The Growth of Firms

LEM people (GB PD GD GF MG AS FT)

CO3 dissemination meeting
Warsaw, 27June 2009

Common Dissatisfaction

Lack of relation between theoretical and empirical investigations. . .

Economics consists of theoretical laws which nobody has verified

and of empirical laws which nobody can explain.

Recent' "Economics" crisis

Present crisis predictable and predicted:

- trade unbalance and foreign debt ownership
- low interest rate and demand for financial instruments
- boom in prices, particular houses
- increased level of leverage

$$\text{leverage} = \frac{\text{equity} + \text{debt}}{\text{equity}}$$

What went wrong?The economics

- wrong pricing models to build and rate securities
- heterogeneity of behaviours and preferences exposes the system to external shocks
- domino effect: self-reinforcing mechanism governing the propagation of shocks in financial and (the avalanche or domino effect)

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Outline

Firms Size

We consider $S_{ij}(t)$ is the size of firm i in sector j at time t. We define the normalized (log) size

$$s_{ij}(t) = \log(S_{ij}(t)) - < \log(S_{ij}(t)) >_i \ .$$

Main results on empirical firms size densities

- Heterogeneity of shapes across sectors
- Bimodality and no log-normality
- Separation core-fringe
- Paretian upper-tails?

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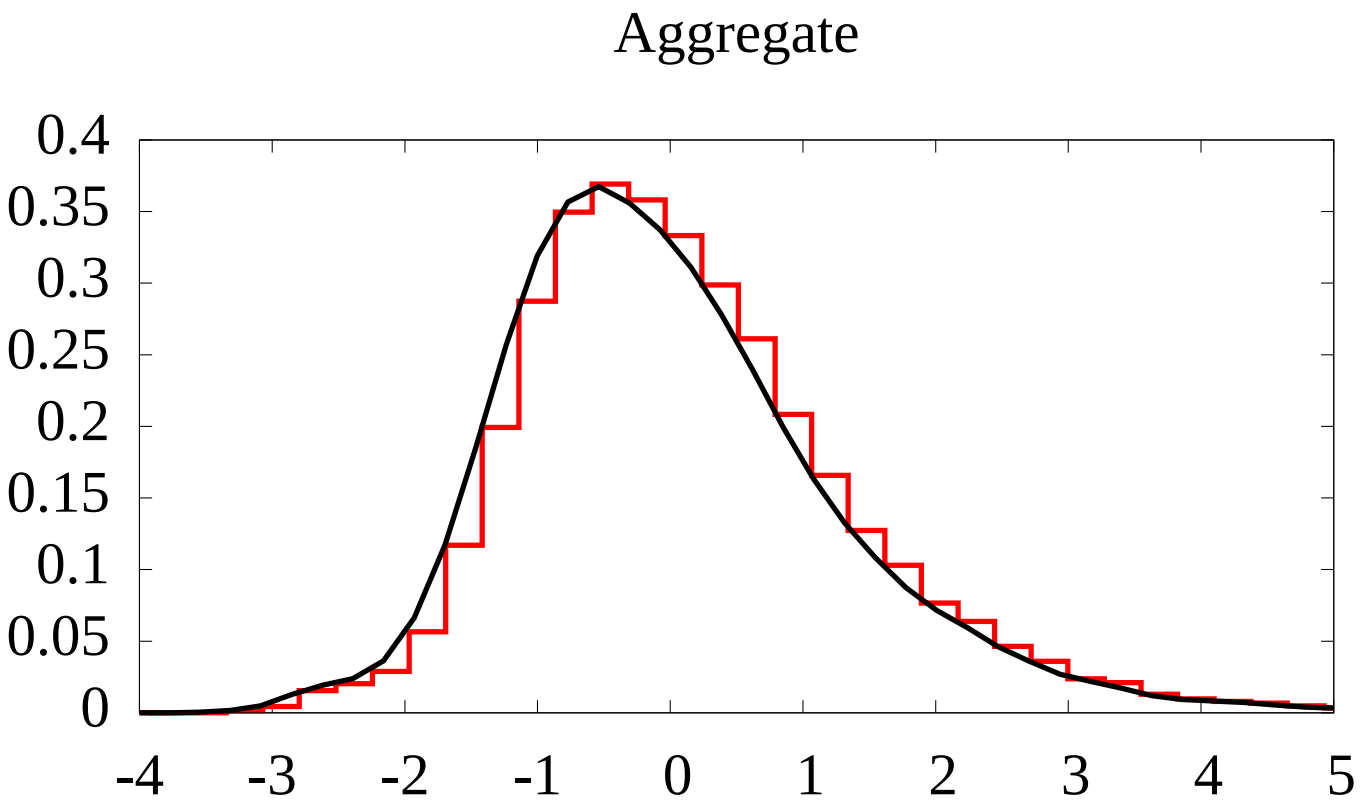
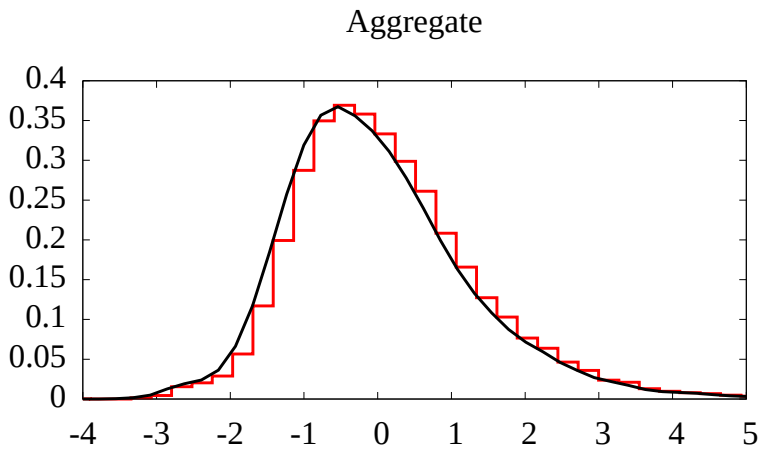
Italian Manufacturing, aggregate



Italian Manufacturing, by sectors



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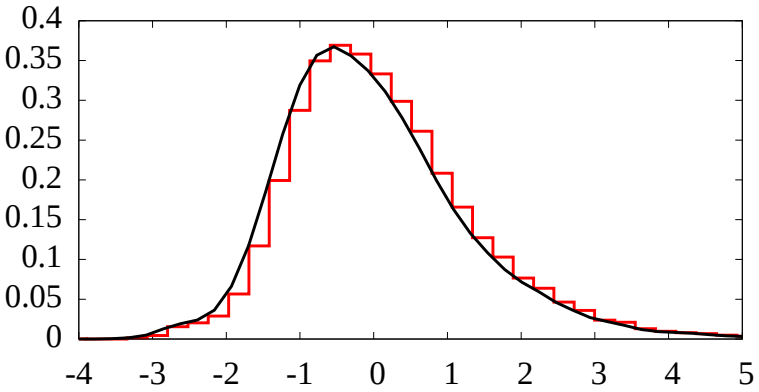

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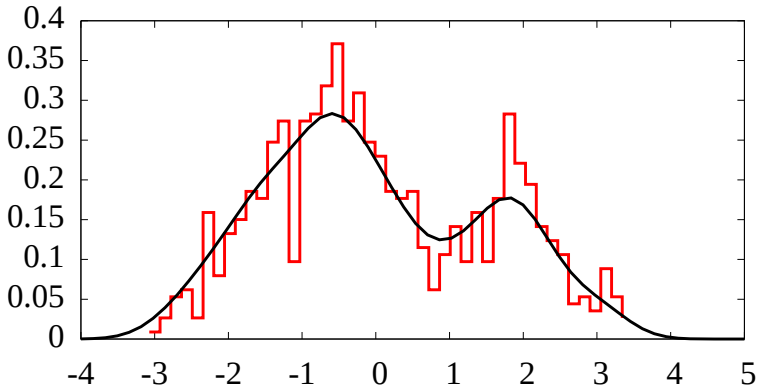

