

RIZIK I RAZUMIJEVANJE (JAVNOSTI)



Zdenko Šimić

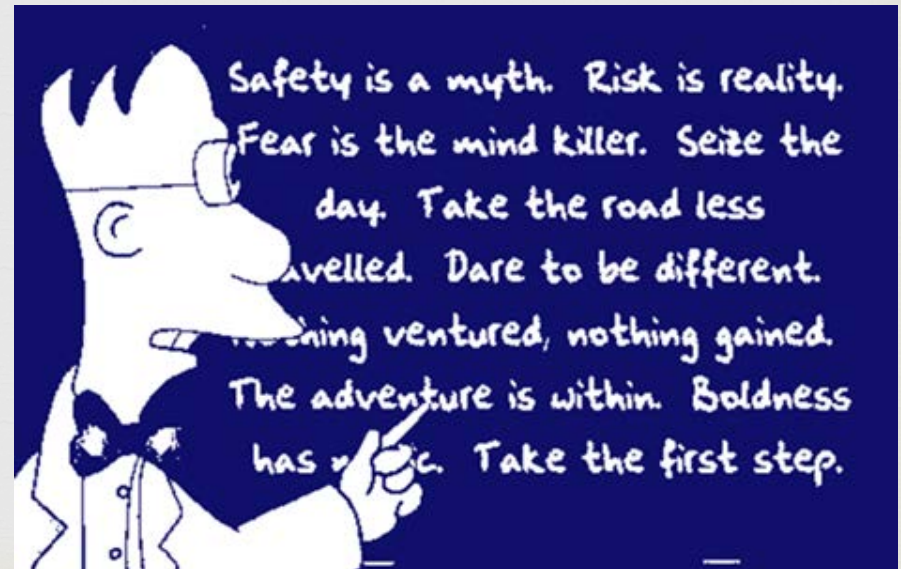
HND i IEEE, Zagreb, 22. prosinca 2011.



Sadržaj



- ☞ Nuklearni paradoks
- ☞ Čovjek i rizik
- ☞ Kako donosimo odluke
- ☞ Čemu težimo



Nuklearni paradoks



Nuklearna je dokazano najviše koncentrirani izvor električne energija, ekonomična i s najmanjim utjecajem na okoliš. Ipak, gotovo sve u vezi NE se smatra opasnim i neprihvatljivim ili barem kontroverzno.

Nuklearni akcidenti



1979. TMI, SAD

- ☞ Zatvoreni ventil, loša instrumentacija i obuka operatera
 - ☞ Ispušteno radioaktivnosti za jedan prirodni dan.
 - ☞ 40 studija da to ispitaju i ~2000 tužbi za uznemiravanje!

1986. Černobil, Ukraina

- ☞ Eksperiment s nesigurnim reaktorom bez kontejnmenta, zakašnjela evakuacija i zaštita
 - ☞ 57 ljudi umrlo tijekom i neposredno nakon akcidenta od ARS-a
 - ☞ 6000, uglavnom djece, oboljelo od raka štitnjače
 - ☞ Odgođene posljedice se procjenjuju na više tisuća (LNT)
 - ☞ Brojne procjene i do milijun stradalih unatoč činjenicama
 - ☞ Najveća žrtva su evakuirani
 - ☞ uslijed nametnutog straha i raseljenosti
 - ☞ Stotine milijardi \$ posve krivo potrošene
 - ☞ Dekontaminacija teritorija oko elektrane na nepotrebno stroge razine
 - ☞ Npr. Njemačka 300M\$ za čišćenje dodataka stoci za uklanjanje potencijalnih +1% na prirodnu radioaktivnost (samo od fosfatnih gnojiva dođe +5%)

Nuklearni akcidenti



2011. Fukushima 1 , Japan

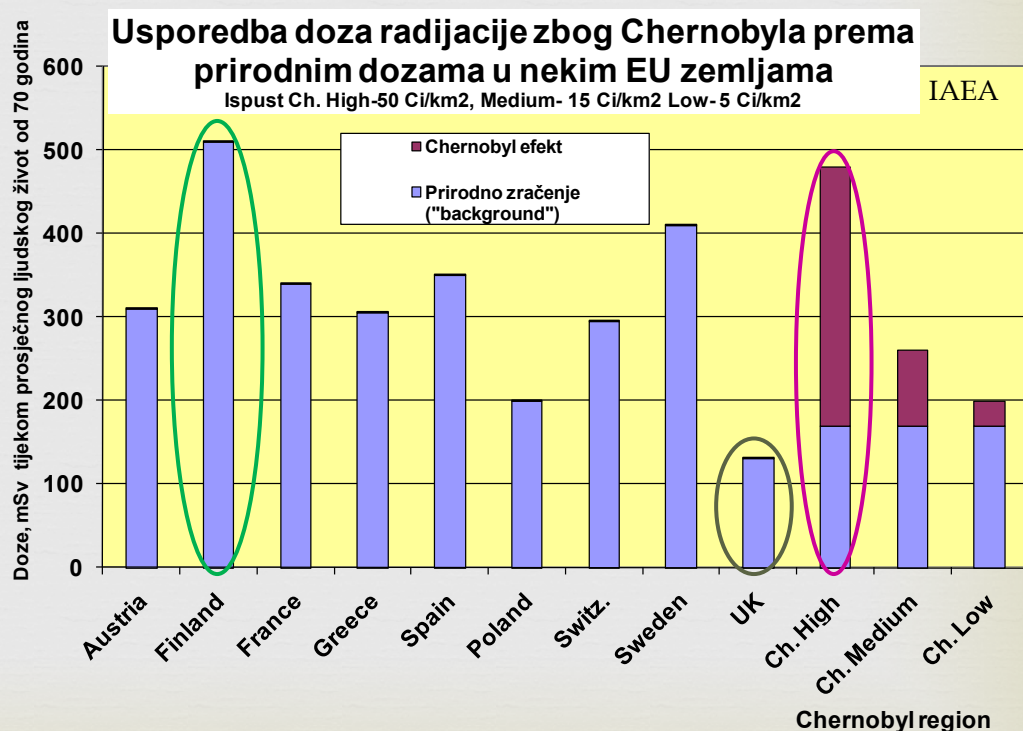
- ⌘ Četvrti po snazi potres u zadnjih 100 godina nije spriječio sigurnu obustavu reaktora, ali izazvani tsunami visine 14 m nadvisio je slabu zaštitu i elektrana je ostala bez električne energije i hlađenja
- ⌘ Tri reaktora su značajno oštećena (taljenje jezgre i eksplozije vodika)
- ⌘ Nije bilo stradalih, 88.000 ljudi je evakuirano
- ⌘ Reaktori su dovedeni u tzv. 'hladnu obustavu'
- ⌘ Dekontaminacija u tijeku
 - ⌘ Problem zadane razine dopuštene radioaktivnosti
 - ⌘ Virtualni rizik i realna cijena
 - ⌘ Strah, nepovjerenje, trajanje raseljenosti

Radioaktivnost



- ❧ Prirodne od 3 do 10 mSv/god.
- ❧ Normalni su i ekstremi od preko 100 mSv/god. bez posljedica!
- ❧ Regulatorna ekstremna:
 - ❧ 1 kg govedine, 500 Bq daje dozu od 8 μ Sv

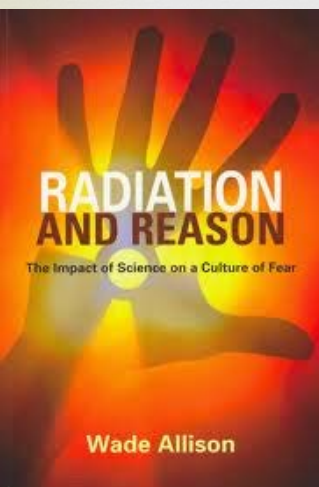
- ❧ Dodatno znanje posve krivo primijenjeno!



Radioaktivnost



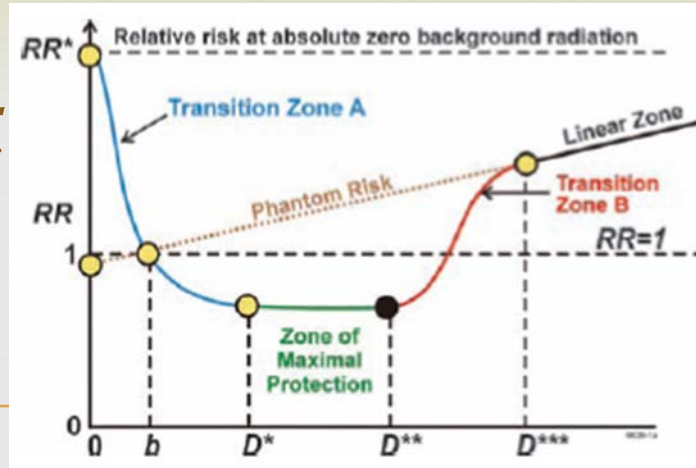
- ⌘ Wade Allison, Oxford Un.
- ⌘ Štetnost od zračenja je enormno precijenjena
 - ⌘ Bez utemeljenja i na ogromnu štetu društvu uključujući strah
 - ⌘ Kriterij 'najniže provedivog' treba 1000x povećati
 - ⌘ 'Hladni rat' je kriv...
- ⌘ Sve je u dozi i vremenu
- ⌘ Norvežani su nakon Černobila primjenjivali ograničenje 12x iznad onoga u Fukushimi
 - ⌘ Samo je dječja hrana držana na niskoj razini
- ⌘ Tek 2002. Šveđani su priznali skupu pretjeranost oko Cezija i mesa
- ⌘ 100 mS jednokratno ili tijekom mjeseca
- ⌘ 5000 mSv tijekom cijelog života





Radioaktivnost

Charles L. Sanders



Korištenje LNT-a je „ na vjeri zasnovana radiološka zaštita”.

– B. Scott

Razdvojenost regulative i znanosti izaziva konfuziju u javnosti i gubitak kredibiliteta.

LNT čini radioaktivnost jedinstveno zastrašujućom i cijena koju za to plaćamo je užasna. - J. Muckerheide

Princip predostrožnosti, dijete LNT-a, vodi do neprihvatljivih društvenih kazni, kao što je demonstrirano nakon Černobiljske katastrofe.

– Z. Jaworowski

Korištenje LNT pretpostavke je „duboko nemoralno korištenje našeg znanstvenog nasljeđa”.

- L. Taylor

Čovjek i rizik



Poimanje rizika je višestruko zahtjevan problem za čovjeka uslijed načina razmišljanja, a time je i mogućnost upravljanja rizikom potencijalno u suprotnost s racionalnim pristupom.



Paul Offit, M.D.

Cijepljenje



Izbjegavanje iz straha od posljedica

- ☞ Strah da cijepljenje izaziva autizam stvorio je u SAD-u pokret protiv cijepljenja
- ☞ 14 studija je to opovrglo
- ☞ Neke iskorijenjene dječje bolesti su se ponovo pojavile

Borba za uklanjanje bolesti: dječja paraliza

- ☞ Od 1985. utrošeno oko 9 G\$ sa 99% uspjehom
- ☞ Nastojanje da se riješi zadnji 1% košta 1 G\$/g.
- ☞ Istovremeno se za isti novac može napraviti daleko više, npr. uklanjanje malih boginja bi koštalo 0.5 G\$ u 14 god.



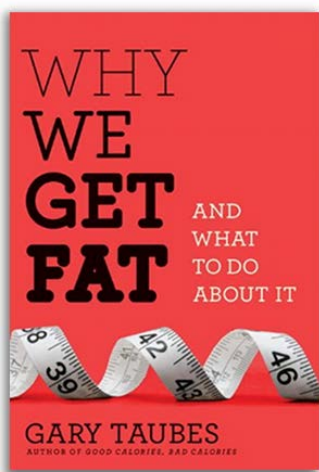
Prehrana



☞ Gary Taubes,
znanstveni pisac

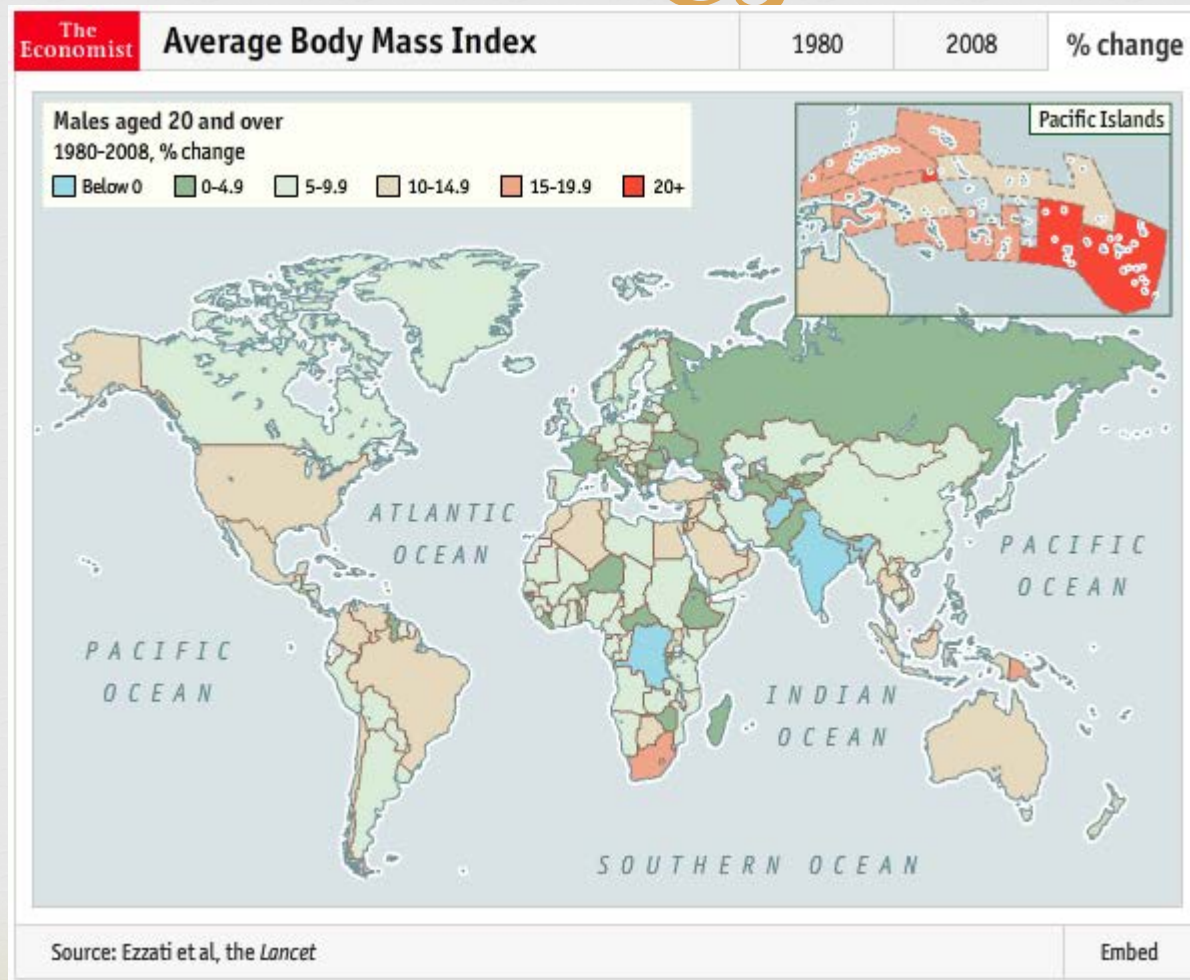
☞ Pokazao da za tvrdnju
da je mast uzrok
pretilosti, srčanih ili
drugih kroničnih
bolesti nema
znanstvenih dokaza
(premda je to
istraživano jako dugo)

