Rare events in social dynamics The alphabet model

Andrzej Nowak
In collaboration with
Sorin Solomon
Gur Yaari
Kamil Rakoczy

The crucial role of rare events



Jerusalem, summer school

Central tendency

- In social sciences prediction is based on measures of central tendency and dispersion
 - Mean
 - Variance or standard deviation
- Experiments provide the ultimate method for verifying theories
- This does not alow us to predict in longer time spans in reality

The power of rare events

- In reality, everything that is important is a consequence of a rare event
- If you want to predict in the real world forget the average
- Not only rare events are most consequential, but the more rare the event the more important consequences it may have
- Stock markets are defined by bubbles and crashes
- The role of catastrophes in social dynamics; wars, inventions, etc
- Social sciences do not have tools to deal with rare events

Phil Anderson

"Real world is controlled ...

- -by the *exceptional*, not the mean;
- -by the *catastrophe*, not the steady drip;
- by the very rich, not the 'middle class' we need to free ourselves from 'average' thinking."

The favorite citation of Sorin Solomon

Life is more than a lab

- One rarely can observe a rare event in a lab, if one does, it is discarded
- In the real world rare events are happening all the time
- Our lifes are defined by rare events
 - How did you meet your husband or wife?
 - How did you find your job?
 - What is the probablity that you inherited exactly your combination of genes?

Rare events: Highly improbable events are highly consequential

- Taleb: The "black swan" effect the tails of the distribution are most important
 - If we took a single day of the fastest growth out of the stock market dynamics, the stock market value would drop by half
- Linear extrapolation fails
 - the case of a chicken
- Important rare events can be detected only after the fact, by their consequences

Beyond undpredictabilty

- Rare events happen all the time
- Only some rare events are consequential
- The "alphabet model" (Nowak & Solomon 2006) provides a formalism for understanding the role of rare events

Strong rare events

- Catastrophic changes: strong events with high consequences
 - Wars
 - Big politial changes: The collapse of Soviet block
 - Stock market crashes
 - Industrial catastrophes
 - Changes of technology (Internet)
 - Fusions and take overs of firms
 - Epidemics
 - Natural disasters
- When we see it, it is immediately apparent that we are dealing with a rare event
- They often result form positive feedback loops

Weak rare events

- Lech Wałęsa jumps the fence of Gdańsk shipyard
 - No one would predict that this would lead to the fall of communism
- Portugal
 - Luís Vaz de Camões (1524?-1580)
 - Os Lusíadas ("The Lusiads")
- Polish poets
 - Adam Mickiewicz, Juliusz Słowacki, Kamil Norwid and the re-creation of Poland

Polish mathematicians met in "Szkocka" cofeeshop

- Functional analysis
 - Stefan Banach
 - Hugo Steinhaus
 - Stanisław Ulam
 - Stanisław Mazur
 - Stanisław Saks
 - Władysław Orlicz
 - Leon Chwistek

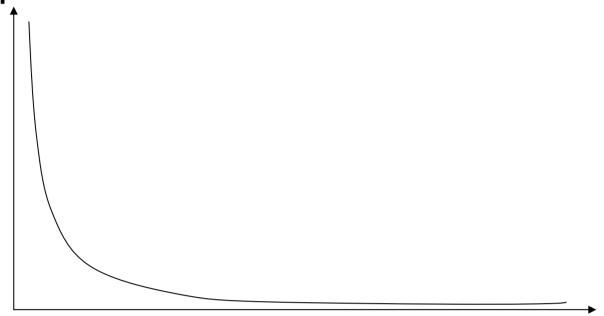
Impressionism

- Meeting of several individuals who agreed to paint light was more consequential that all the artist's schools
- Gates and DOS operating systems
- WWW

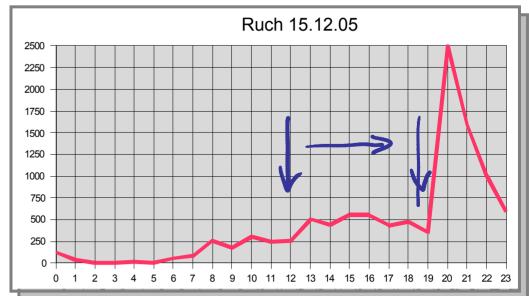
The power law and scale free distribution