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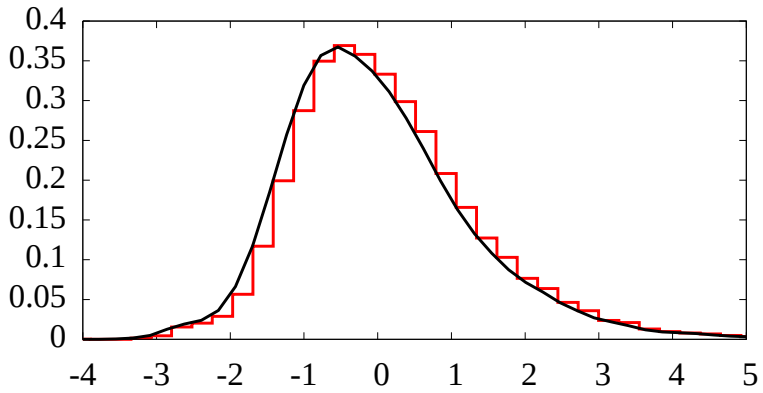

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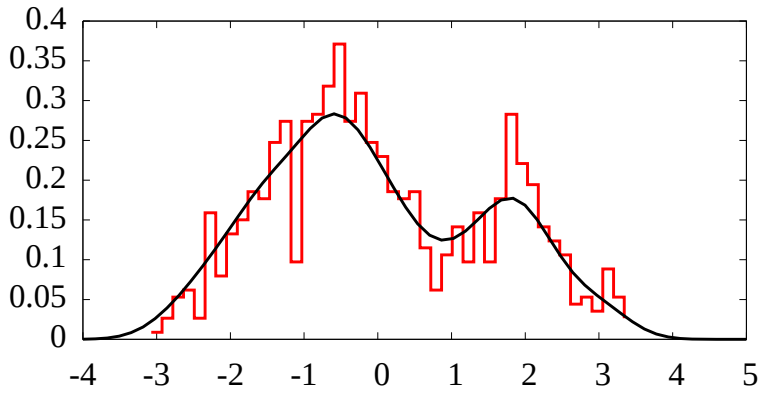
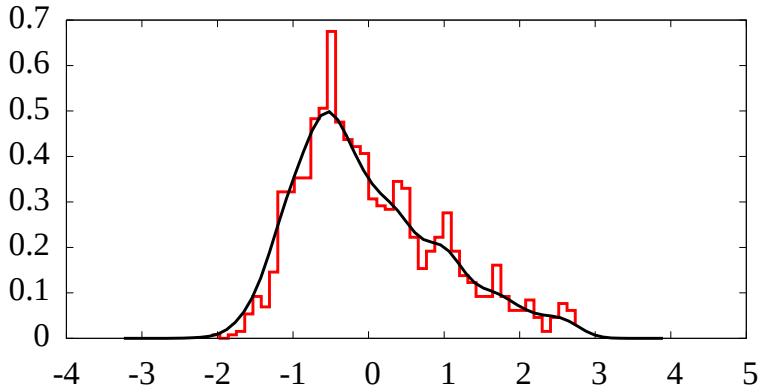


Cutlery, tools and general hardware



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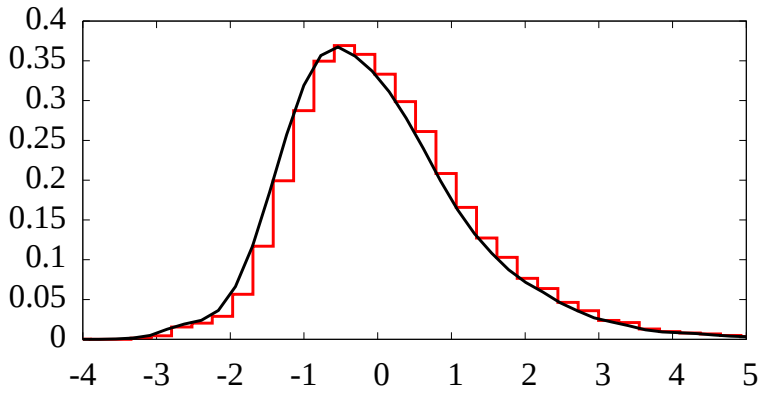

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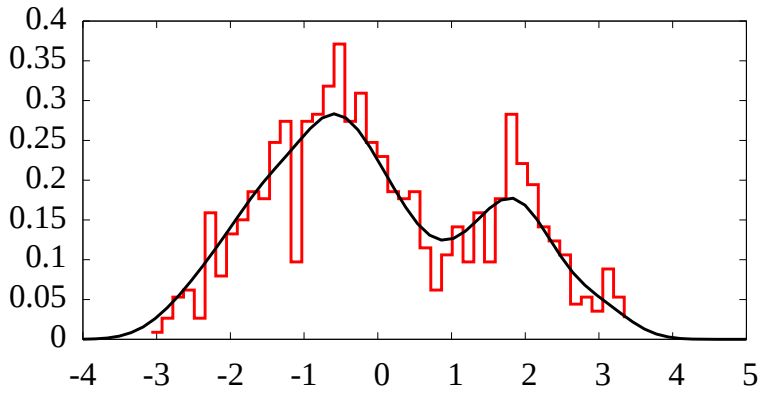

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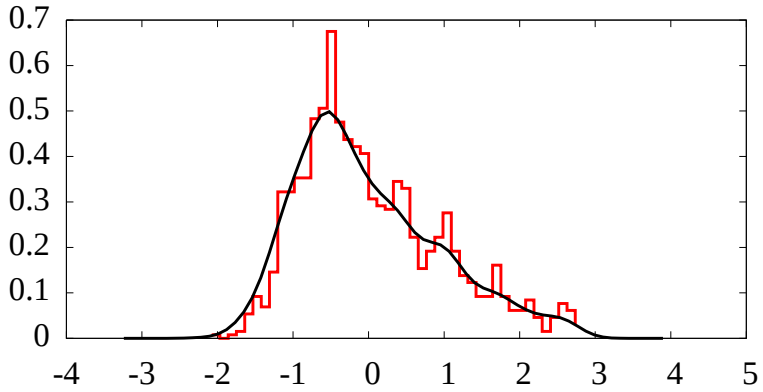

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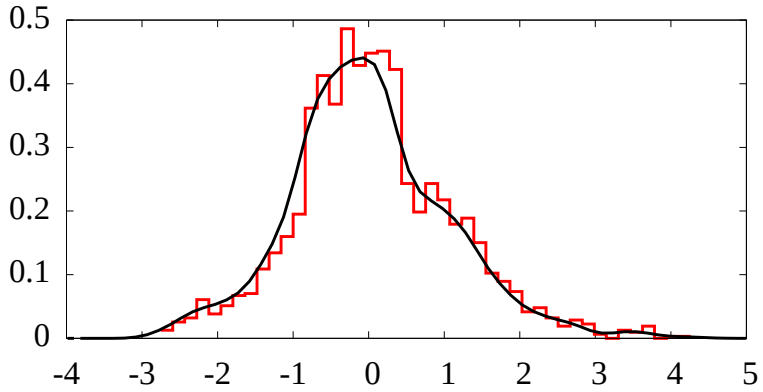

Outline

Input intensity

The amount of labor L (employees) or capital K (tangible assets) necessary to produce a unit of output S.