- ☞ Hrana se gubi tijekom cijelog lanca od proizvodnje do potrošnje
 - ☞ 1.3 Gt hrane godišnje propadne (>30% proizv.)
 - ☞ Značajan je problem jer postoje gladni i jer proizvodnja hrane treba energiju, vodu i druge resurse
 - ☞ Subvencije su dio problema



www.plosone.org/article/info:doi/10.1371/journal.pone.0007940

Indeks mase tijela, BMI



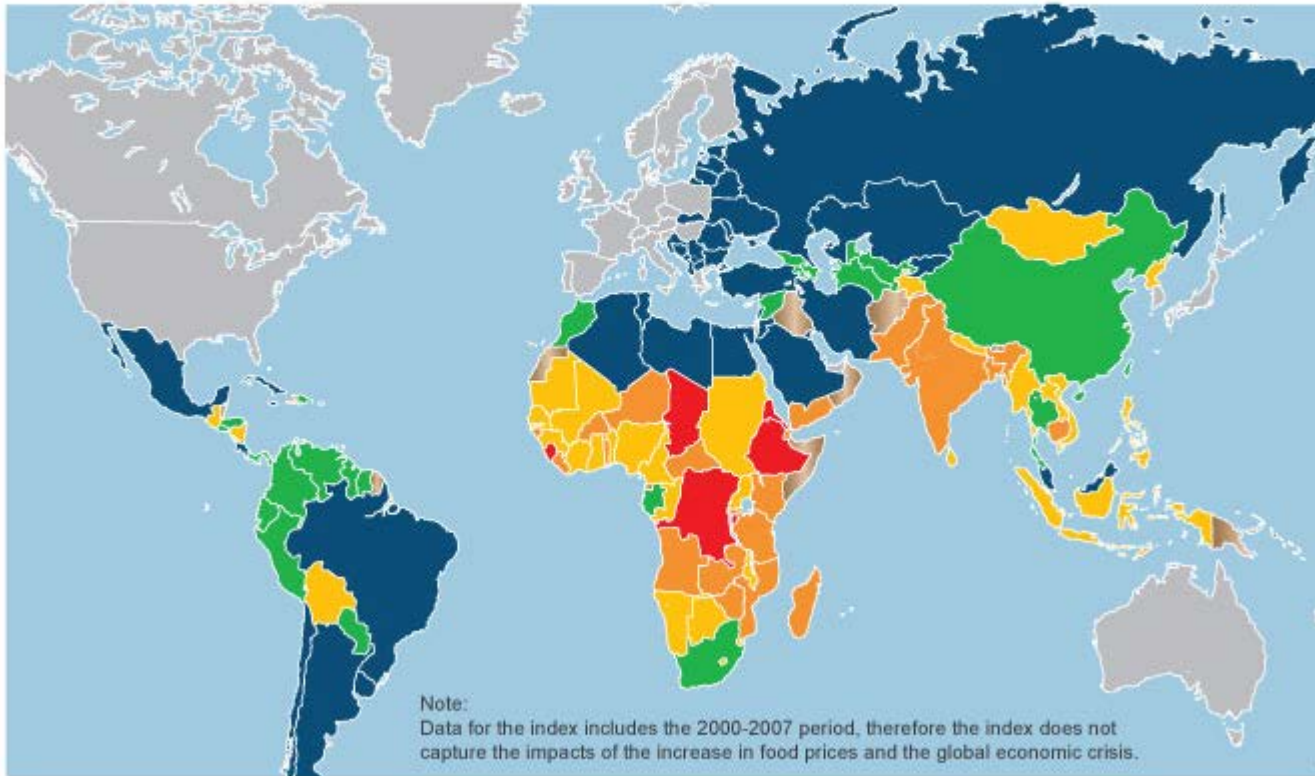
www.economist.com/blogs/graphicdetail

Globalna glad

Global hunger index - 2009

Despite some progress in fighting world hunger, 29 countries have alarmingly high levels of hunger. Countries are ranked by the percent of the population that are undernourished, the prevalence of underweight children under the age of five, and child mortality rates.

Extremely alarming Alarming Serious Moderate Low No data Industrialized country



Source: International Food Policy Research Institute

10/14/09

Reuters graphics/Jasmin Melvin

REUTERS

graphics.thomsonreuters.com/109/GLB_HUNGER1009.jpg

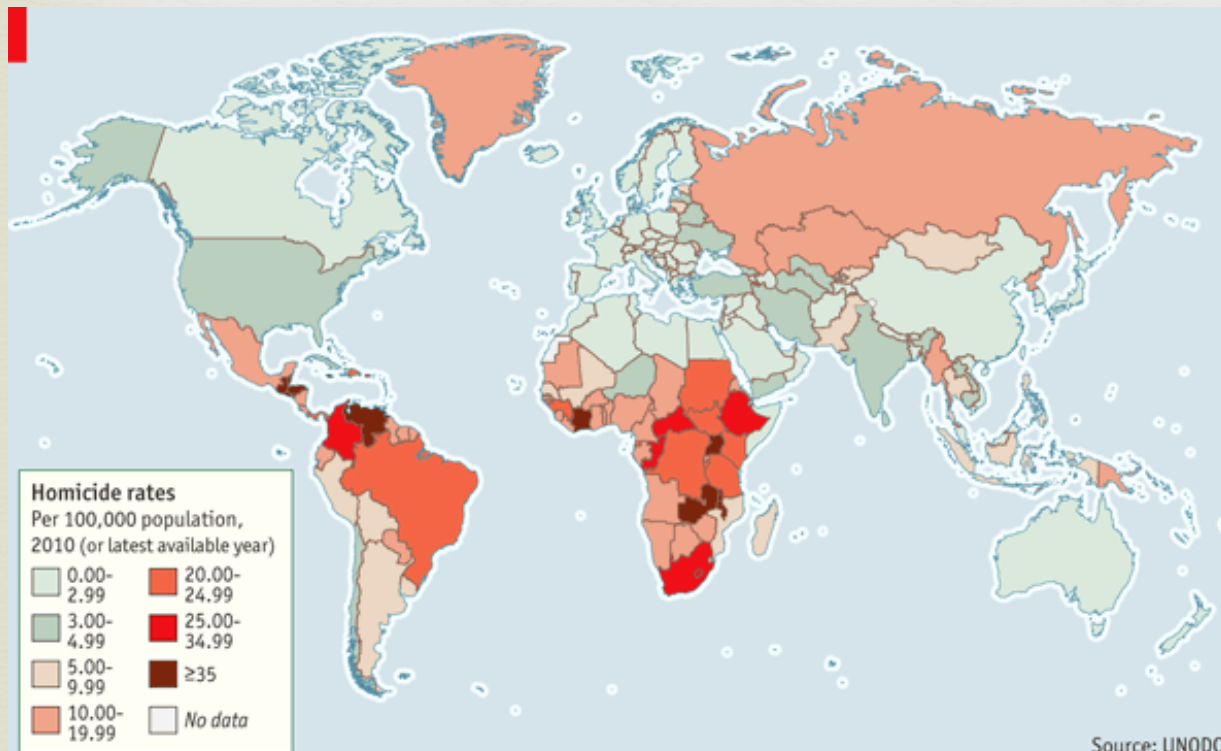
Umiranje od straha



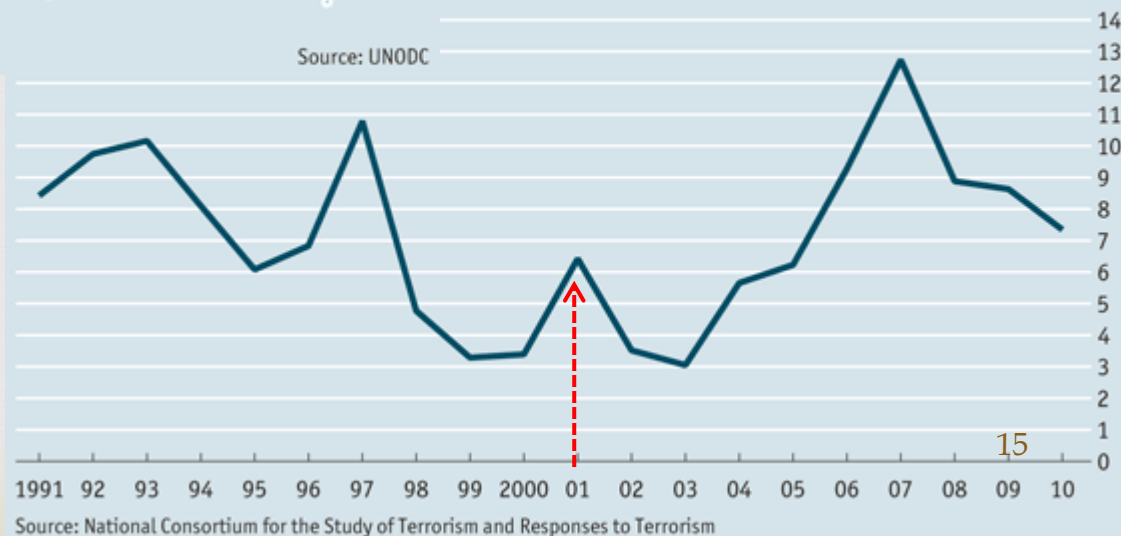
- ☞ Nakon rušenja 'blizanaca' 9/11 2009. u SAD-u je značajno povećan cestovni promet i to je rezultiralo s više od 2000 dodatno smrtno stradalih
- ☞ Usporedivo sa brojem mrtvih u napadu
- ☞ G. Blalock, V. Kadiyali, D.H. Simon: *Driving Fatalities After 9/11: A Hidden Cost of Terrorism*, Cornell, 2005.



Ubojstva i terorizam



Globalno ubijeni od terorista
'000



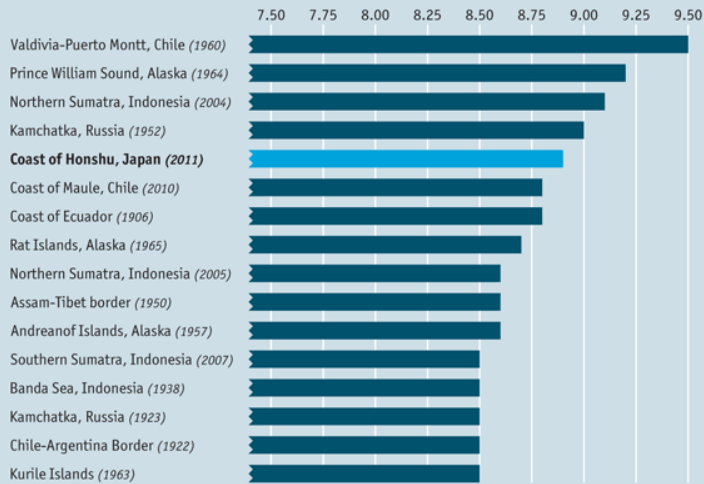
468,000 ubojstava u 2010.