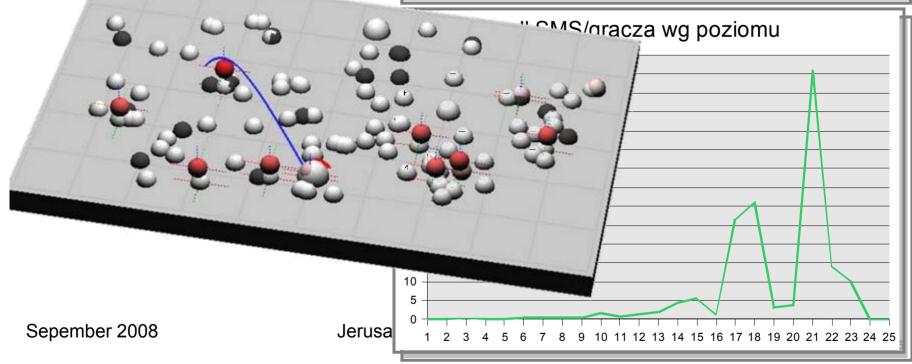
The power of the extreme end of the distribution

Poisson distrubution and the autocatalitic process



Community Management





Rare individuals: Social entreprenpurs

- Individuals can cause social change visible on a macro level
- Ashoka 1 in 10000000 (ten milion)

Valley of Strug, county Chmielnike Vovidship. podkarpackie

- In the 80th and early 90th:
- Izolated poor farms;
- Negative attotudes toward cooperation
- Very bad education system
- High and growing alcoholism

Prepared by R. Praszkier



Kazimierz Jaworski

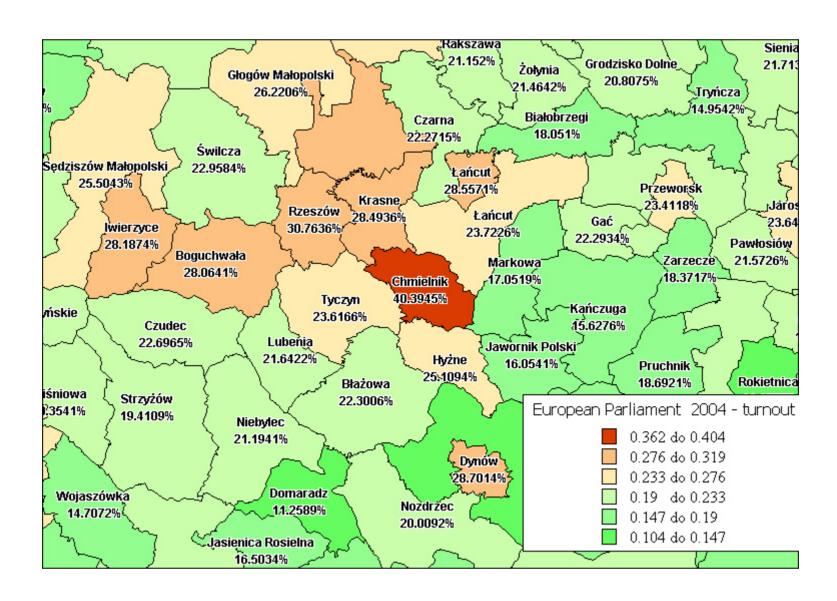
Gmina Chmielnik

First independent telephone system in Poland

8500 households connected

Free local calls

- Telekardiomat, Internet broadband access
- Sewage treatment
- Mineral water
- Direct sales of farmers products 100 trucks, 500 employees, 100.000 customers
- Information technology in schools
- Dance lessons for boys
- In 10 years the number of enterprises grew from 200 To 900
- Percent of vote in EU access referendum 35% mean in the region 169



Other examples from Poland

- Dagmara Bienkowska:
 Zegocin: cookbook
 - Failure of previous attempts of change dissintegration
- Dorota Komornicka: Śnieżnik:
 - very small local funds invested in financing children projects, exhibitions, education

Singular growth centers drive economic growth

- The rare events of local existience of conditions facilitating growth can drive global economic growth
- In processes of exponential growth not only rare events govern the macro dynamics, but in longer time spans the rarest events dominate social dynamics

Local effects in economy

Examples:

- Spatial clustering of innovations
- Spatial clustering of farming practices
- Spatial clustering of industries
- Spatial clustering of rent agreement in farming

The role of data on a forming economy

- It is difficult to understand the dynamics of economy that is well established and relatively stable
- Formation and change provides the ritchest insights into the dynamics of a system
- Political and economic transformations in Eurpe in the 90th prrovide a rich laboratory for understanging the dynamics of economy

The Polish reform

- Balcerowicz plan introduced in 1990 transformed the economic system from ineffective central planning to a free market economy
- Following the doctrine of Jeffrey Sachs, the purpose of the plan was to stimulate steady economic growth by limiting the involvement of the state in the economy, and by turning control over to de-centralized market mechanisms.

Dynamics of the economic transition

- The critical importance of local processes
 - A global model cannot explan the dynamics
- The importance of the social factors in economic processes: education, culture, history, politics
- the liberalization transition follows a 'microscopically' discretized version of the classical logistic dynamics
- this 'microscopic representation' approach allows us to connect complex macroscopic collective trends to their simple local causes.

