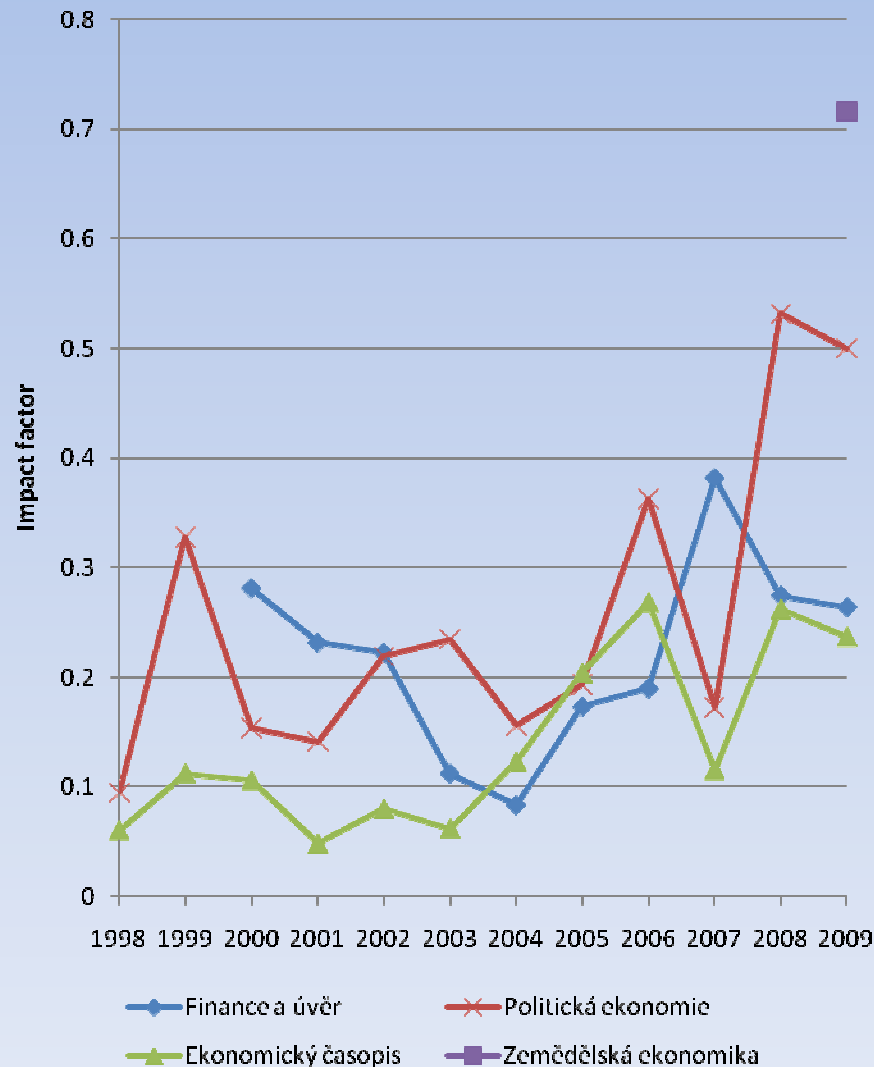


## 2.B IF inflation & 'national' journals

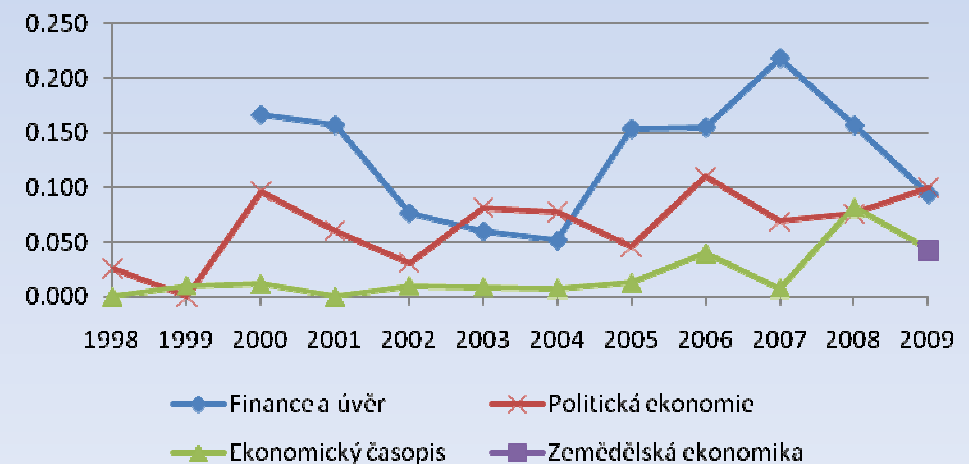
- Formulaic use of IF leads to bizarre behavior
- New WoS IF journals mushrooming with high IF based on within-journal / within-country cites
- The ability to control/manipulate an IF this way a key feature of 'national' journals, esp. in SS:
  - In 2010 *Transformations in Business and Economics* had 90% journal self-citation rate and 2<sup>nd</sup> decile IF
  - The 3rd highest IF journal in Economics on the planet in 2011 is another new Lithuanian journal...