2010. teroristi ubili 7,200

Prirodne katastrofe

World's largest earthquakes

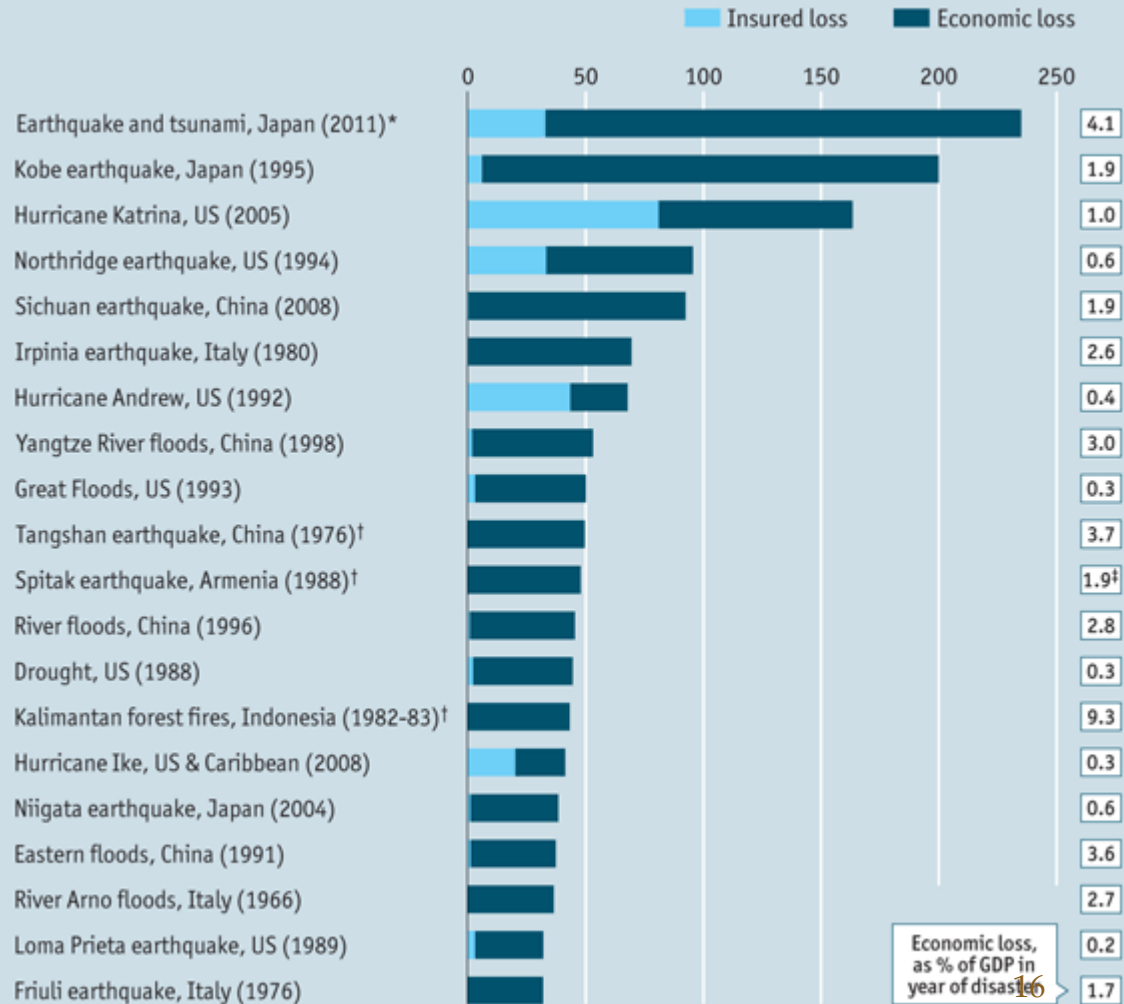
Since 1900, magnitude



Source: United States Geological Survey

World's costliest natural disasters since 1965

2010 \$bn

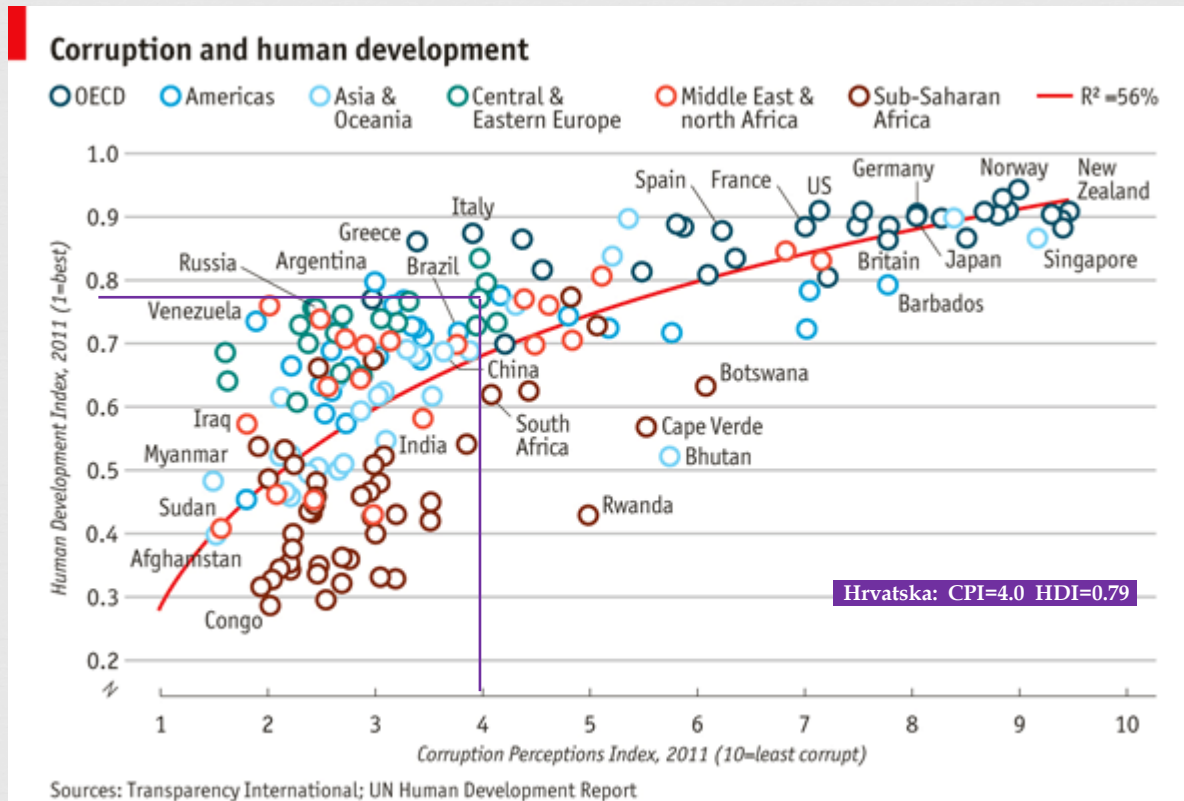


Economic loss, as % of GDP in year of disaster

Sources: Munich Re; IMF; World Bank; *The Economist*

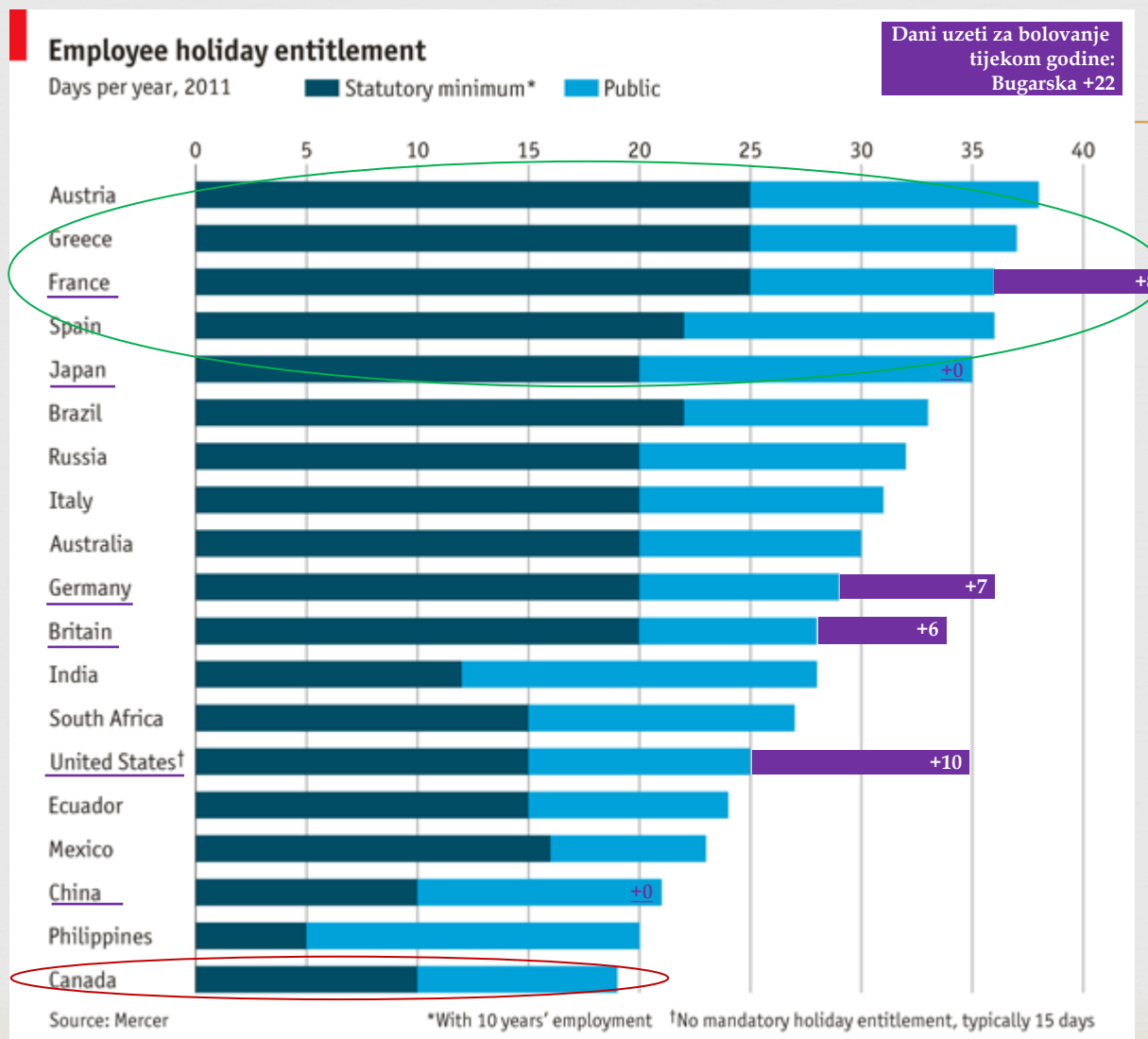
*Provisional †Insured loss unavailable ‡Soviet Union's estimated GDP

Korupcija i razvoj

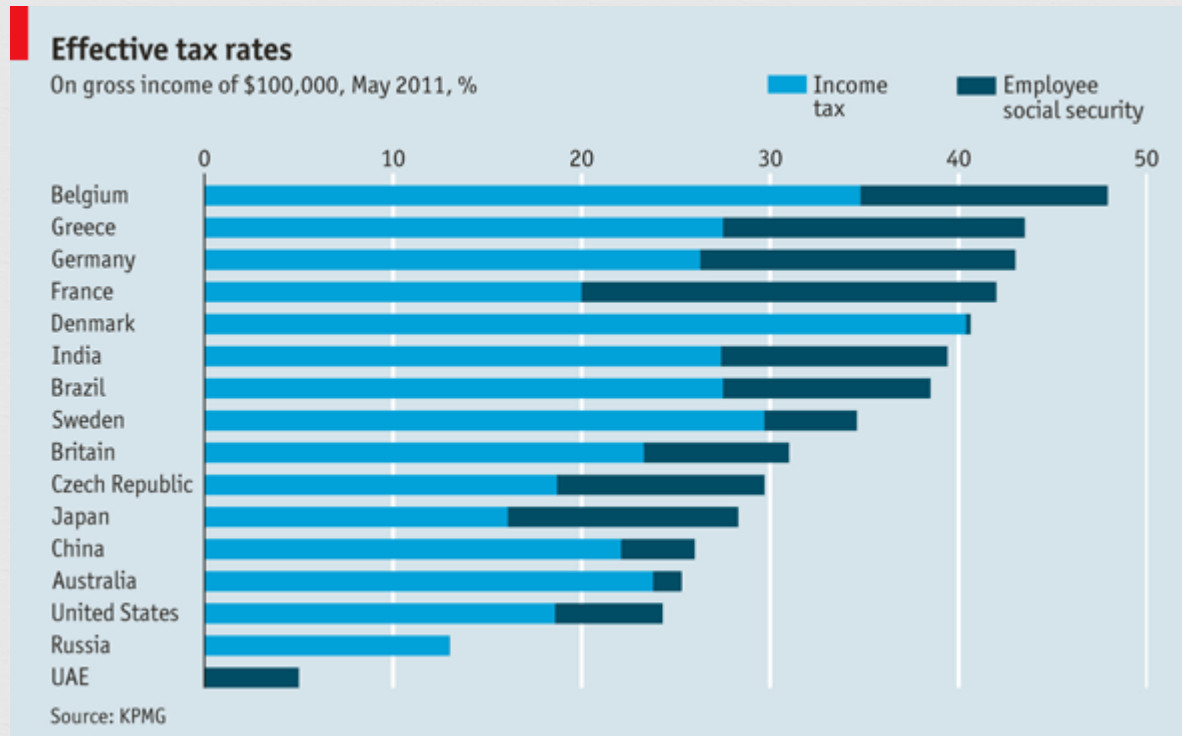


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Slobodni dani



Porezi



www.economist.com/blogs/graphicdetail

Poticanje produktivnosti



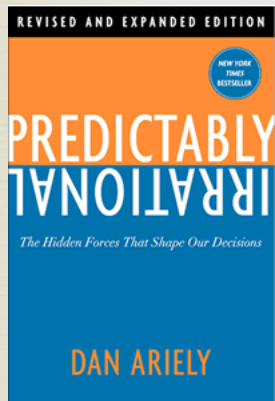
- ❧ Istraživanja (MIT, London School of Economics) pokazuju da pretjerano financijsko poticanje smanjuje produktivnost za složene vrste poslova
- ❧ Izloženost (javnosti) također smanjuje produktivnost
- ❧ Produktivnost najviše povećavaju:
 - ❧ izazov, svladavanje vještina i davanje doprinosa
- ❧ Sve ove čvrste spoznaje ne smetaju velike tvrtke da čine upravo suprotno
- ❧ Problem ne prihvaćanja ovih spoznaja postoji u cijelom društvu
 - ❧ Obrazovanje i istraživanje



Dan Ariely



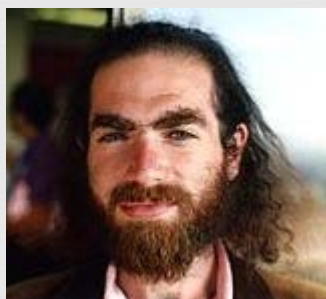
- ❧ Bavi se biheviorističkom ekonomijom
- ❧ Predvidivo iracionalni
- ❧ Pretpostavka o racionalnosti naših odluke je pogubna u svakodnevnom životu i tako pogotovo u ekonomiji
- ❧ Eksperiment s poticanjem za svladavanje niza složenijih zadataka
- ❧ Relativno novo područje s puno iznenađenja