ALPHABET model (Nowak & Solomon 2006) Complexity view of social change

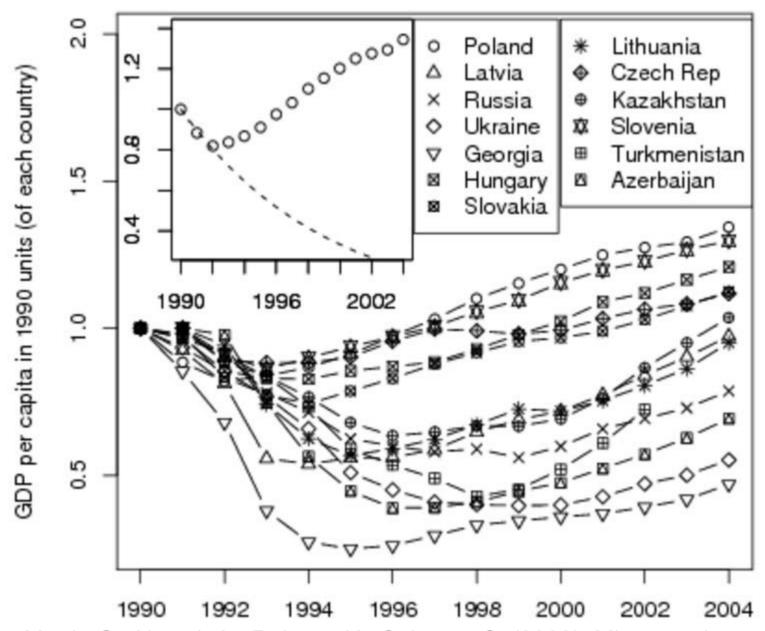
- Dynamical variable "B"
- Collection of letters A,C,D,....Z,
- Some logical combination of letters is needed for B to grow
- The letters can be produced by the process

Properties of the Alphabet model

- New view on the causality in the social sciences
- Possiblity to relate to empircal data and know theoretical effects in the social sciences
- Rare events are the effect of measurable properties (the conjuntion of measurable variables is very small)
- Importance of correlation

"Soft" factors decide abouth the rate of growth

- Education
- East-West orientation
- History
- Social influence

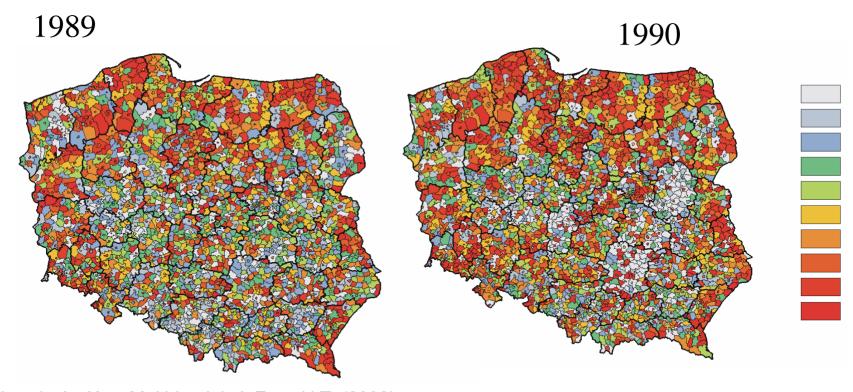


From: Yarri., G., Nowak A., Rakocy, K., Solomon S. (2008) Microscopic Study Reveals the Singular Origins of Growth European Physics Journal B, 62, 4

The evolution of the Polish GDP after the liberalization

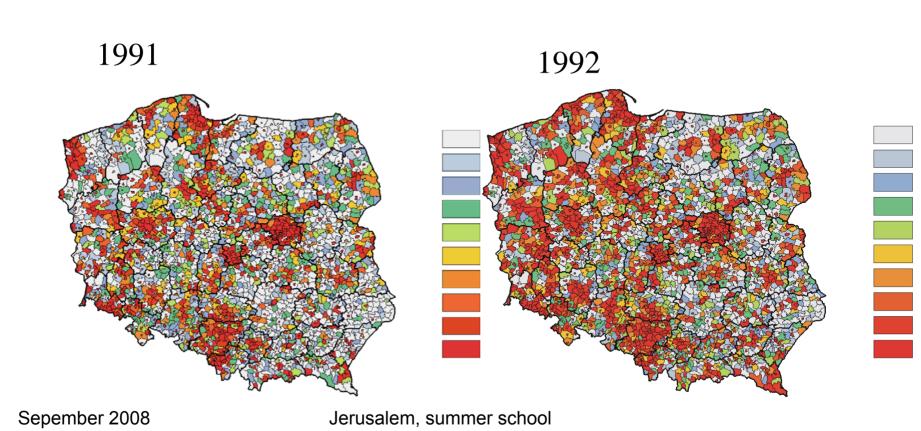
- The first 2 points represent the rather static communist economy (growth rate 0.2 %).
- The next 2 years, after the liberalization reform fit well a decaying logistic curve (the dashed line). The 1400 counties that are decaying overwhelm in the national GDP the speedy development of the singular (16 educated) counties. The effect of the singular growth centers is felt at the national level in the subsequent years (1992-) as their relative economic weight increased