## 2.B IF inflation, cont.: Czech journals

Impact factor according to WoS

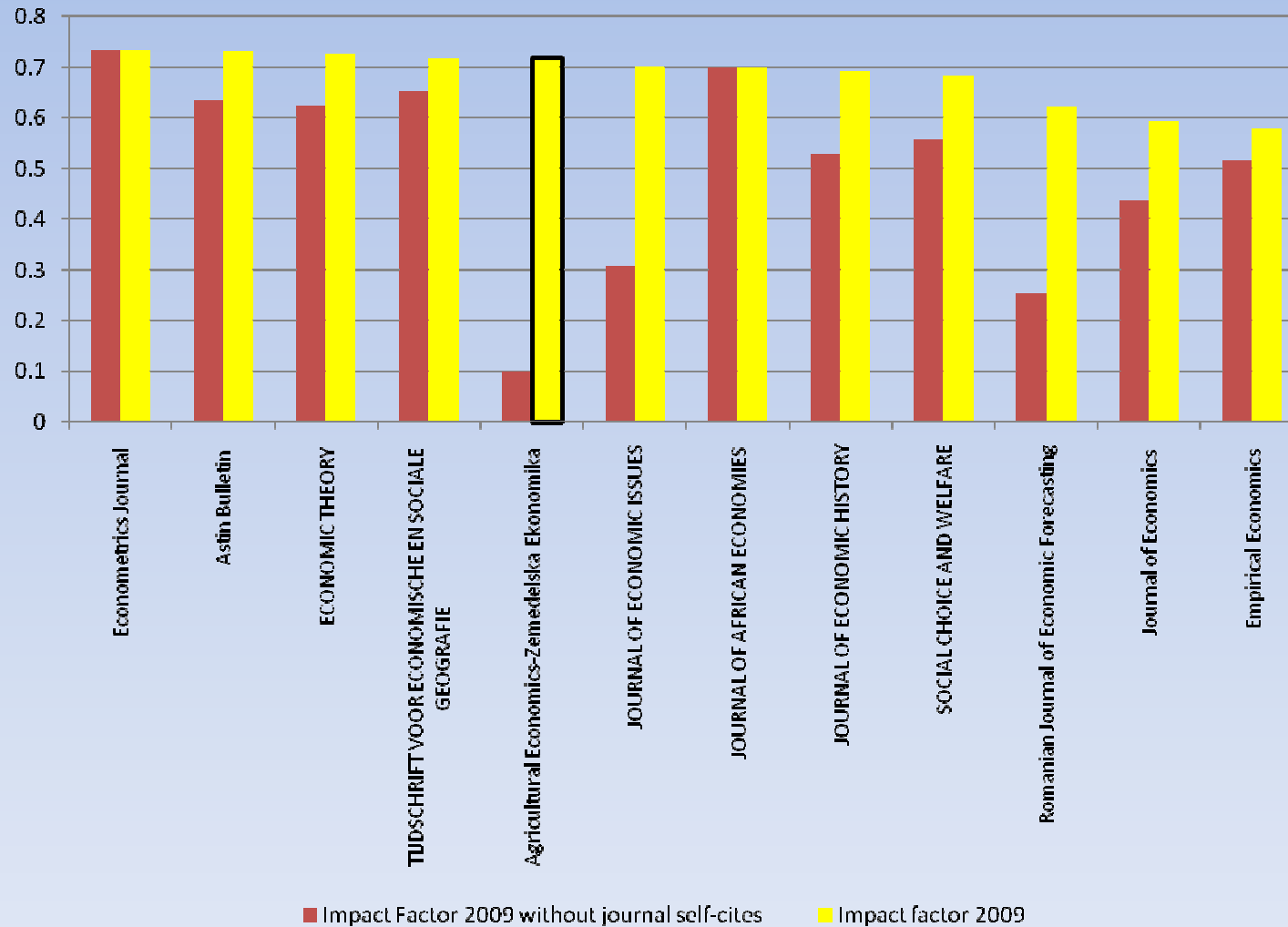


Impact factor, excl. journal self-citations and non-impacted sources



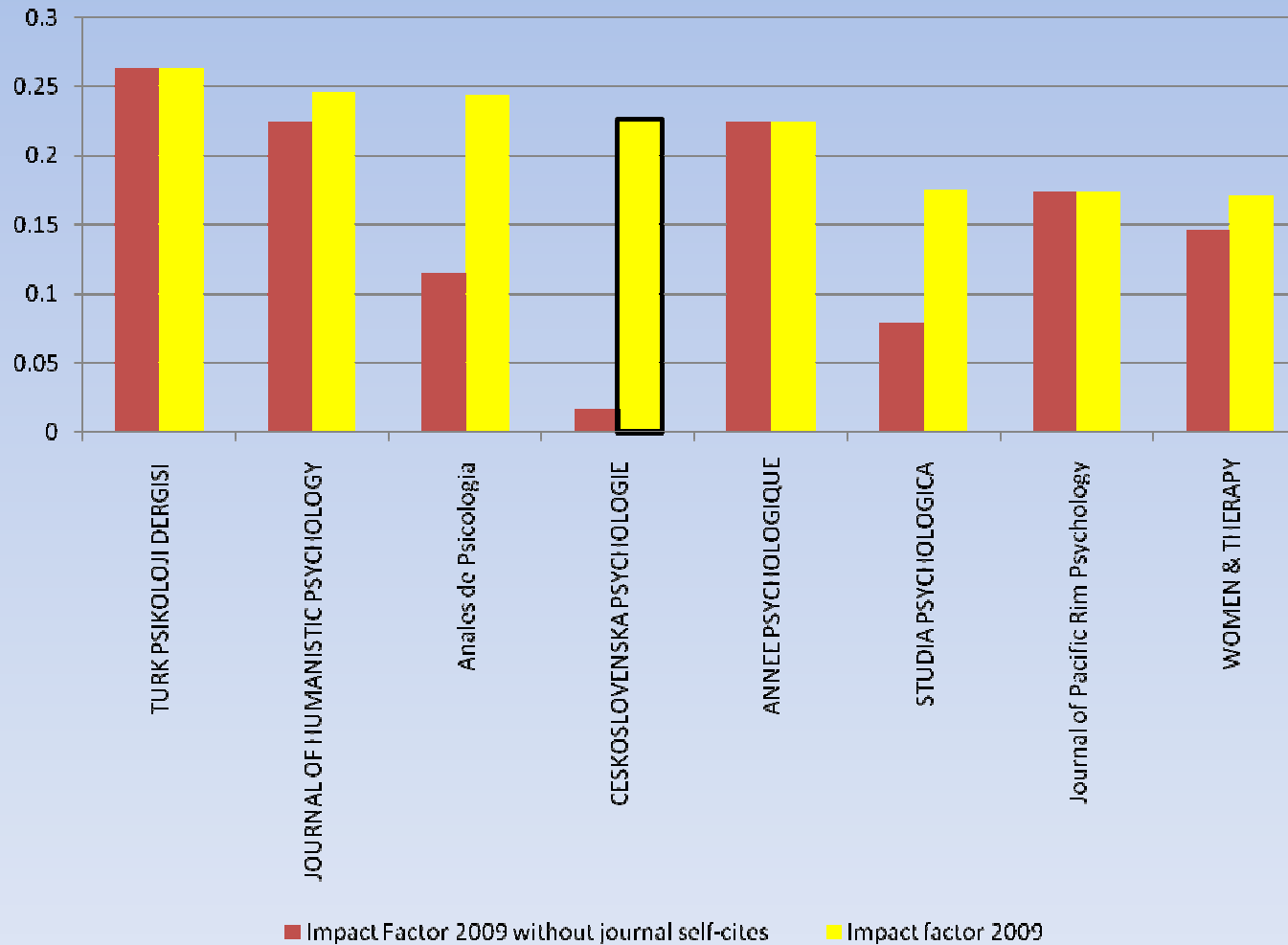
## 2.B 'national' IF, continued

Comparison of IF in ECONOMICS



## 2.B 'national' IF, continued

Comparison of IF in PSYCHOLOGY



## 2.B 'national' IF, continued

- There are 4 Czech IF journals in Economics now.
  - Politická Ekonomie*: 60% of citation impact from itself, over 90% from the Czech/Slovak Republics.
  - Macroeconomic Dynamics*: identical IF, but only 11% of citations from within the journal and the rest is international, including citations from high IF.
- Share of local IF output in SS:
  - Sweden 1%, Czech Republic: 71%.
- National journals are necessary, but how many and what to make of their IF, which they control directly

## 2.B Use of IF in all fields with little cost/frequency normalization

- Evaluations in other countries account for field differentials in costs of research production
- IF is not an optimal citation measure (it does not account for the quality of the citing source, Scopus indexes (JCR a SNIP) do)
- The British REF exercise: out of 36 sub-panels only 12 use citation data (including economics) and only as input into peer review (that can easily eliminate rid of bogus journals)