How much different S/K or S/L can be inside a sector? Estimate the joint density $\text{Prob}(\log(S/K), \log(S/L))$.

For any couple of $(\log(S/K), \log(S/L))$ the height of the surface is proportional to the probability of finding a firm using that amount of inputs.

1997 data. Sales and capital in thousands of Liras (1 Eur $\sim$ 2KL)

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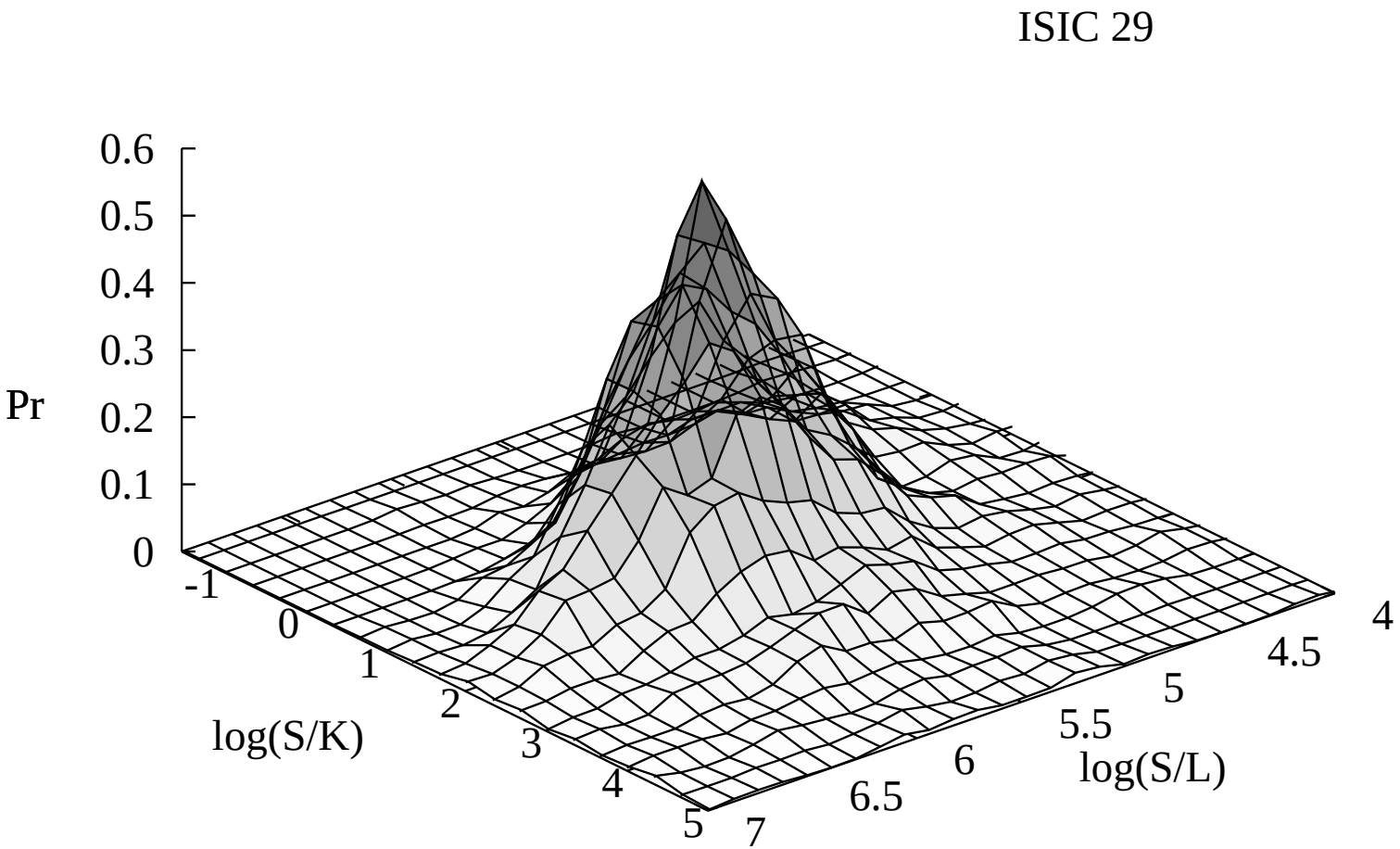
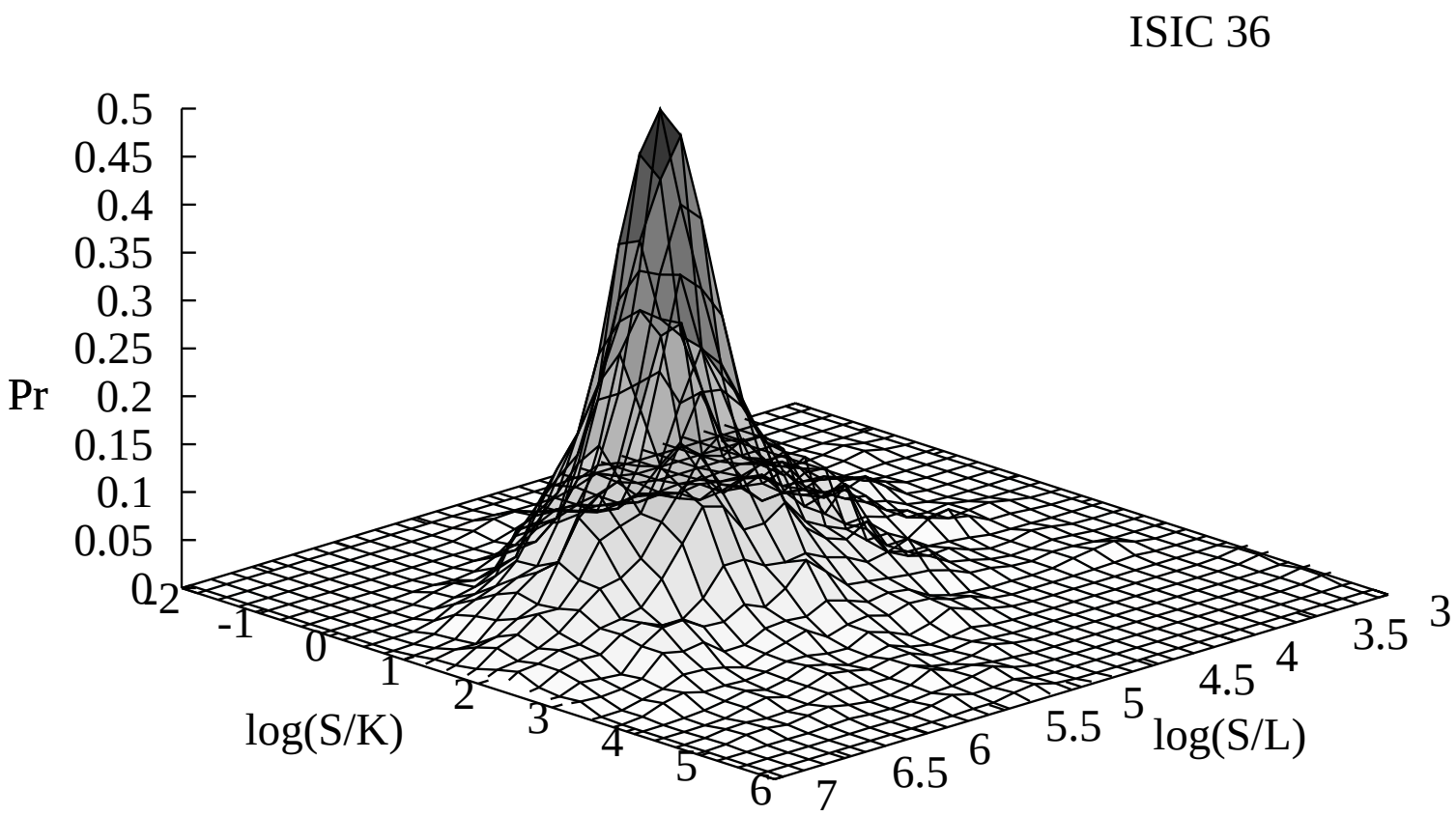
Input Intensity - Industrial machinery, year 1997



Input Intensity - Furniture, year 1997



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Risk Rating

Group firms according to CEBI rating classes, intended to measure probability to default. Widely used: capture financial fragility and access to credit market.