Poticanje produktivnosti



Grigori Y.
Perelman



☞ Dokazao
Poincaréov teorem

☞ Odbio brojne nagrade
(EMS, Millenium i
Fields Medal)

Selected international prizes

	Awarded for	Value
X Prize/Challenge*	Privately funded advances in space flight, lunar robotics, genomics, car fuel efficiency and oil-spill clean-up	\$1m-\$30m
Ibrahim prize	Good governance of an African country	\$5m over ten years then \$200,000 per year
Heritage health prize*	Better predictions of which patients will be admitted to hospital in the next year	\$230,000-\$3m
NASA Centennial Challenge prize*	Aeroplane fuel efficiency, solar technology, satellite technology, robotics, and others	Up to \$2m
Templeton prize	Contribution to affirming the spiritual dimension of life	£1m (\$1.6 m)
Advanced Market Commitment*	Low-priced vaccines for pneumococcal disease in developing world	\$1.5m
Hilton humanitarian prize	Alleviation of human suffering (given to a charity or non-governmental organisation)	\$1.5m
Nobel prize	Economics, literature, physics, chemistry, medicine and peace	SKr10m (\$1.5m)
Abel prize	Outstanding achievements in mathematics	NKr6m (\$1.1m)
Netflix prize*	Improvements on algorithms for online recommendations	\$1m
Shaw prize	Astronomy, life science and medicine, and mathematics	\$1m
Planeta prize	Spanish-language novel	€601,000 (\$822,000)
Wolfson economics prize*	How to manage the orderly exit of one or more member states from the European Monetary Union	£250,000 (\$390,000)
Goldman prize	Environmental work (six awards)	\$150,000 each
Loebner prize	First computer to mimic human interaction	\$100,000 and gold medal
Man Booker prize†	English-language novel	£60,000 (\$94,000)

Source: *The Economist*

*Incentive prizes †For citizens of Commonwealth countries, Ireland or Zimbabwe

Kako donosimo odluke?



Brojna istraživanja u biheviorističkoj ekonomiji, psihologiji i sociologiju ukazuju na to da mehanizmi donošenja nisu uvijek određeni racionalnim i da je to određeno našom prirodom.

Korist i odabir



- ❧ Svaki odabir se temelji na određivanju vrijednosti
 - ❧ Ocjena vrijednosti nije uvijek laka i u pravilu je subjektivna (referentno stanje)
 - ❧ Ulog je bolje određen, ali ne uvijek dovoljno (vrijeme)
- ❧ Odlučivanje je dodatno nepouzđano kod
 - ❧ Nedostatka vremena
 - ❧ Osjećaja važnosti
- ❧ Značajan utjecaj na naše odlučivanje imaju naoko posve nebitne okolnosti u kojima se nalazimo



Daniel Kahneman



- ∞ Nobelova nagrada za ekonomiju 2002.
 - ∞ Za rad na prospekt teoriji sa Amosom Tverskym
 - ∞ Bihevioristička ekonomija
- ∞ Naše odluke su određene stanjem, ali i tzv. uokvirivanjem situacije
- ∞ Hedonistička psihologija ili ono što čini doživljaj života ugodnim ili ne
 - ∞ Različit doživljaj 'sada' i u sjećanju (memoriji)
 - ∞ Naše sjećanje je nesavršeno, ali i predvidivo

Predvidivo iracionalni



Uokvirivanja

Npr. prijeti bolest od koje se očekuje da će stradati 600 ljudi. Dvije su alternative za prevenciju, ali i dva načina prezentiranja (kao A ili B i C ili D):

1. A: „200 ljudi će biti spašeno.”

72% odabire A

B: „Postoji 1/3 vjerojatnosti da se spasi svih 600 ljudi i 2/3 da neće nitko biti spašen.”

2. C: „400 ljudi će umrijeti.”

D: „Postoji 1/3 vjerojatnosti da nitko neće umrijeti i 2/3 da će svih 600 umrijeti.”

78% odabire D

Predvidivo iracionalni



Teorije

☞ Kognitivne

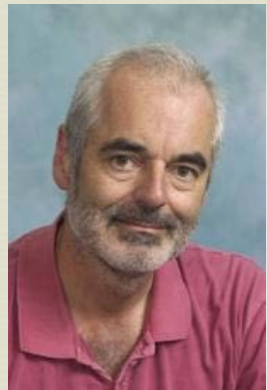
- ☞ *Fuzzy trace* na temelju iznosa kognitivnih procesa posvećenih za određivanje gubitaka i dobitaka
- ☞ Kompromis cijene i koristi odnosno između želja, tako da se donese ispravna odluka uz minimalni kognitivni napor

☞ Prospekt

- ☞ Preferencije razlikovanja doživljenih vrijednosti, uz pretpostavku da gubici imaju veću težinu od dobitaka

☞ Motivacijska

- ☞ Hedonističke sile straha i želja te povezanih emocija i veće težine negativnih osjećaja