## 2.B Differences in natural IF frequency

TABLE 3  
Journal Publication Rates and Related Information for Eight Disciplines

Discipline	Annual journal publications per faculty (USA)	Acceptance rates in top five journals (%) <sup>a</sup>	Number of authors per per article <sup>b</sup>	Equivalent pages per per article <sup>c</sup>	Equivalent pages per author per year <sup>d</sup>
Economics	0.54 <sup>e</sup>	9	1.6	8.8	2.97
Finance	0.26 <sup>f</sup>	11	1.9	11.4	1.56
Geology	1.54 <sup>e</sup>	51	2.6	13.3	7.87
Psychology	1.80 <sup>f</sup>	22	2.2	10.6	8.67
Physics	2.10 <sup>f</sup>	69	4.7	6.6	2.95
Oceanography	2.11 <sup>e</sup>	72	5.0	8.0	3.38
Chemistry	2.86 <sup>g</sup>	55	4.3	7.2	4.79
Geophysics	3.65 <sup>e</sup>	69	2.5	8.7	12.70

*Notes and Sources:*

<sup>a</sup>Our survey of the top 5 journals in each field except oceanography, where only 3 journals provided information.

The top five economics journals we selected were the *American Economic Review*, *Journal of Political Economy*, *Southern Economic Journal*, *E* the top 5 journals in the other disciplines, we asked department chairs to rank the "best" journals in their respective disciplines. In finance, the *Financial Economics*, *Journal of Financial and Quantitative Analysis*, *Review of Financial Studies*, and the *Journal of Banking and Finance*. The *ps* *nal of Experimental Psychology*, *Psychological Bulletin*, *Psychological Review*, and the *Journal of Applied Psychology*. The physics journals we *Review A, B, C, and D*. The geology journals were *Bulletin of the Geological Society of America*, *Geology*, *Bulletin of the American Association* and *American Journal of Science*. The oceanography journals were *Journal of Physical Oceanography*, *Journal of Geophysical Research (green)*, *nals* were *Journal of Geophysical Research (JGR-Red Solid Earth)*, *Geophysics*, *Tectonophysics*, *Geophysical Journal International*, and *Geophy* were *Journal of the American Chemical Society*, *Journal of Biological Chemistry*, *Biochemistry*, *Journal of Medicinal Chemistry*, and the *Journal*

<sup>b</sup>Based on 1992-93 data for the top 5 journals in each discipline, except for economics, where data on the top 24 journals were used.

<sup>c</sup>"Equivalent page per article was estimated as average number of words per other discipline journal page divided by average number of words per *A* discipline" journals and top 24 economics journals were included in the sample. Estimates were adjusted for number of co-authors in Table 1.