Class	Rating	Definition
Low	1	high reliability
	2	reliability
	3	ample solvency
Mid	4	solvency
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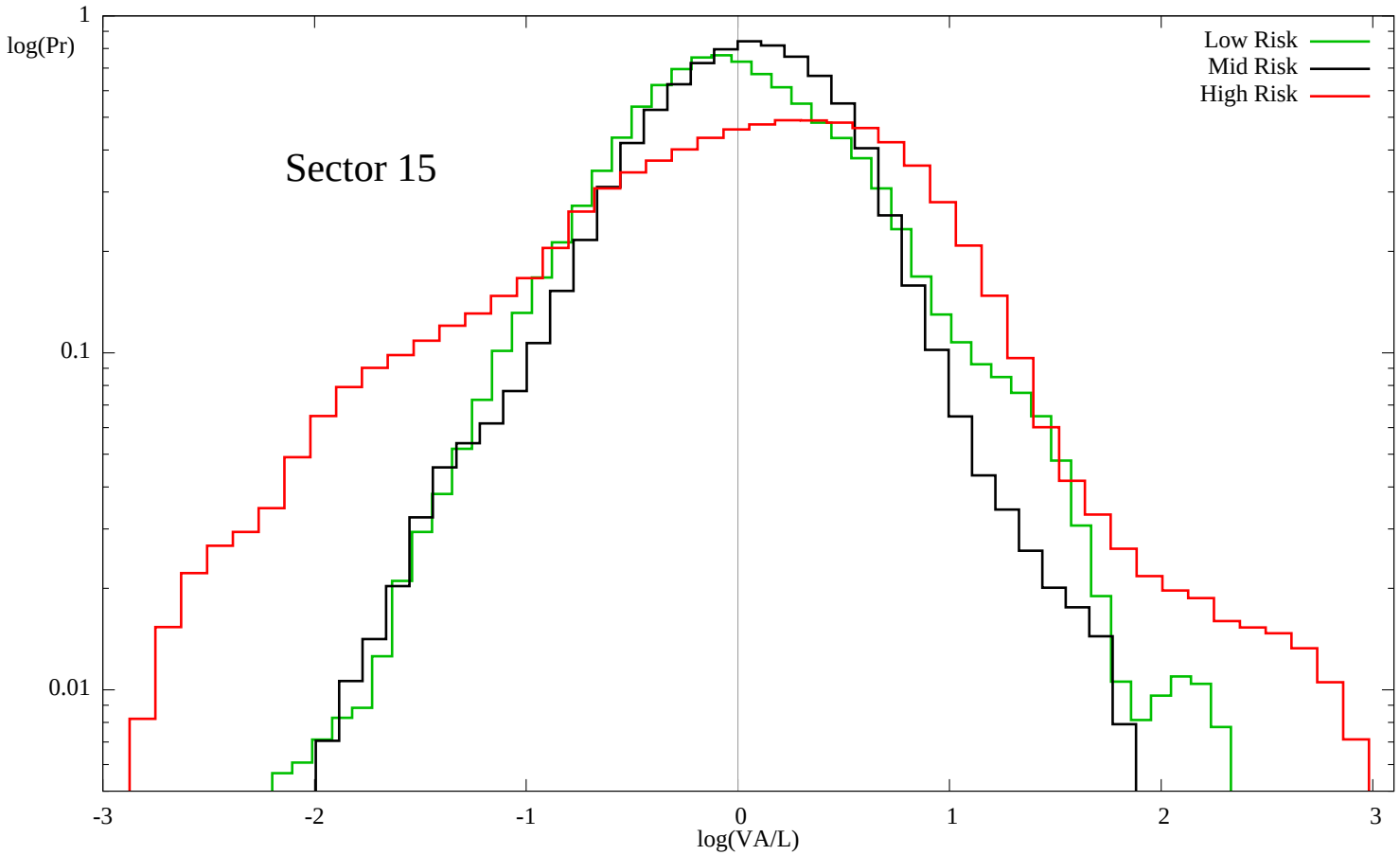
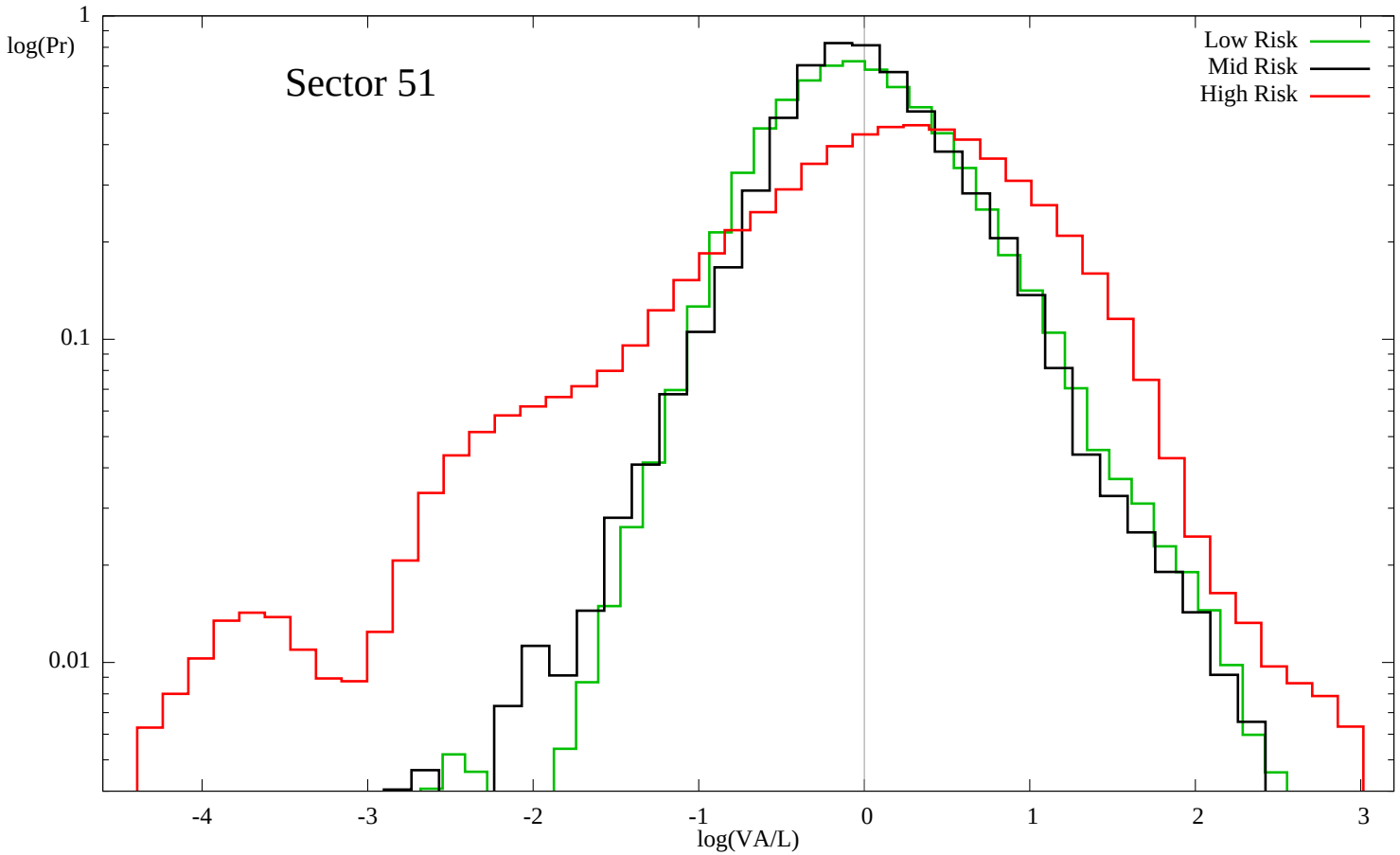
Food and Beverages (ATECO 15), year 2004