Number of enterprises per capita



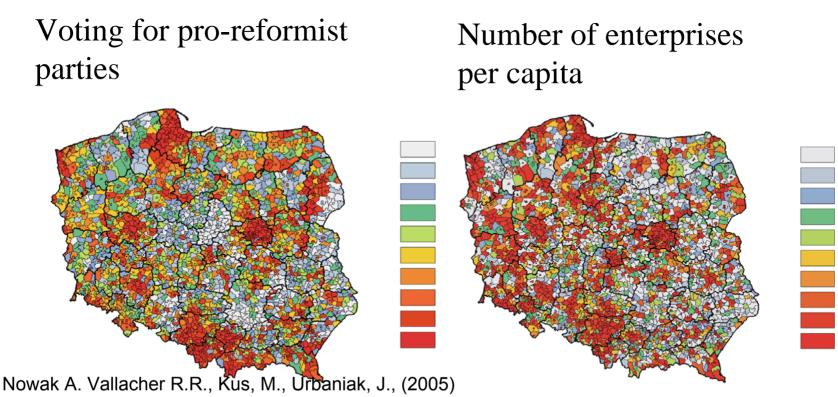
Nowak, A, Kus, M. Urbaniak J, Zarycki T. (2002)
Simulating the coordination of individual economic decisions. Physica A, 297, 613-630
Sepember 2008
Jerusalem, summer school