## 2.C 'Soft' output distorts everything

	Evaluation year	2010	Growth rate (%)	2009	2008	2007	2006
	Years counted	2005-9	2010/09	2004-8	2003-7	2002-6	2001-5
Jimp	Article in WOS journal	35617	8	33056		29773	25478
	Article in SCOPUS or ERIH journal	14113	14	12352			
	Article in Czech journal-reviewed	19263	30	14824			
Jneimp	Article in non-WOS journal- Total	33376	23	27176		47445	46581
J	Article in journal-Total	68992	15	60232	40124	77218	72059
B,C	Book, chapter	21096	61	13094	13111	17756	18740
B	Book					7164	6468
C	Chapter					10592	12272
D	Proceedings	7481	66	4501	2730	104340	83713
P	Patent	229	-38	371	276	562	363
F	Utility model, industrial design	566	210	183			
G	Prototype, functional model	2225	143	915			
H	Results implemented into legislation or standards	183	215	58			
N	Certified method	1325	393	269			
R	Software	1692	192	580			
V	Secret report	8	-98	400	2		
S	Prototype, applied method	3065	-7	3284	3133	1077	
Z	Trial operation, variety, breed	902	52	593			
T	Prototype, trial operation	352	-36	551			
Z*	Trial operation, verified technology, variety, breed	1253	10	1144	887	1676	1471
L	Specialized maps			105			
	<b>Total number of items</b>	<b>108116</b>	<b>28</b>	<b>84744</b>	<b>60263</b>	<b>202630</b>	<b>176350</b>

Numbers in black are taken from the webpages of RVVI, numbers in red are Technology Centre calculations, based on the above data

\*This category was named Technologies (T) in 2006 and may include also some other types of results.

## 2.C 'Points' in Social Sciences, 2010

<u>Shares of output types</u>	<u>IF</u>	<u>non-IF journals</u>	<u>Books</u>	<u>Proceedings</u>	<u>Total</u>
AH - Economics	<b>23</b>	25	48	4	100
AN – Psychology	43	18	34	5	100
AO - Sociology, demography	27	19	52	1	100

# Summing Up How 'Points' Work: Example of a Social Science: Economics

Table 7.3. ISI coverage indicators per discipline

<i>Discipline</i>	<i>1a Importance of journals (%)</i>	<i>1b ISI coverage of journal literature (%)</i>	<i>1a*1b Overall ISI coverage (%)</i>
Molecular biology & biochemistry	96	97	92
Biological sciences related to humans	95	95	90
Chemistry	90	93	84
Clinical medicine	93	90	84
Physics & astronomy	89	94	83
* Total ISI *	84	90	75
Applied physics & chemistry	83	89	73
Biological sciences ~ animals and plants	81	84	69
Psychology & psychiatry	75	88	66
Geosciences	77	81	62
Other social sciences ~ medicine & health	75	80	60
Mathematics	71	74	53
Economics	59	80	47
Engineering	60	77	46
Other social sciences	41	72	29
Humanities & arts	34	50	17

Disciplines are ranked by descending overall ISI coverage (last column).

Definition of the indicators:

*Importance of journals as communication media:* % References to documents published in journals, relative to total references.

*ISI coverage of journal literature:* % ISI source journal literature, relative to total references.

*Overall ISI coverage:* The latter indicator is the numerical product of the first two indicators.

Applied physics & chemistry includes amongst others the journal categories applied physics,

Internationally relevant basic research in economics is published predominantly in impact factor journals.

# Example of 'points' in Economics (2004-08)

**% shares of articles by IF tercile, institutions A, B and C**

Institution	IF tercile		
	Top	Middle	Bottom
A - share on economics	<b>70</b>	<b>54</b>	18
A - share on economics, political sc., sociol., psychol.	28	25	8
B - share on economics, political sc., sociol., psychol.	23	13	24
C - share on economics, political sc., sociol., psychol.	19	24	29

B is Academy of Sciences, C is Charles University (both excluding A)