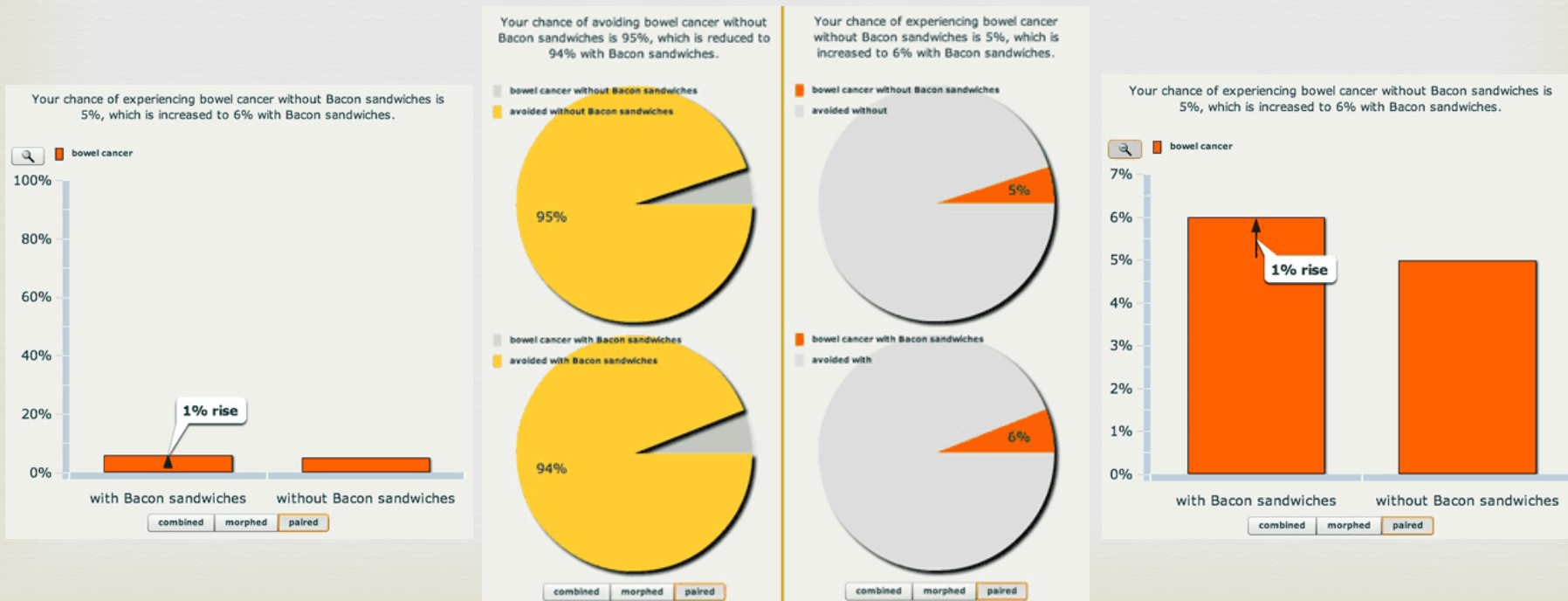
Razumijevanje neodređenosti



David Spiegelhalter, Cambridge

Winton professor of the Public Understanding of Risk

understandinguncertainty.org

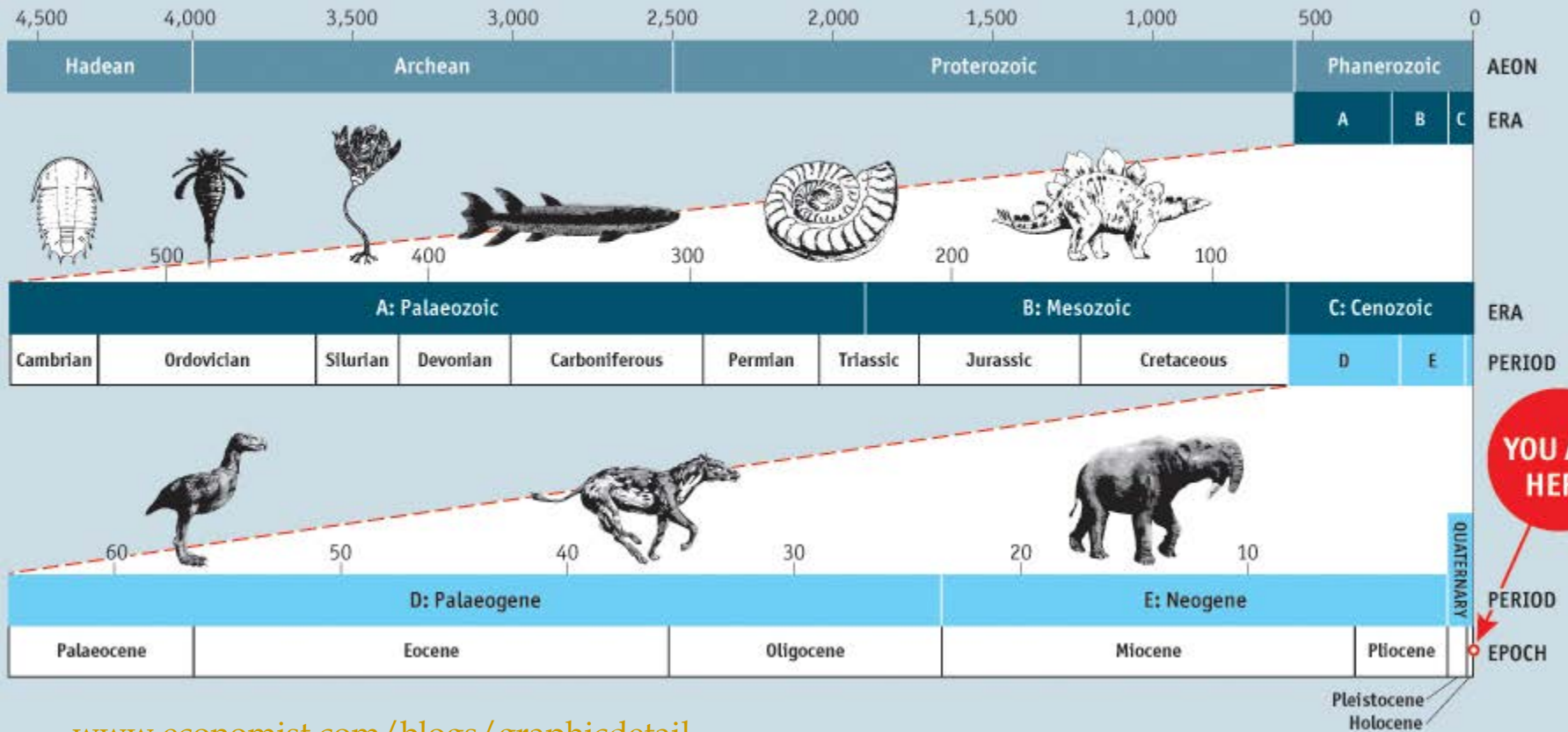


Antropocen

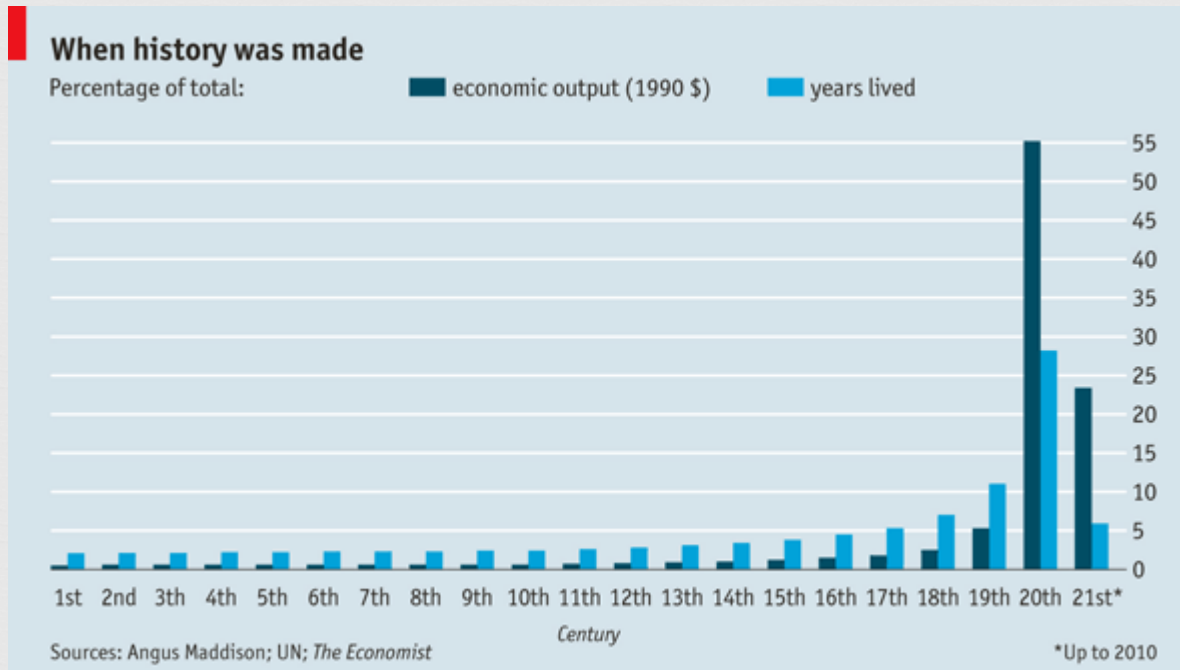


A geological timeline of the Earth

MILLIONS OF YEARS AGO

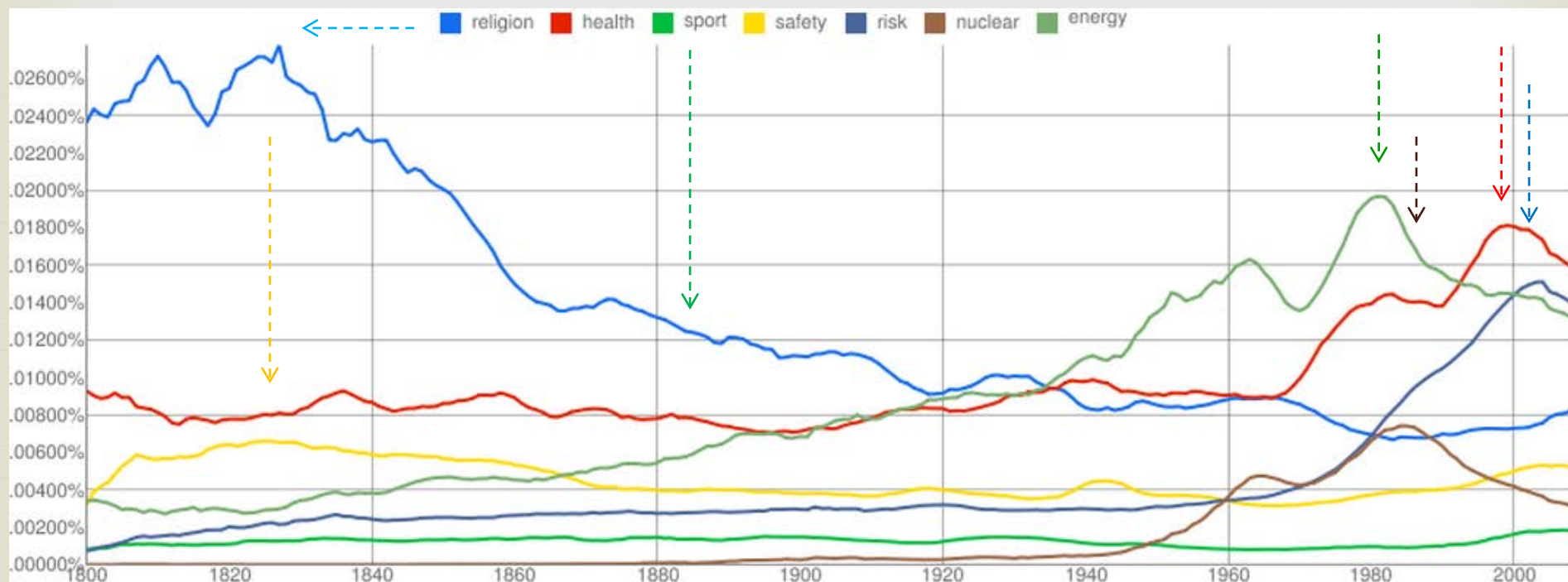


Eksponencijalni rast



www.economist.com/blogs/graphicdetail

Riječi u knjigama



[books.google.com/ngrams/graph?content = religion, health, sport, safety, risk, nuclear, energy](https://books.google.com/ngrams/graph?content=religion,health,sport,safety,risk,nuclear,energy)

Čemu težimo?

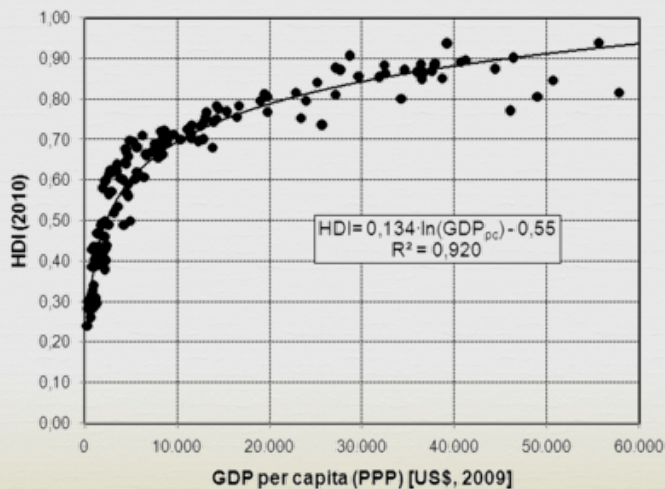
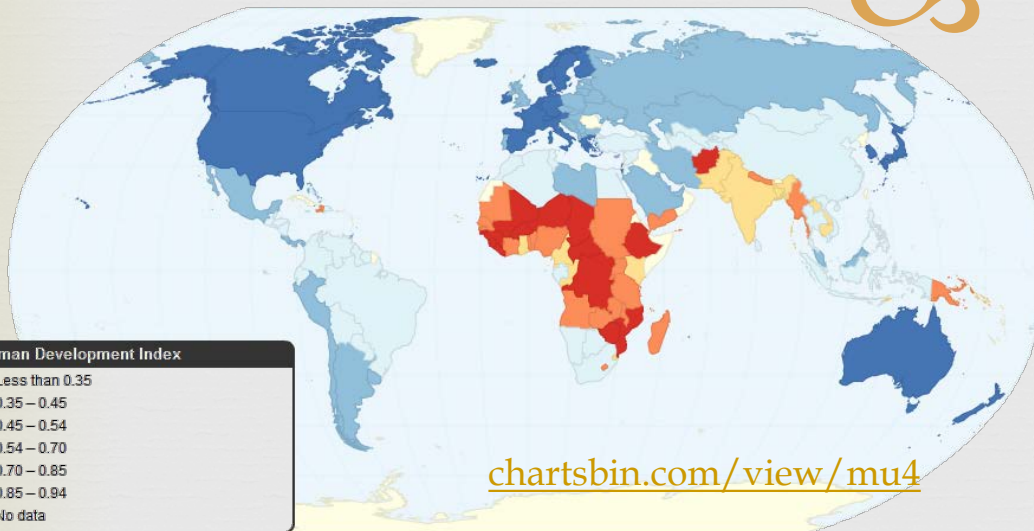


Racionalno težnja je poboljšati uvjete života (standard) i smanjiti stradanja. Nepobitno za to je potrebno ostvariti ekonomski razvoj. Ovo je pogotovo važno u borbi protiv svih rizika od siromaštva. Negativne posljedice su neizbježne, ali zanemarive u odnosu na pozitivne i mogu se smanjivati.
Dostupnost energije nužna je za razvoj.

Razvoj

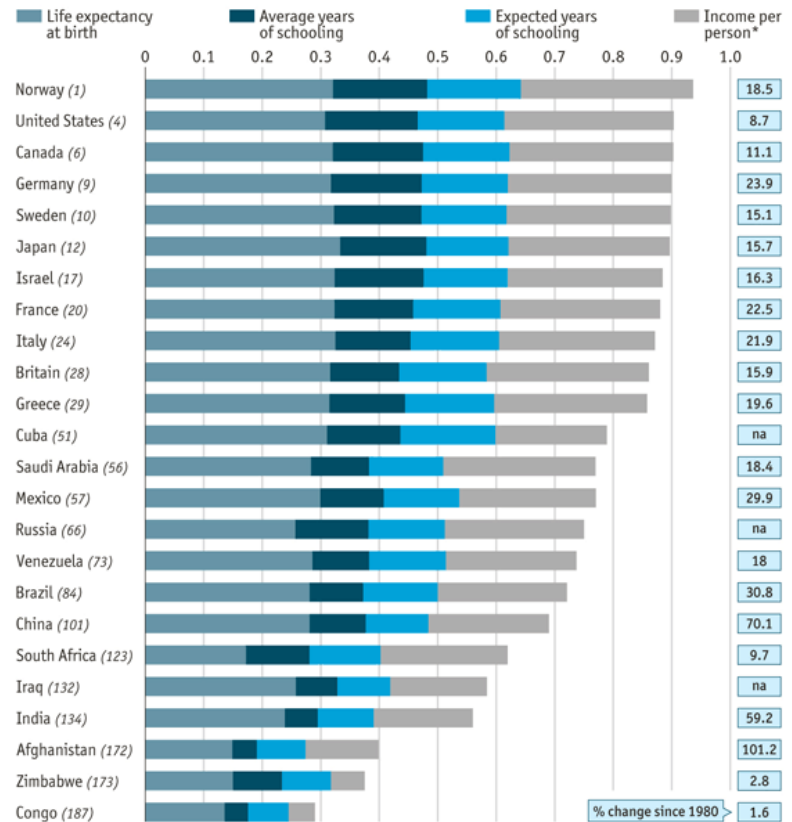


Human Development Index (HDI)



Human Development Index

1=best (rank out of 187)



Source: UN Human Development Report

*Gross national income

www.economist.com/blogs/graphicdetail

Zadovoljstvo i GDP



Life satisfaction and GDP per person at PPP*

Circle size is proportional to population size

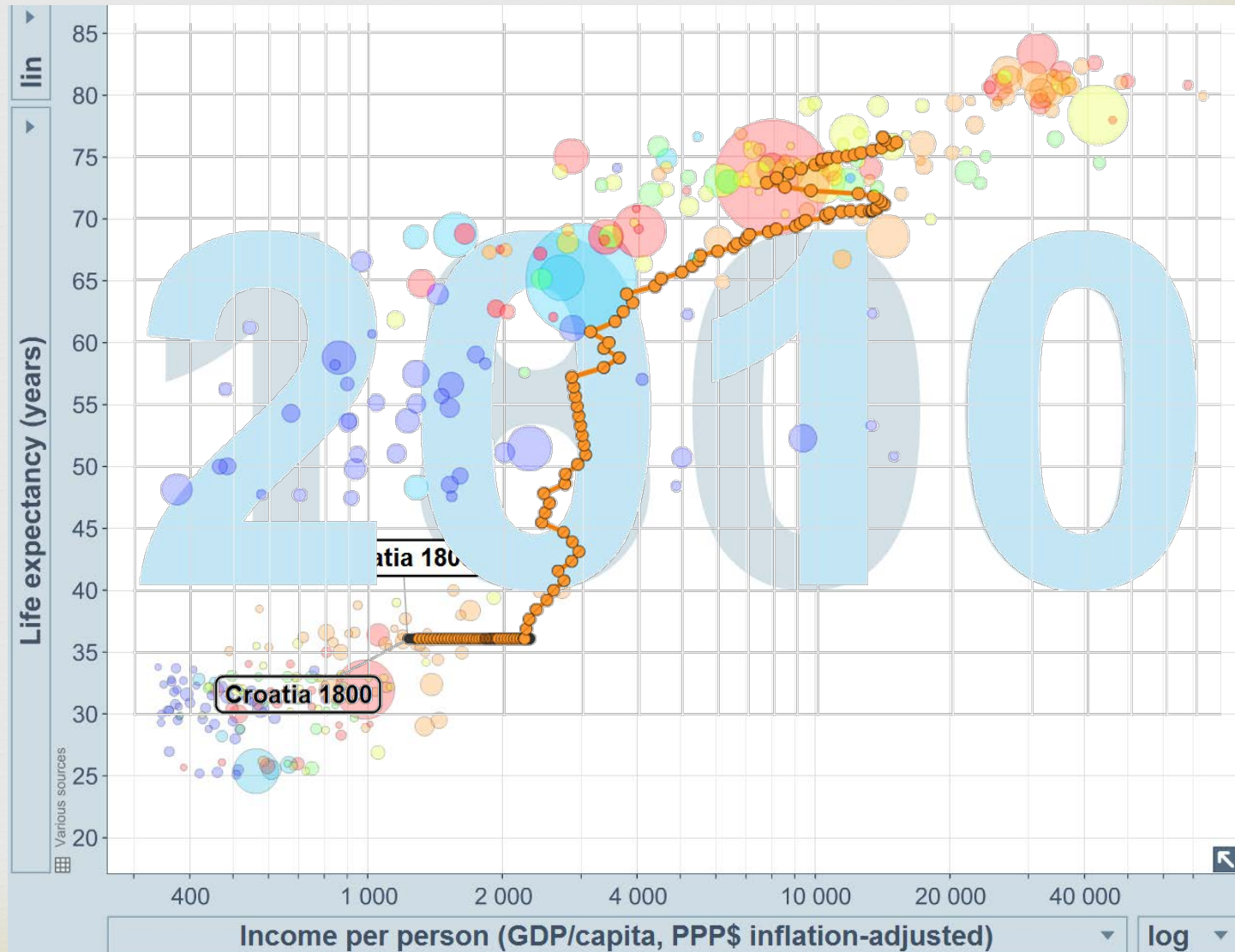


Sources: Penn World Table 6.2; Gallup World Poll, Angus Deaton

Život i razvoj: LE-GDP from 1800 to 2010

Hans Rosling
o 200 zemalja i
200 godina:
*The Joy of
Stats, BBC
Four*

www.gapminder.org



HVALA NA PAŽNJI!

RIZIK I RAZUMIJEVANJE (JAVNOSTI)



Zdenko Šimić

HND i IEEE, Zagreb, 22. prosinca 2011.