Wholesale (ATECO 51), year 2004



Outline

Behaviour of the upper tail

Let s_i the size of firm i and let $s_i = \log(S_i)$ its log,

$$F_s(x) = \text{Prob}\{s \leq x\} = \text{fraction of firms with log(size)} \leq x \ .$$

On a log-log scale

$$\log\left(1 - F_S(x)\right) \sim -ax$$

Pareto (Type I) behaviour

$$1 - F_S(x) = \text{Prob}\{S > x\} = \sim \left(\frac{S}{S_0}\right)^{-a}$$

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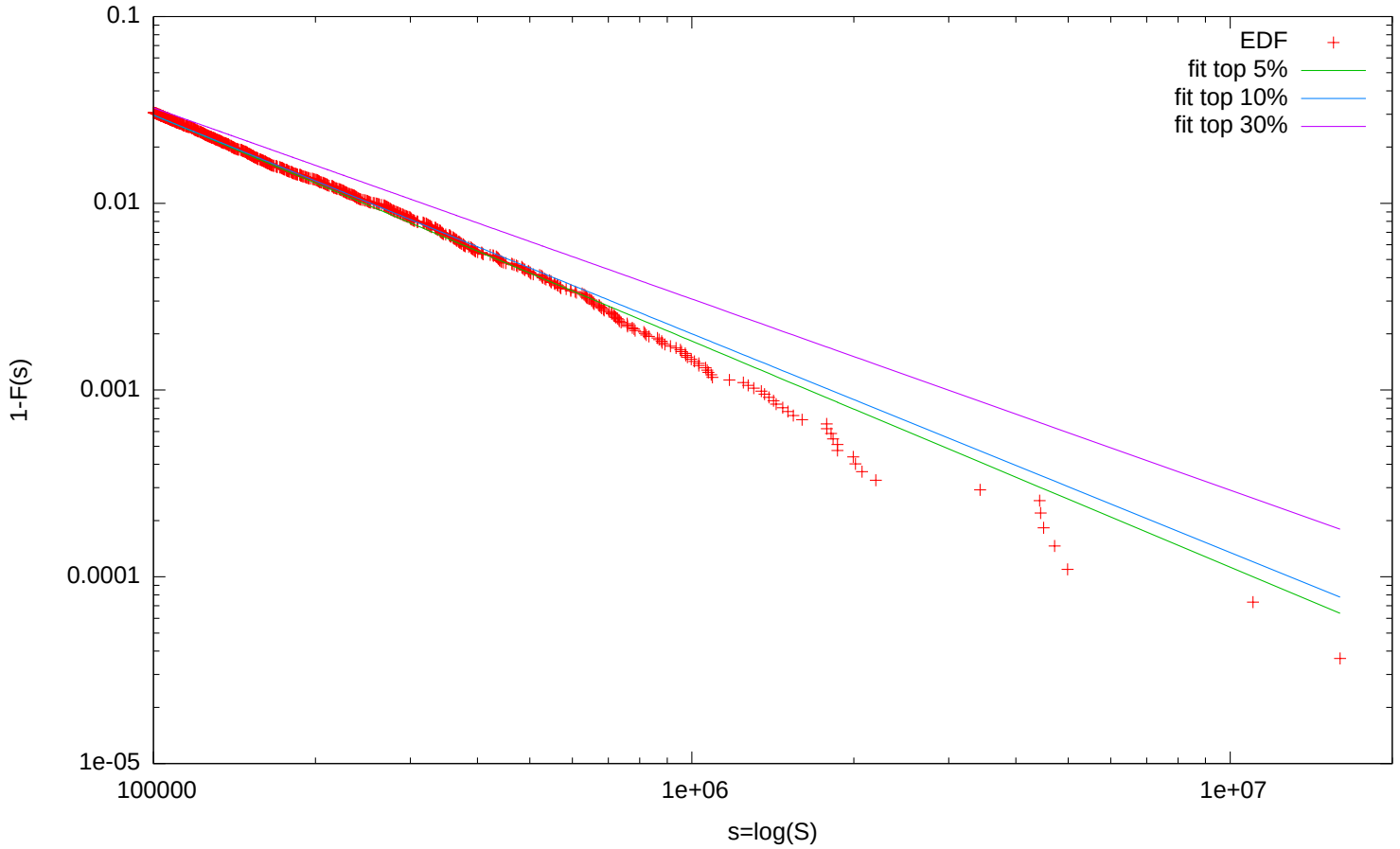
Parteo type I, Zipf's plot



Power-law provides a bad fit.

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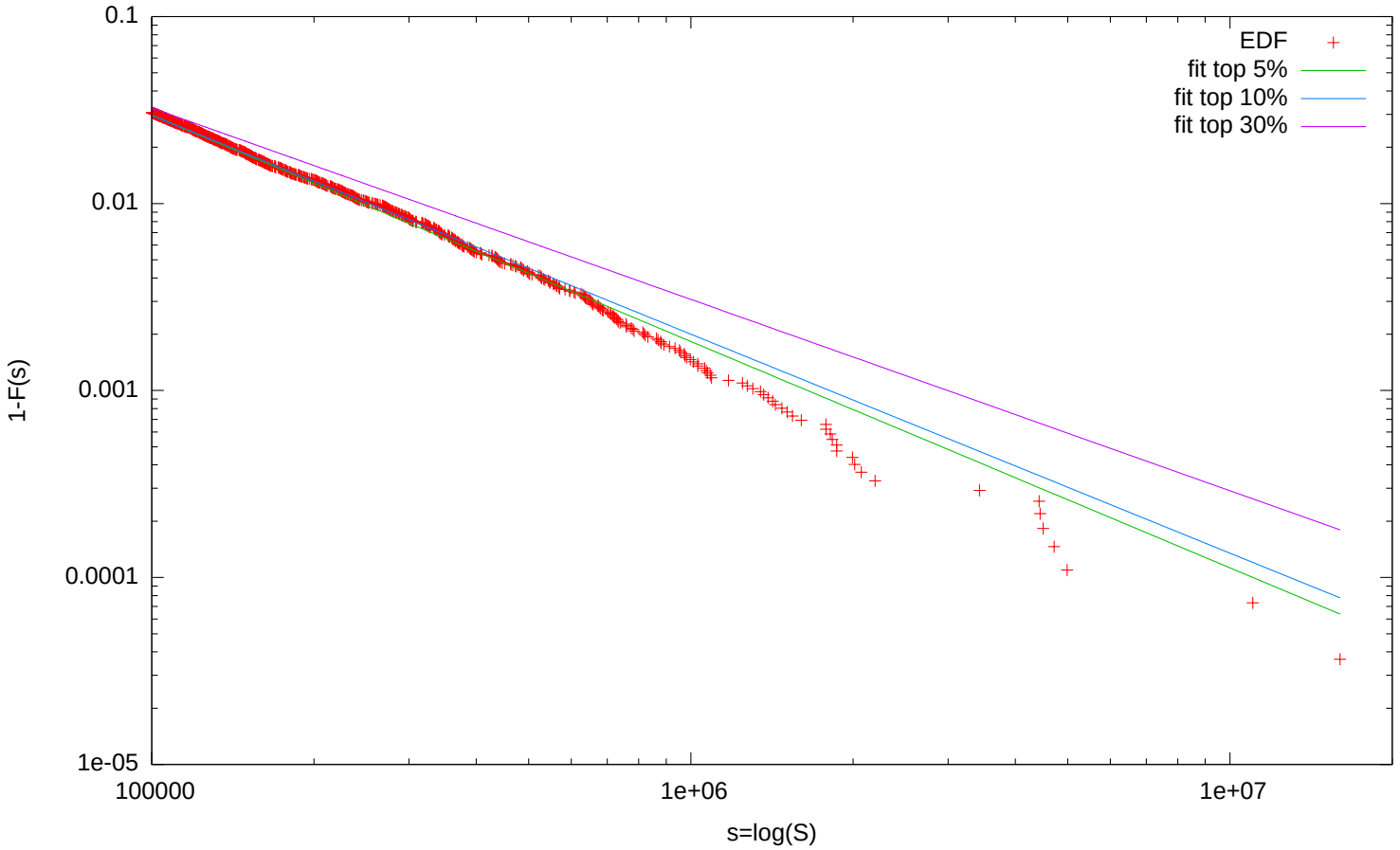