**% share of Economics 'points' by type of output**

	Type of output			Total %
	IF	non-IF	Books	
A	<b>46</b>	15	4	<b>16</b>

### 3. Thomson Reuters Analysis

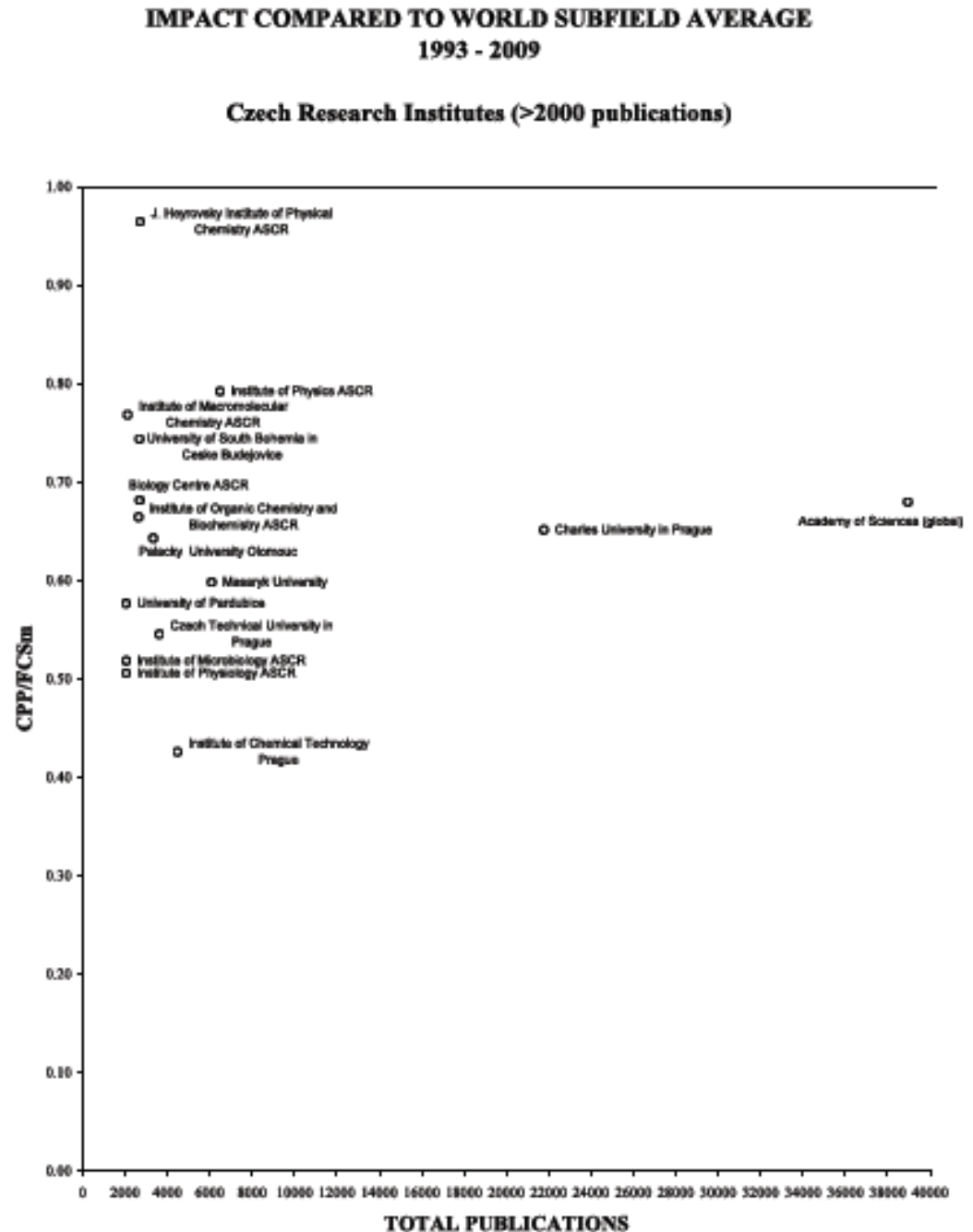
- Publ./citation aggregates by institution, field
- No documentation, vague variable description
- No systematic check on address assignment
- Inappropriate comparisons (for example: h-index for institutions of different size or field)
- No information on inputs, so no productivity
- Results not published yet, after two years

## 4. Technology Center Analysis

- To provide a bibliometric evaluation of field productivity for priority setting exercises
- Not released yet
- In addition to RCIO gives some output size info (shares of Czech publ. on world field output)
- No input data, so no productivity assessment (the share of an institution on Czech output or its number of RCIO>1 publications says little about productivity without scaling by inputs)

# 5. CWTS analysis

- + Normalized citation impact against aggregate output of each unit
- So far no input data, productivity?
- Citation analysis fully counts 'national' journals



## Bottom line

- Incentives provided in evaluation/financing methodology are key to scientists' productivity
  - Bibliometric data a vital part of accountable evaluations of research in some fields
  - No useful Czech bibl. data 22 years after 1989
  - Naïve use of bibliometric data = natural disaster
- => Urgent systemic need for transfer of know how and build up of local human capital / culture in evaluation techniques and bibliometric analysis