Number of enterprises per capita

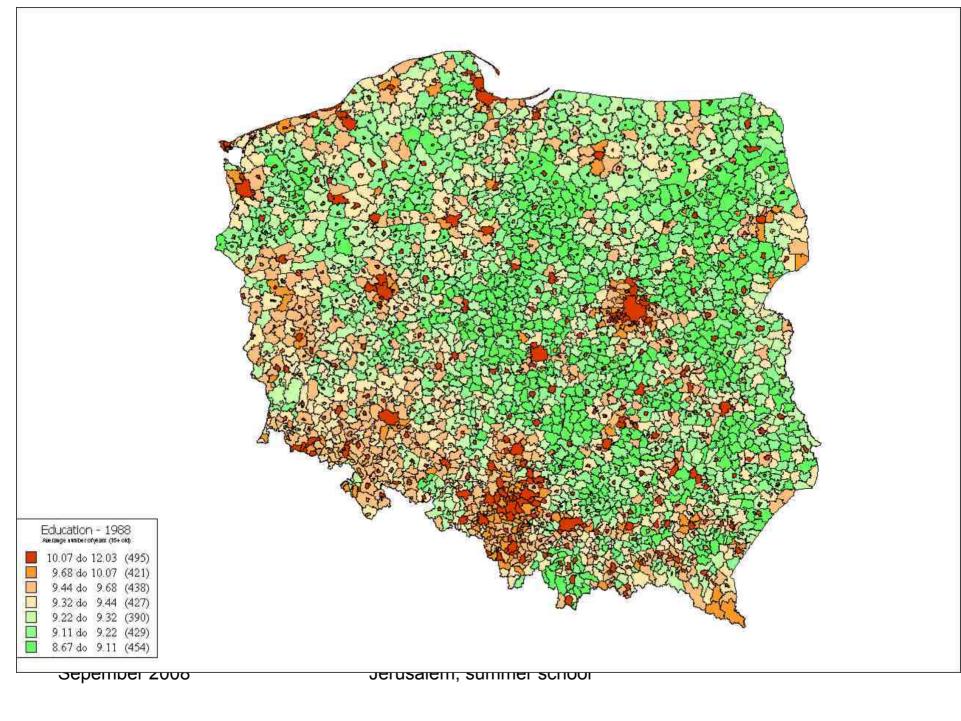


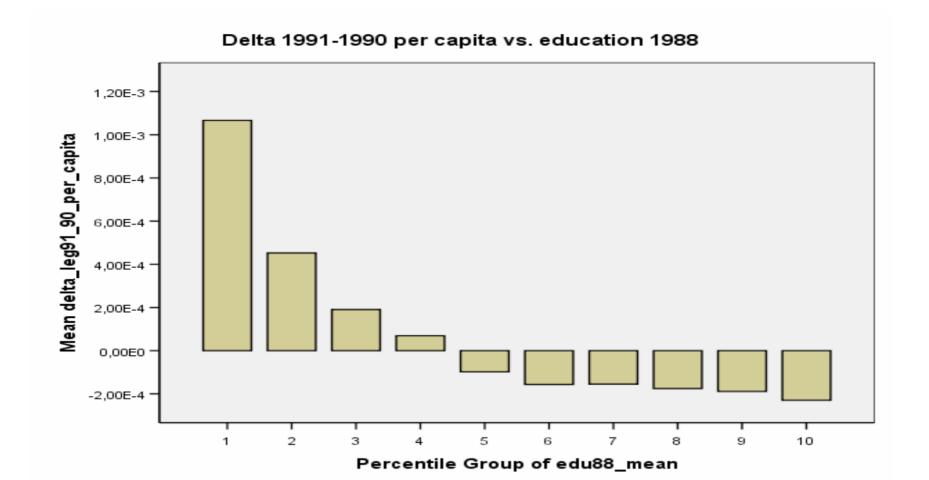
Double reality of social transitions:

Regions of "new" and "old", political and economic data



The Dynamics of Societal Transition: Modeling Non-Linear Change in the Polish Economic System, International Journal of Sociology. Jerusalem, summer school