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Pareto type III, Zipf's plot

Power-law with exponential dumping works much better.

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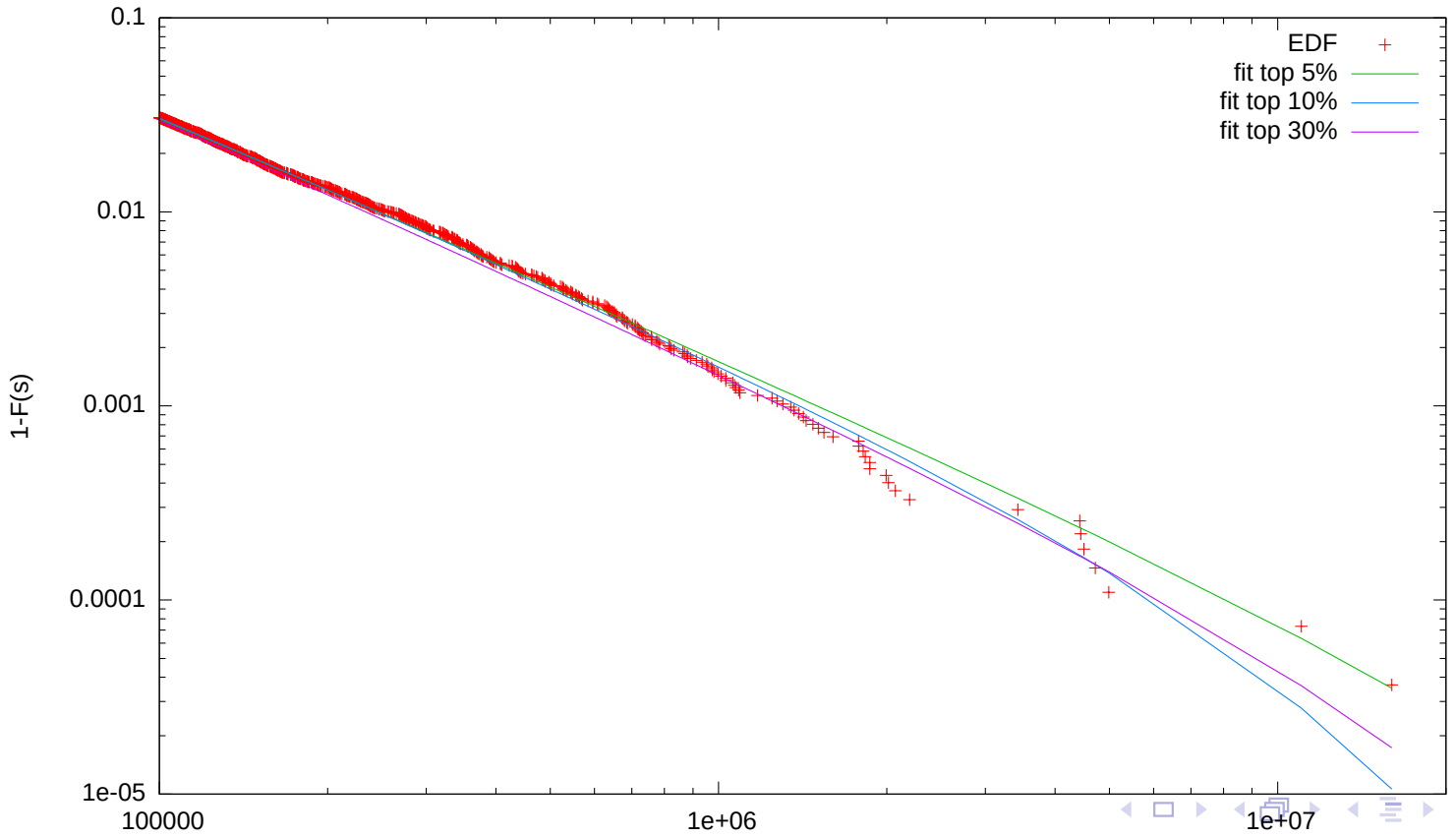

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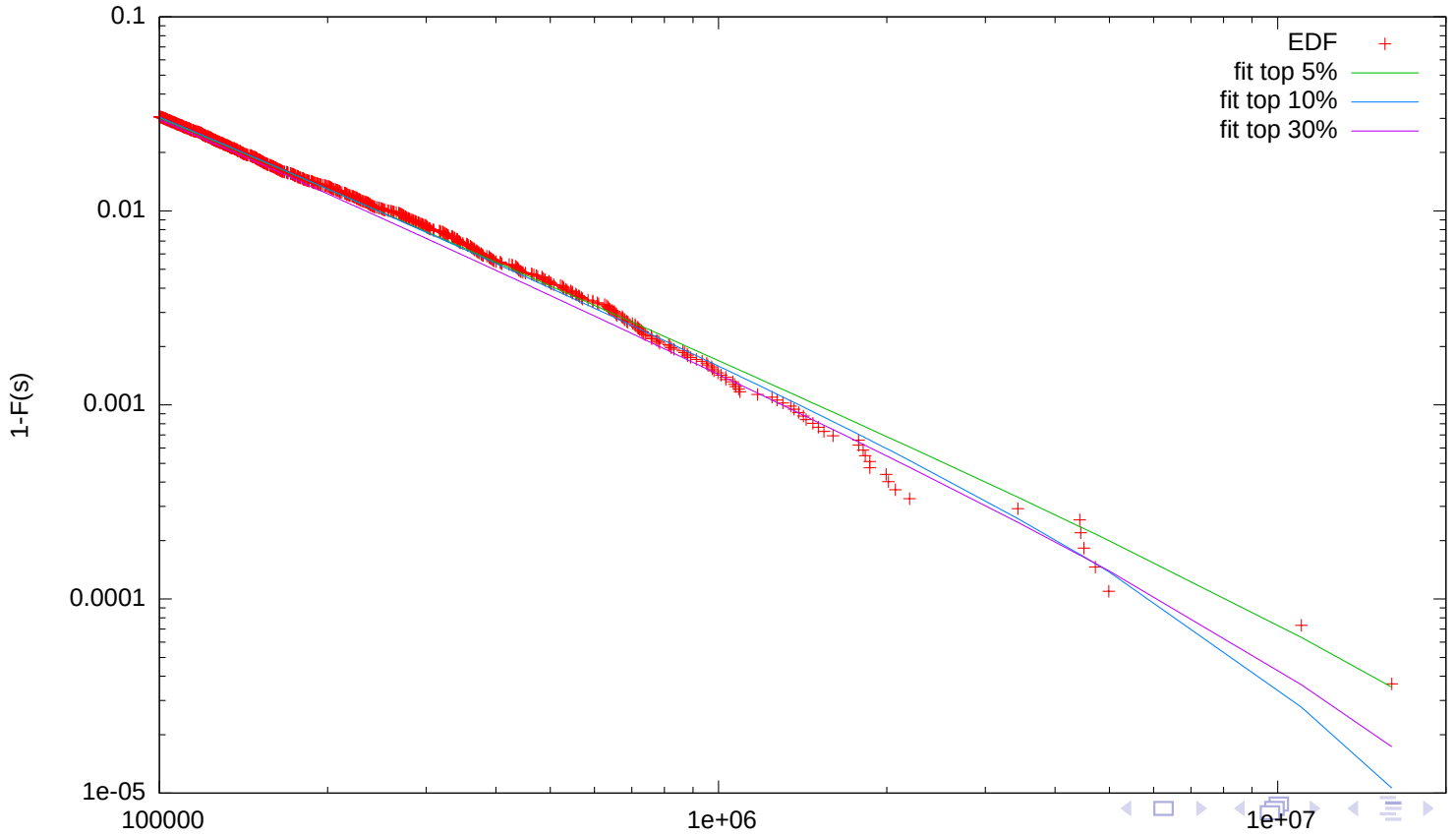