Nuklearni akcidenti

Rating nuclear danger

Selected events, INES* scale, 7=maximum

Level	Place	Year	Incident
7	Chernobyl, Ukraine	1986	An explosion and a fire in the reactor core at the Chernobyl nuclear power plant sent a radioactive plume across large swathes of Europe. Chernobyl remains easily the worst nuclear accident in history
7	Fukushima, Japan	2011	Following an earthquake and a tsunami, a series of partial core meltdowns and a fire in a fuel pond at the Japanese Fukushima Dai-ichi plant caused fluctuating releases of radiation into the sea and the surrounding countryside
6	Kyshtym, Russia	1957	A failed cooling system caused an explosion that destroyed a tank containing 70-80 tonnes of liquid radioactive waste at a waste-reprocessing plant. Current best estimates suggest that more than 10,000 people received significant doses of radiation
5	Windscale, Britain	1957	The core of a reactor at Windscale in Cumbria (now called Sellafield) caught fire; the plume of smoke deposited radiation across the surrounding countryside and parts of Europe
5	Three Mile Island, United States	1979	A stuck valve led to a partial core meltdown at a Pennsylvania nuclear power plant. Despite the severity of the accident, comparatively little radiation was released
5	Goiania, Brazil	1987	Thieves stole a canister of highly radioactive caesium chloride used in nuclear medicine from an abandoned hospital. It ended up in a scrapyard, exposing many people to high doses. Four subsequently died from radiation sickness
4	Tokaimura, Japan	1999	Nuclear workers were preparing a batch of fuel for an experimental reactor. Fuel stored in a tank accidentally reached "critical mass", began undergoing nuclear reactions and emitted enough radiation to kill two workers
3	Sellafield, Britain	2005	Over 20 tonnes of nuclear fuel, dissolved in nitric acid, leaked from a pipe at a nuclear reprocessing plant, on the same site as the 1957 Windscale fire. None made it out into the wider environment
2	Forsmark, Sweden	2006	A reactor was shut down following an electrical fault. Two of four back-up diesel generators, designed to power the cooling systems in an emergency, failed to start properly
1	Gravelines, France	2009	A bundle of nuclear fuel got stuck during an operation to replace fuel in the core of a reactor. The reactor building was evacuated, but no radiation was released

Sources: IAEA; *The Economist*

*International Nuclear and Radiological Event Scale

Havarija u NE Fukushima-Daichi



- **Zemljotres 14:46 11. ožujka 2011. magnitude 9.0 M_w na 24km dubine**
- **Tsunami visine 14m**
- **Bez tsunamija ne bi bilo havarije**
- **Preko 28,000 ljudi umrlo i nestalo**



1% čini razliku

Prof. Ian Ayers, Yale

Aaron S. Edlin, Berkeley

*Don't Tax the Rich. Tax
Inequality Itself*, NYT
18.12.2011

1980. 1% najbogatijih
>9% prihoda prije
poreza, 2006. to je skoro
19% i raste!

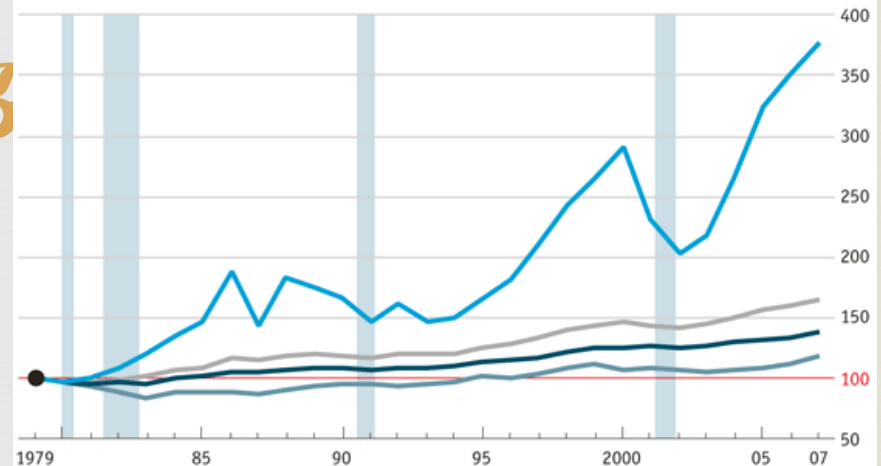
Tzv. Brandeis omjer je
porastao od 12x na 36x

US real average after-tax income

1979=100

Recessions

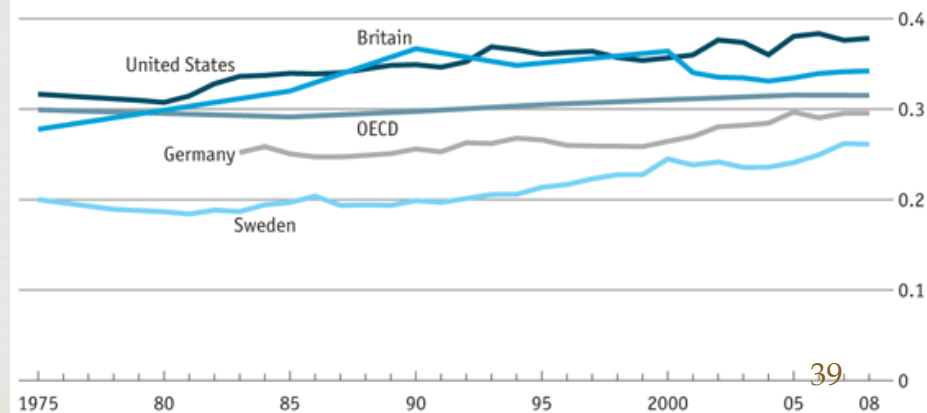
Top 1 percent
81st to 99th percentiles
21st to 80th percentiles
Lowest quintile



Source: Congressional Budget Office

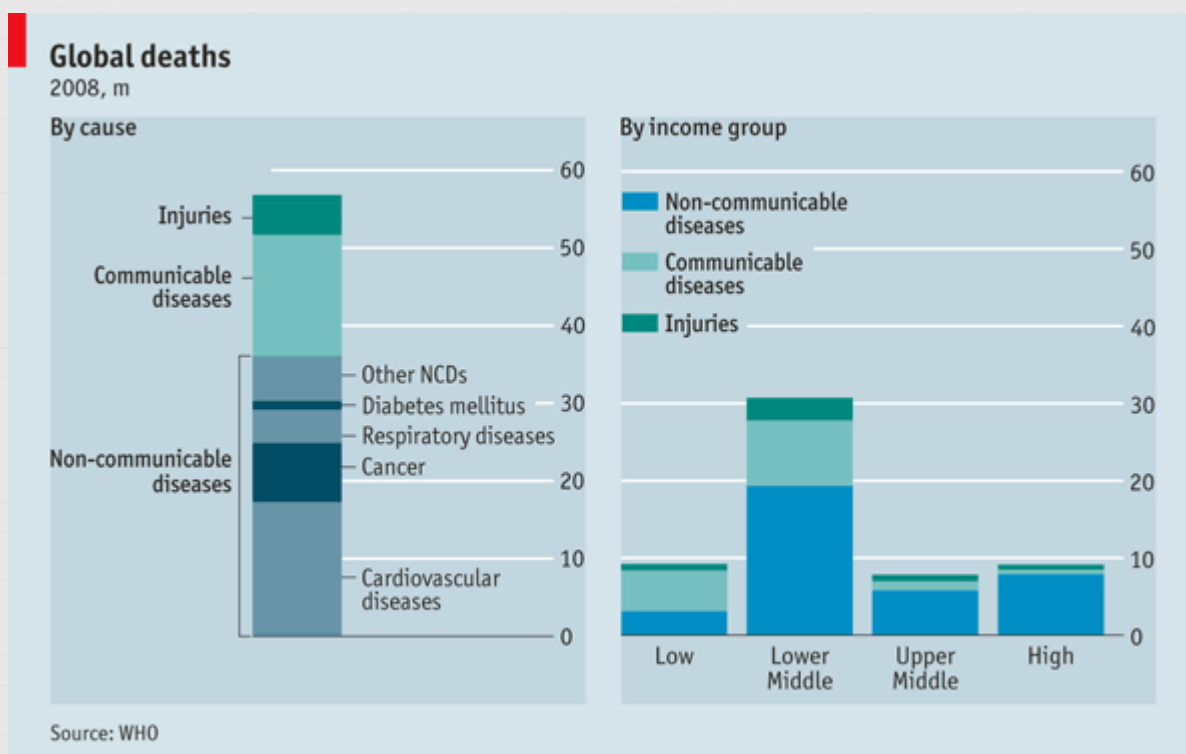
Income inequality

Gini coefficient, 1=perfect inequality



Source: OECD

Globalni uzroci smrti

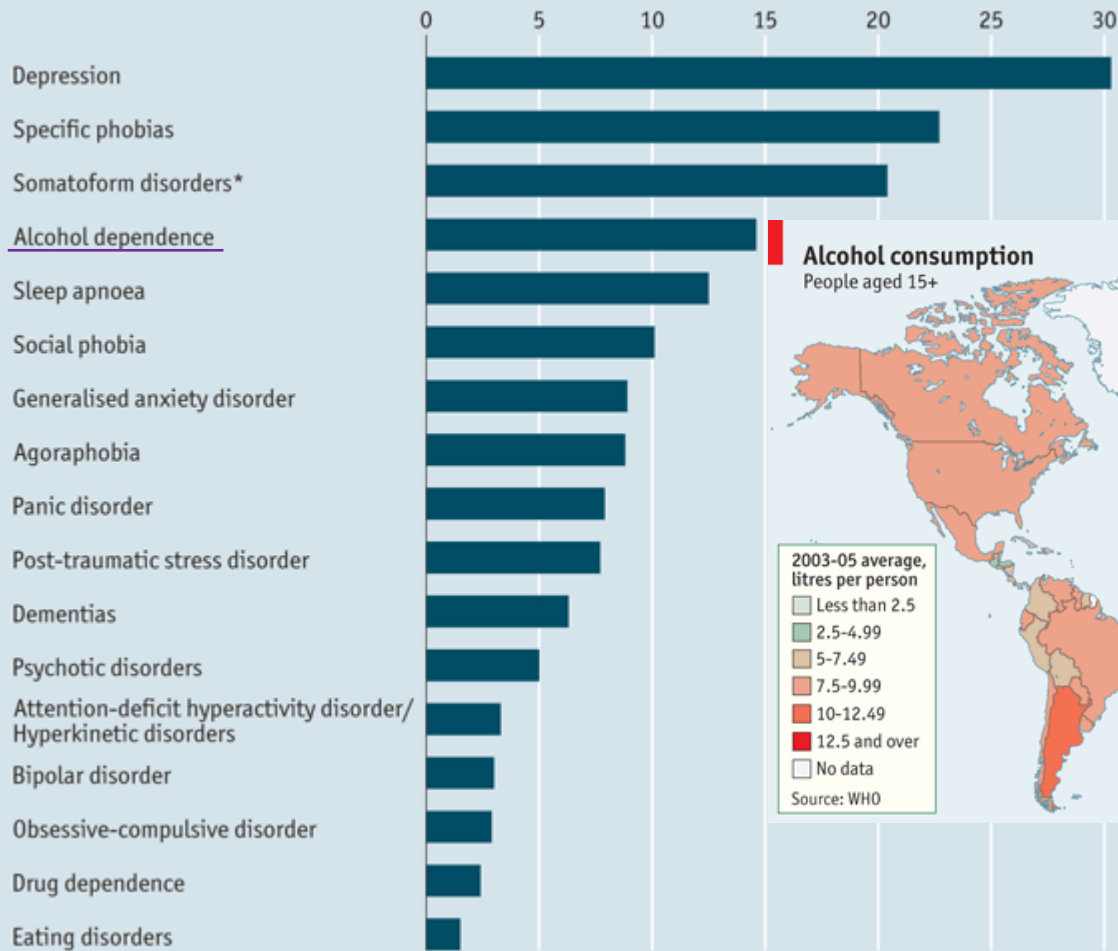


www.economist.com/blogs/graphicdetail

Mentalni poremećaji

Number of Europeans affected by selected mental disorders

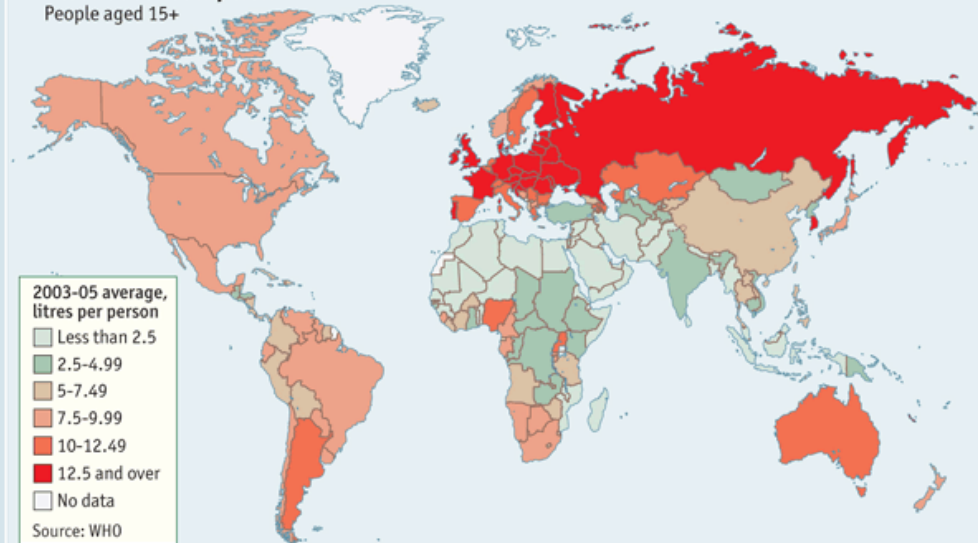
12-month prevalence, latest available year, m