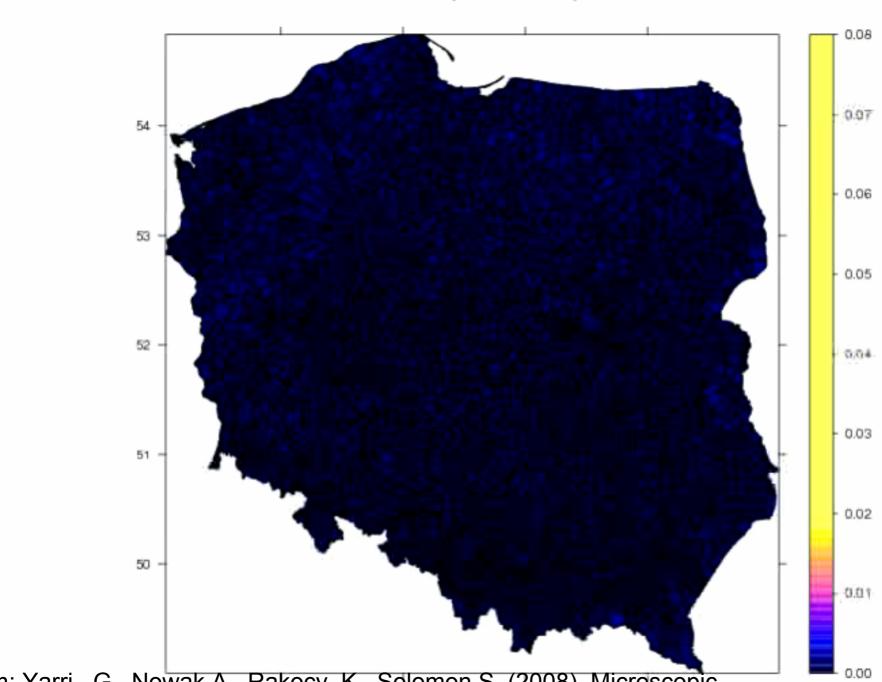


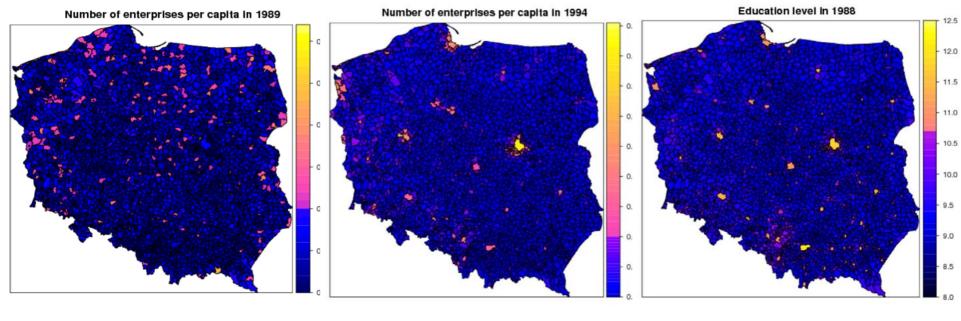
Jerusalem, summer school

 $(Rakoczy\ 06)$

Sepember 2008

Number of Enterprizes Per Capita at 1989





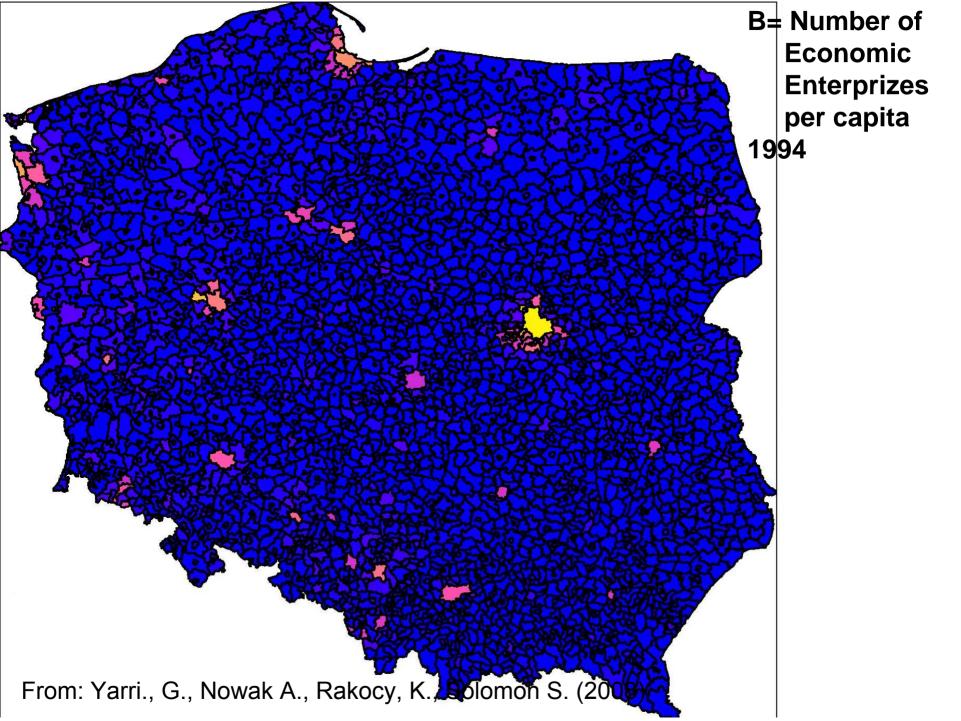
Number of Economic Enterprizes per capita 1989

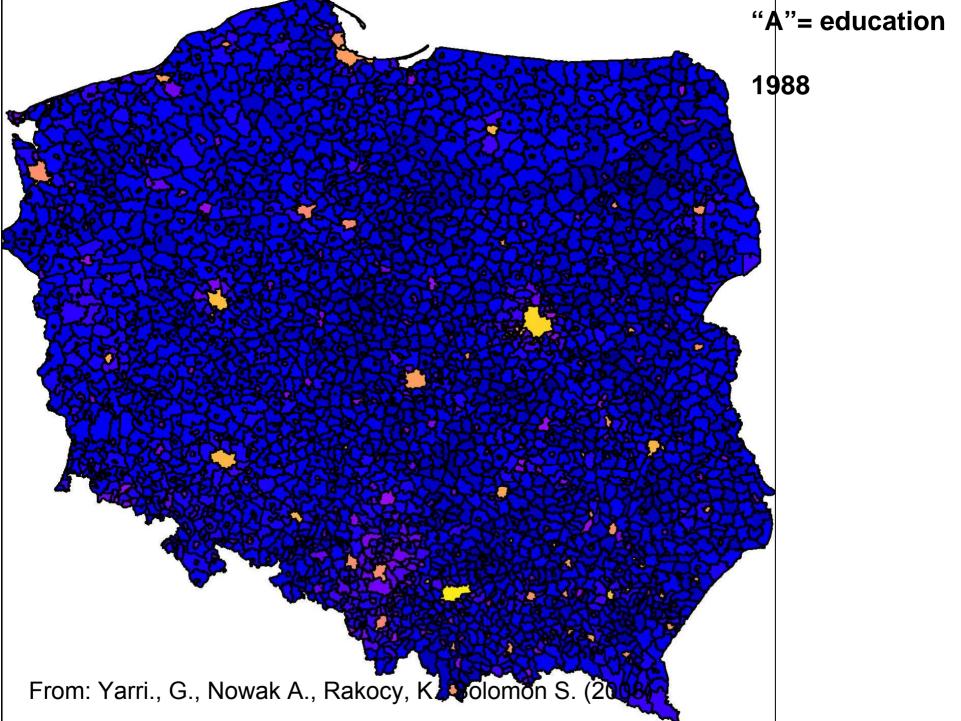
B= Number of Economic Enterprizes per capita 1994

"A"= education

1988

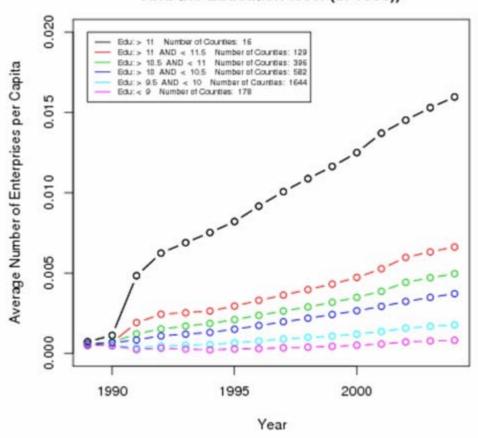
From: Yarri., G., Nowak A., Rakocy, K., Solomon S. (2008) Microscopic Study Reveals the Singular Origins of Growth <u>European Physics Journal B</u>, 62, 4