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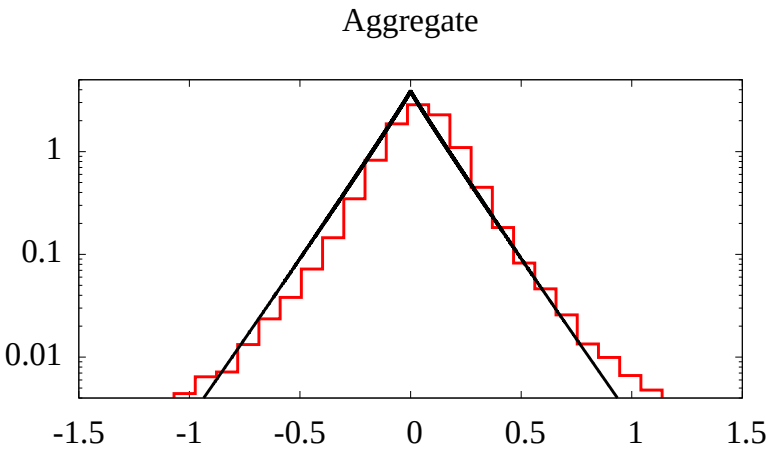
Empirical Growth Rates Density



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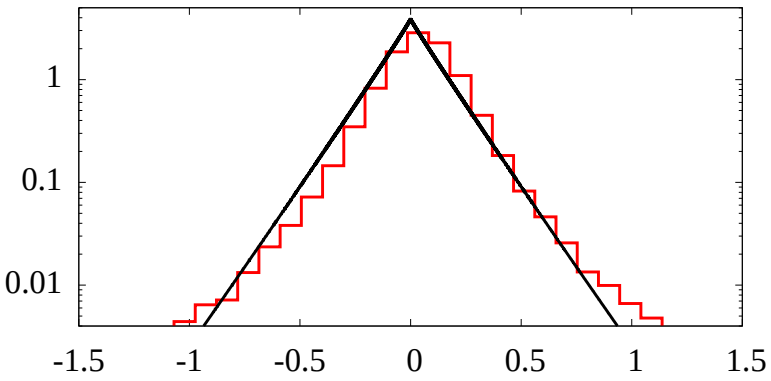

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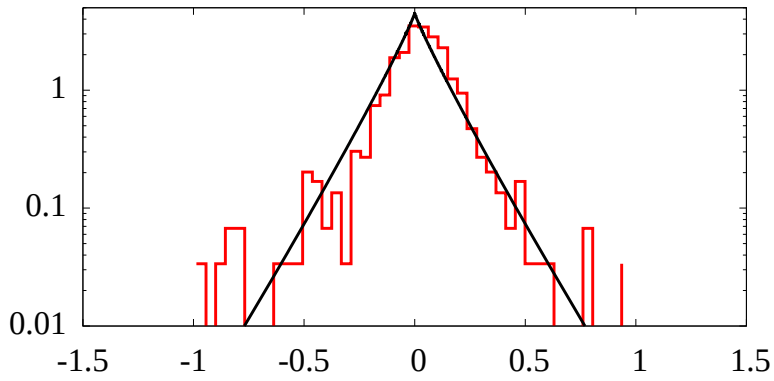

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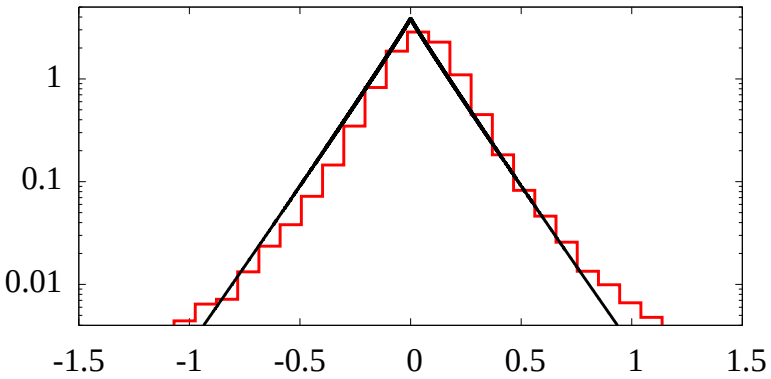

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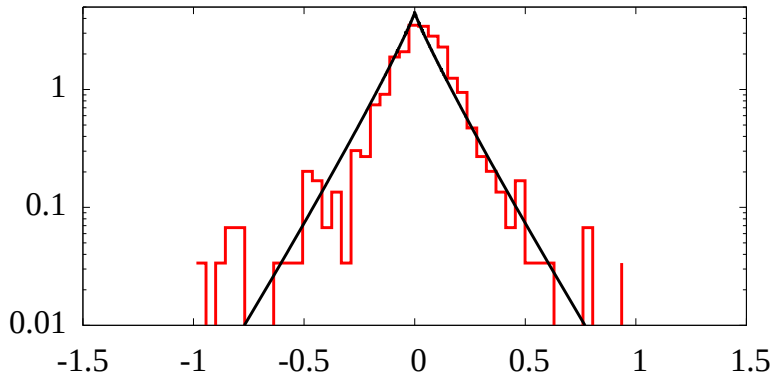

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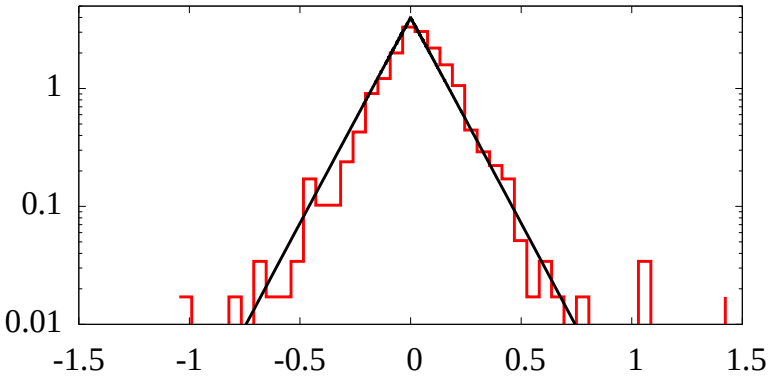