Europe

Alcohol consumption

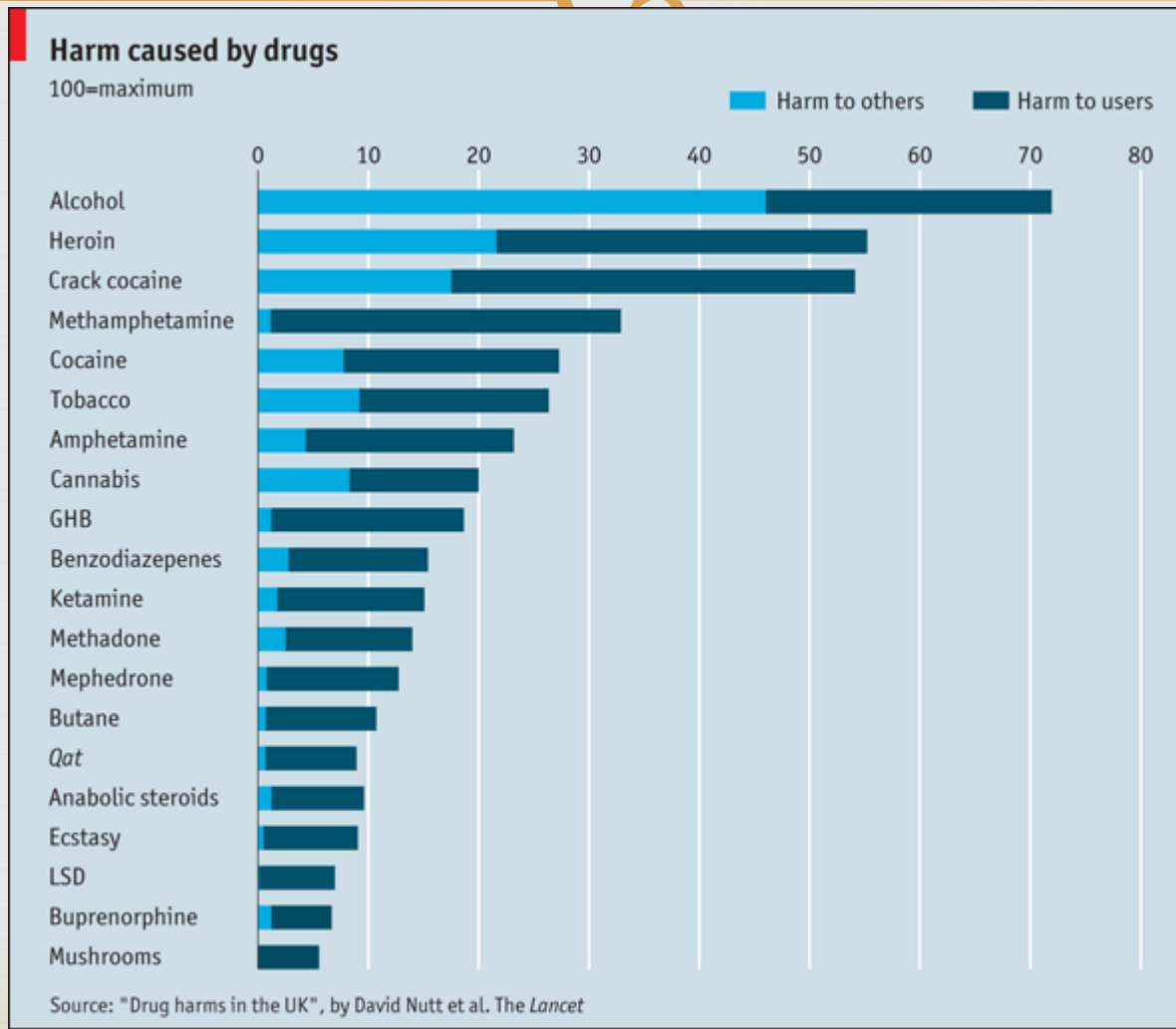
People aged 15+



Source: "The size and burden of mental health disorders and other disorders of the brain in Europe 2010" by Wittchen et al, *European Neuropsychopharmacology* 2011

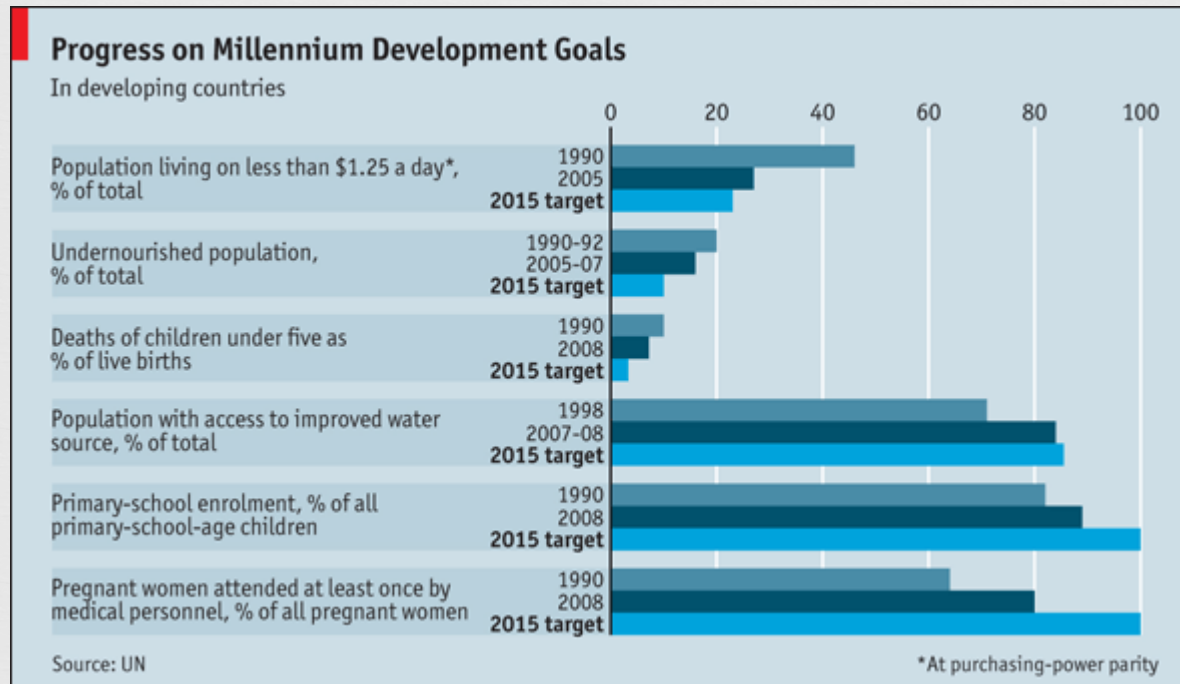
*Hypochondriasis, persistent pain disorder and somatisation disorder

Štetnost ovisnosti



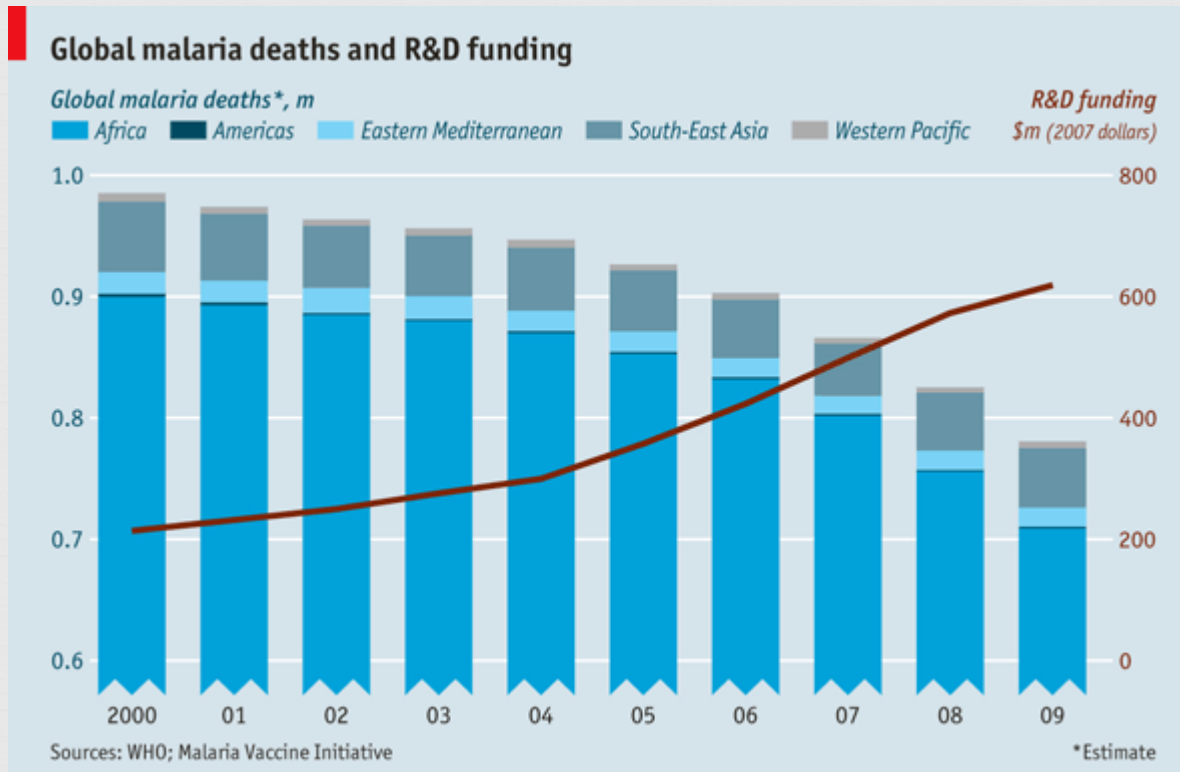
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Milenijski ciljevi