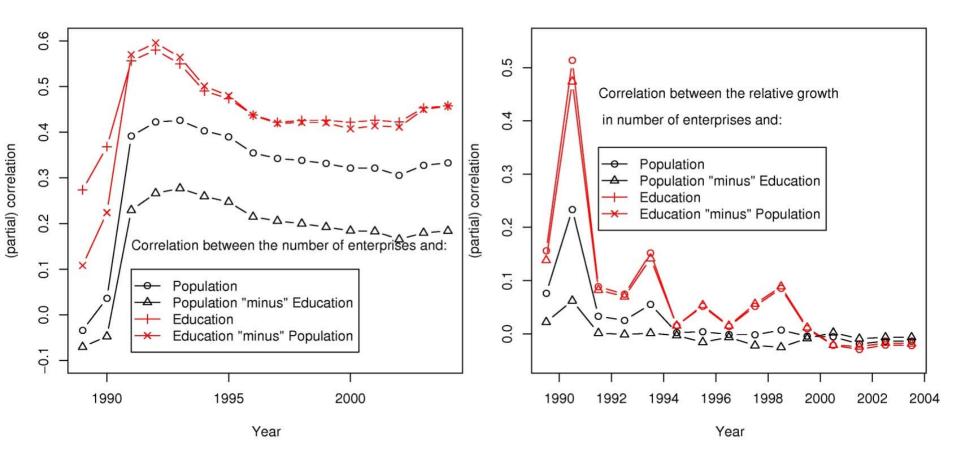
[b]

The connection between the Number of Enterprises per Capit: And the Education level (in 1988))



The singularity of growth

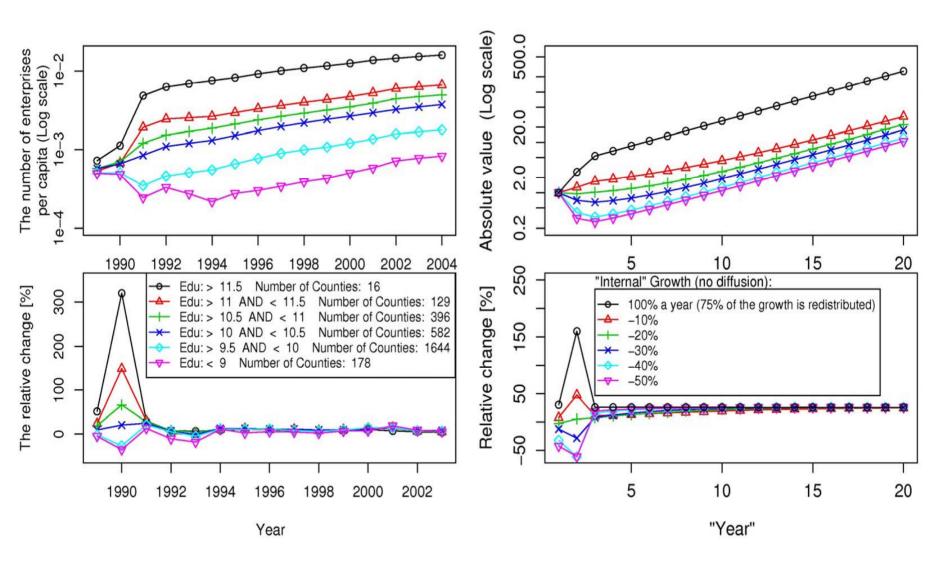
- 16 counties with the highest educational level experienced during the transition year (1990-1991) extremely high growth rates in the number of new enterprises (450%)
- In most of the country the number of enterprises almost halved. The total number of counties in Poland is 2945.
- Uniform distribution of the relative growth rate in the later years is consistent with the continuous increase in the inequality between the educated and less educated counties.



From: Yarri., G., Nowak A., Rakocy, K., Solomon S. (2008)

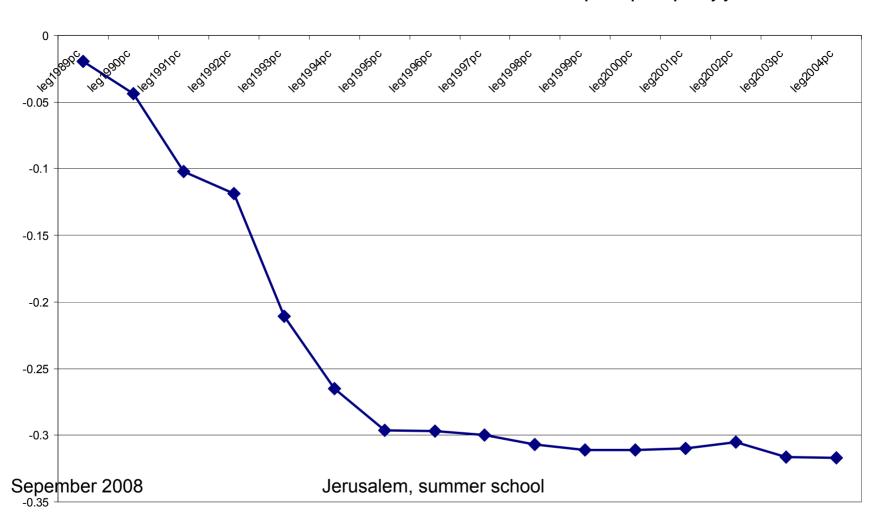
Sepember 2008

Jerusalem, summer school



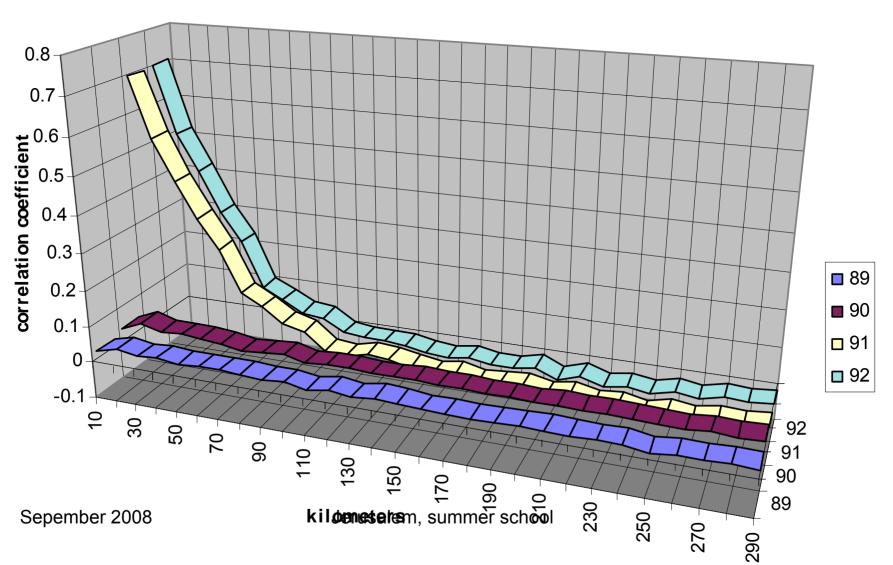
Sepember 2008 Jerusalem, summer school From: Yarri., G., Nowak A., Rakocy, K., Solomon S. (2008)

Correletion distance from Polish-German borde with number enterprises per capita by year



The length of the correlation function for number of enterprises per capita

(Urbaniak 1998)

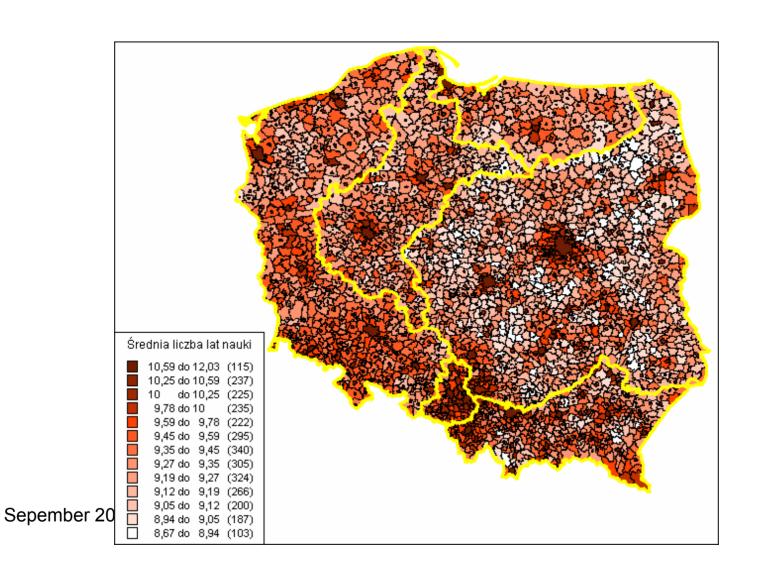


The role of social interactions

- Interviews with firm owners (Jakubiak 1995, Tomczyk 2004)
- Social interactions play a crucial role for starting the first enterprise
 - they acquired most of the information in informal interactions with friends and acquaintances
- The role of social factors decreases with distance
- Informal interactions play a less important role for creating next enterprises

Mean number of years in education in 1988.

(Kamil Rakoczy 2004)



Economic factor voting 93