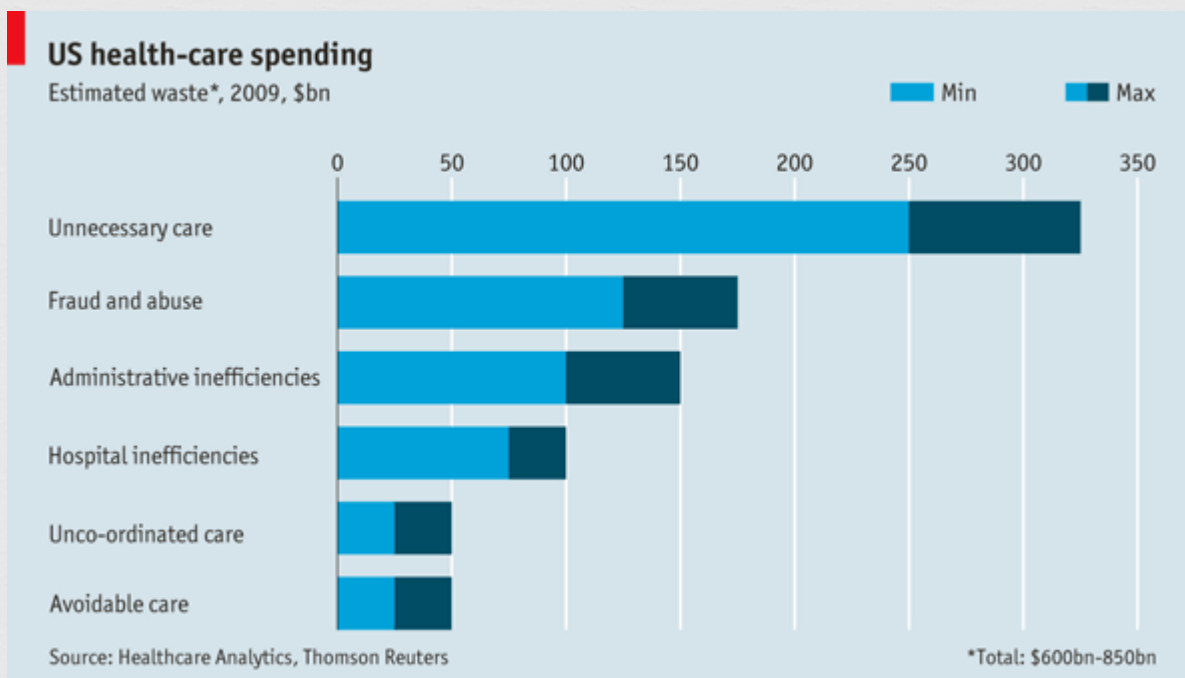
www.economist.com/blogs/graphicdetail

Malaria i R&D



www.economist.com/blogs/graphicdetail

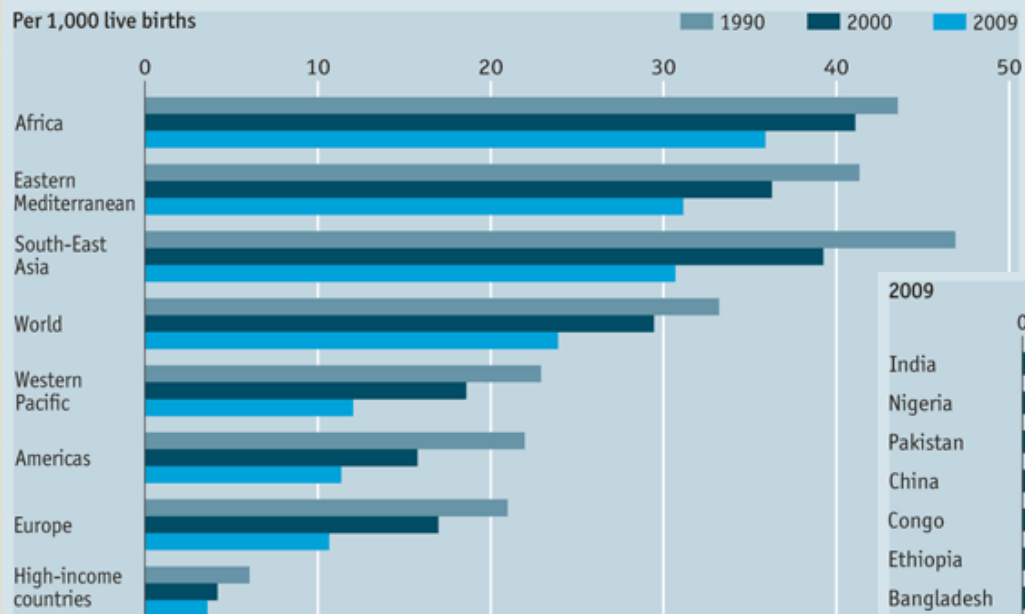
Zdravstveni \$ u SAD-u



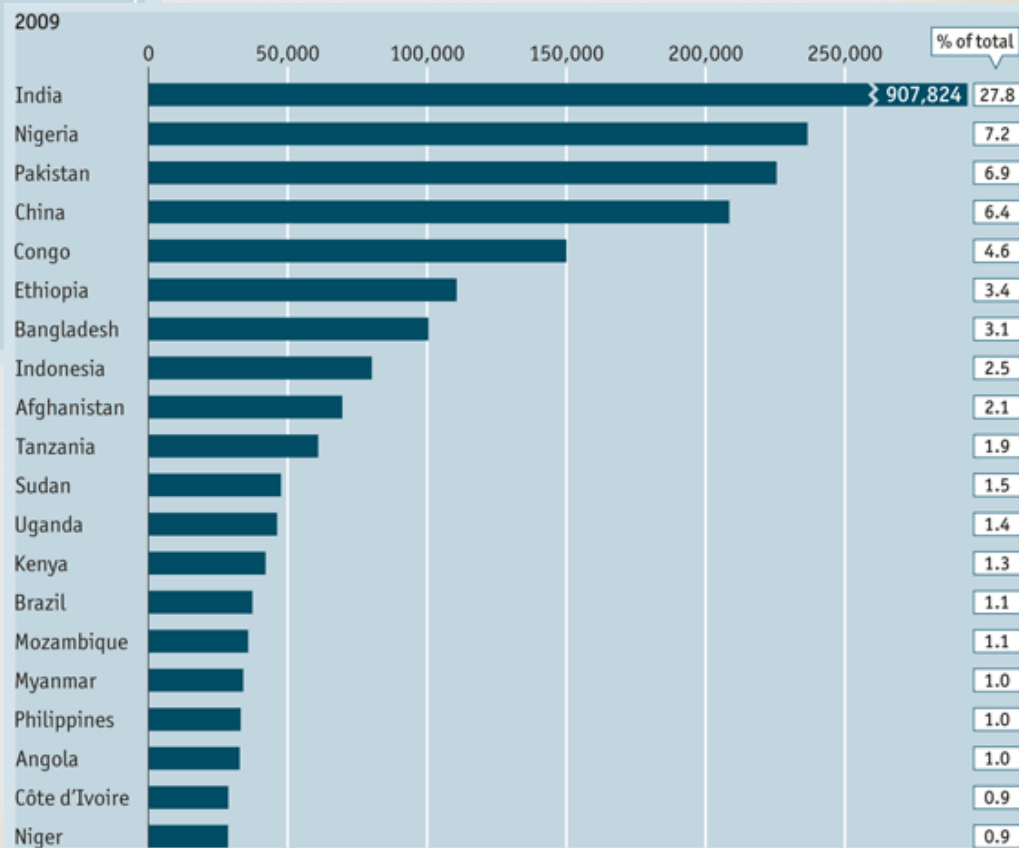
www.economist.com/blogs/graphicdetail

Bebe na planetu Zemlja

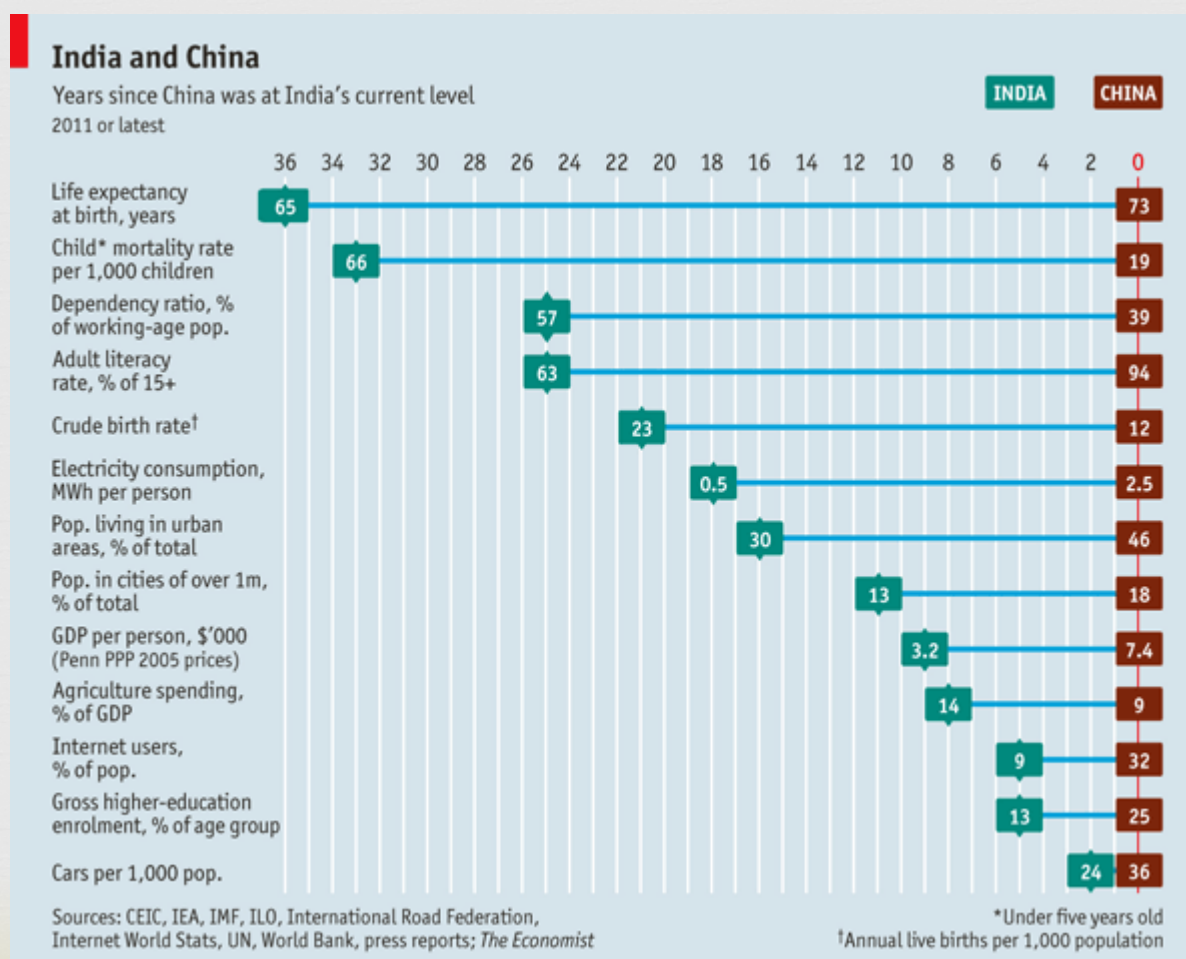
Deaths of babies under 28-days old



3.300.000 umrlo u 2009.



Razvoj: Indija i Kina



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Pretilost i vožnja

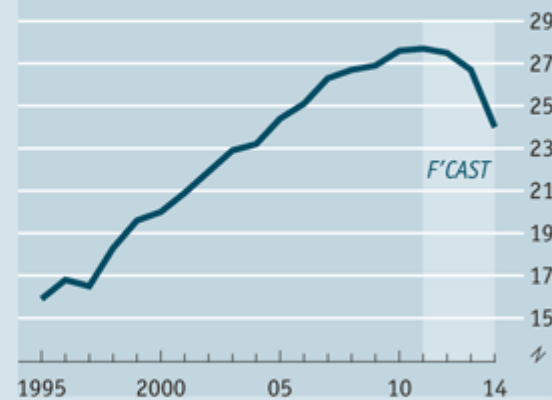


Obesity and driving in America

Correlation, lagged by six years

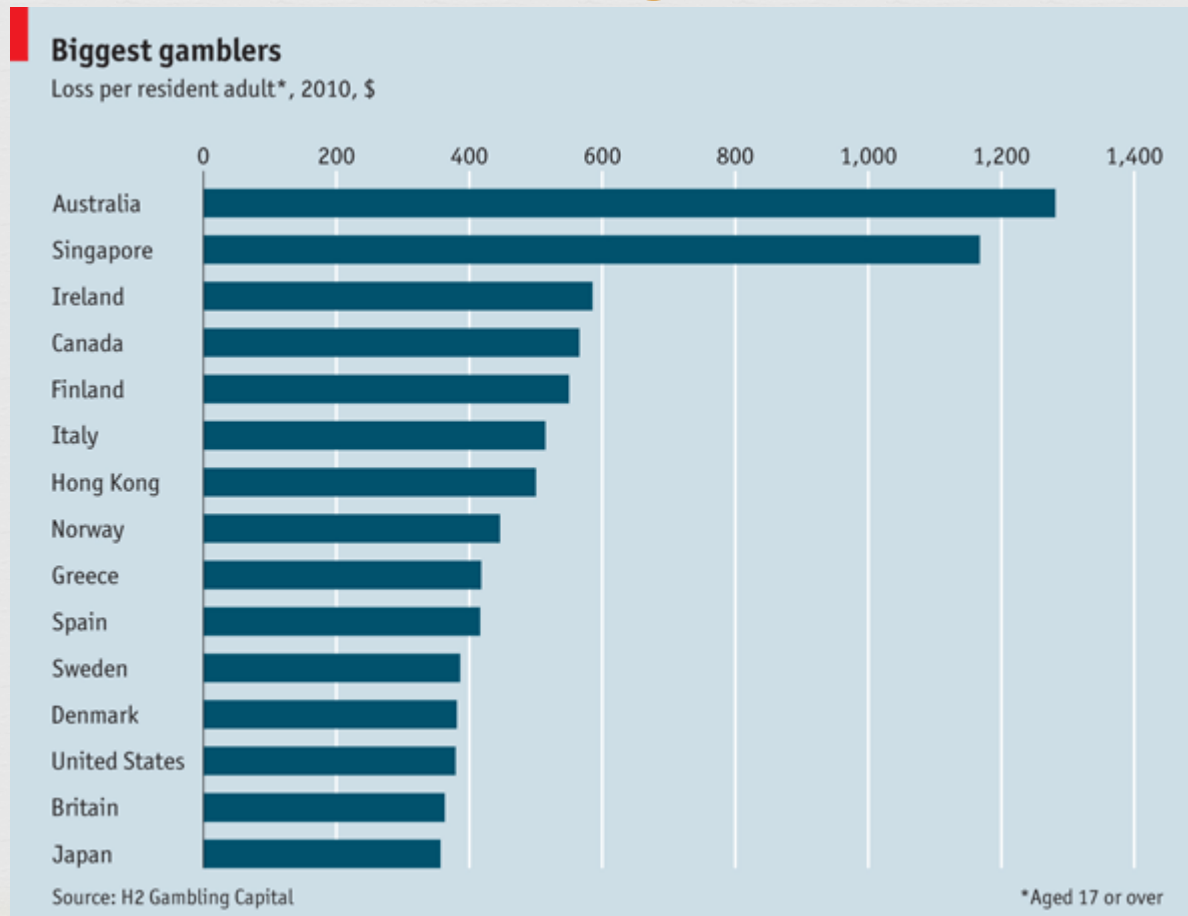


Obesity rate, % of adult population



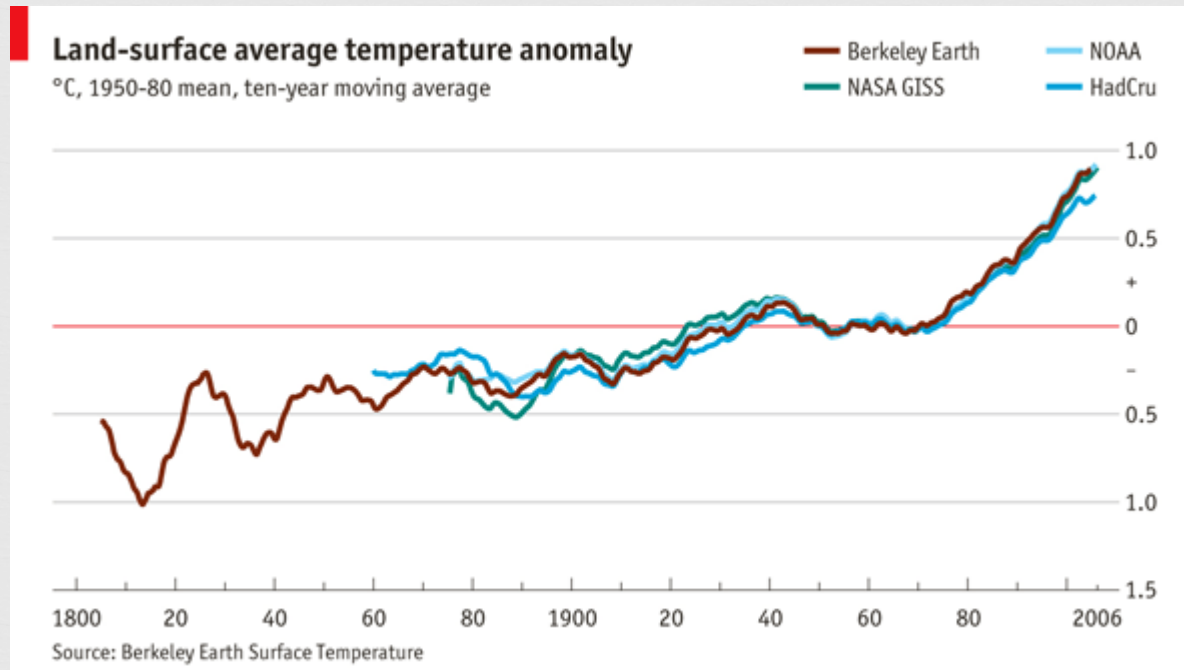
Sources: "A note on the relationship between obesity and driving" by Sheldon Jacobson *et al*, *Transport Policy*, 2011; Bureau of Transport Statistics; Centres for Disease Control and Prevention; Department of Transport

Kockari



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Prosječna temperatura



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