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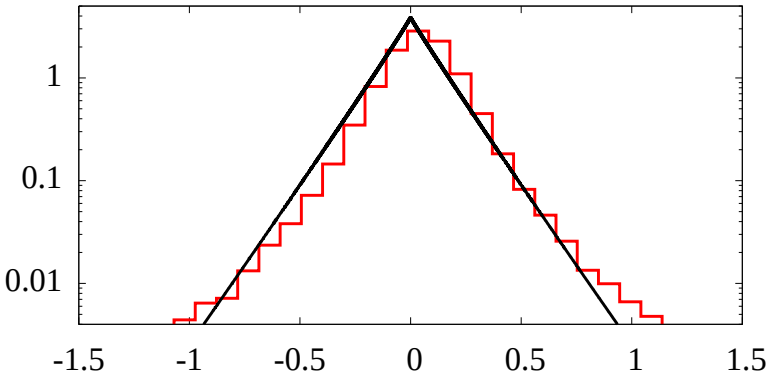

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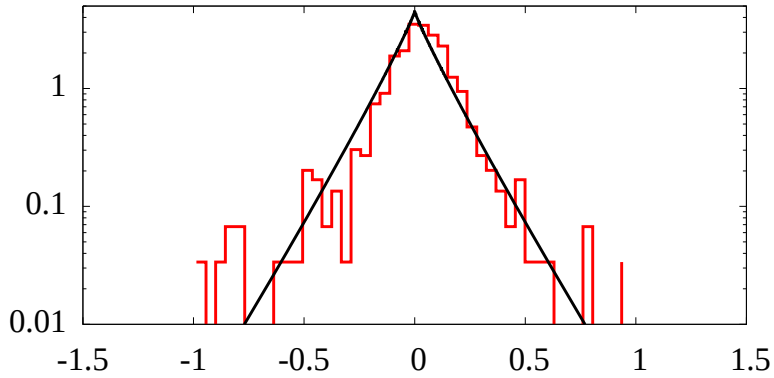

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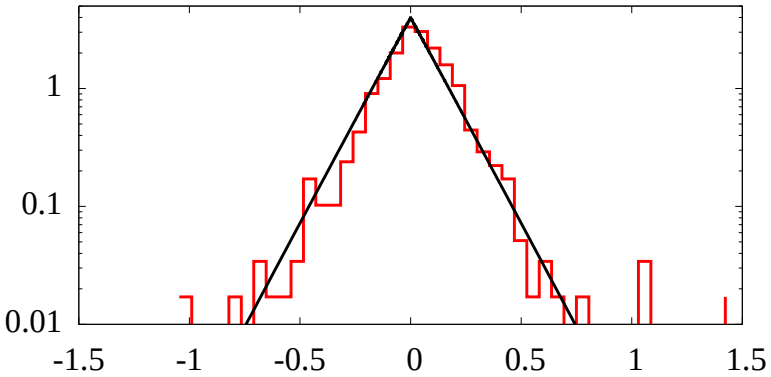

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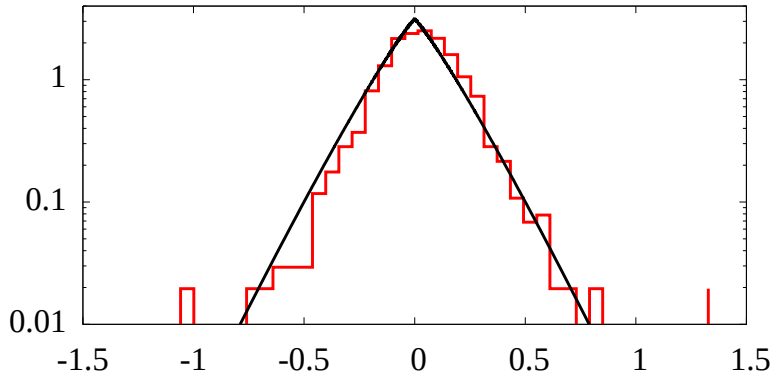

Positive-feedback model

Observed growth as the cumulative effect of diverse "events"

$$g(t;T) = s(t+T) - s(t) = \epsilon_1(t) + \epsilon_2(t) + \ldots = \sum_{j=1}^{G(t;T)} \epsilon_j(t)$$

- shock ϵ_j are independent from size s
- opportunities G progressively captured by firms

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The Polya Assignment of Business Events

1. Consider an urn with N different balls, each representing a firm
2. Draw a ball and replace with TWO of the same kind. (Here the first draw from an urn with two types of ball)
3. Repeat this procedure M times

RESULT: partition of M events on N firms.

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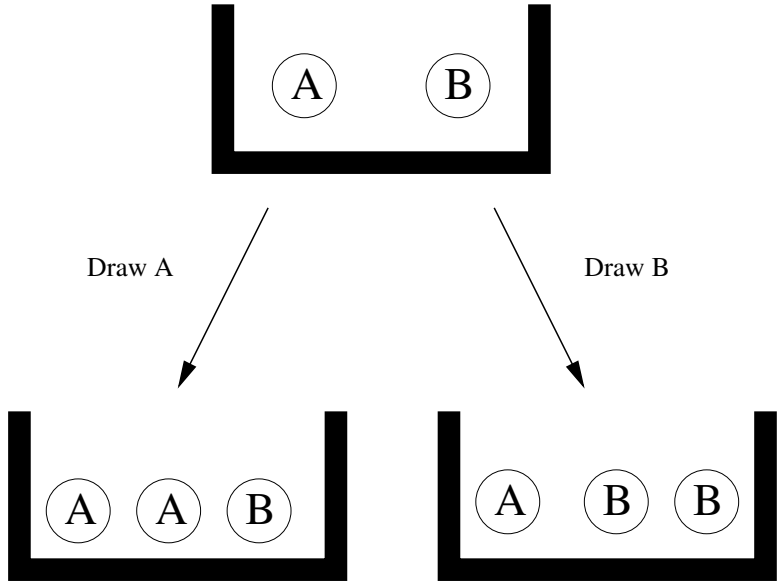
2. Draw a ball and replace with TWO of the same kind. (Here the first draw from an urn with two types of ball)



3. Repeat this procedure M times

RESULT: partition of M events on N firms.

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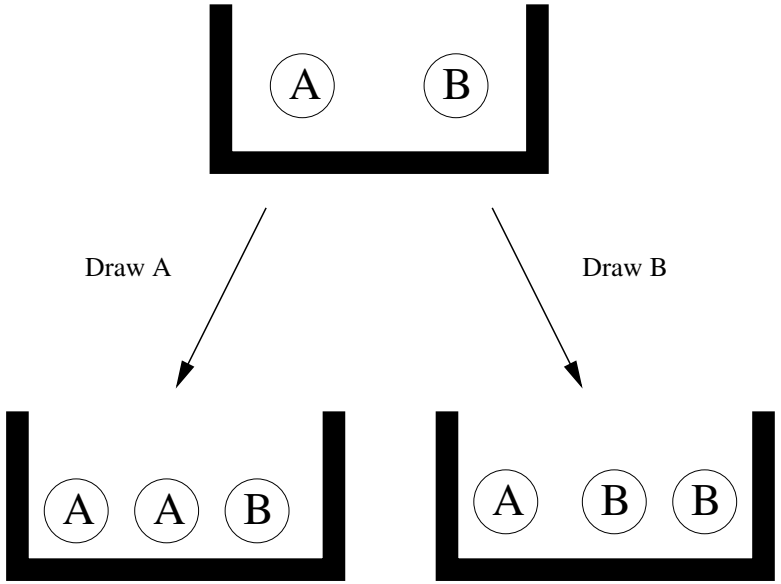

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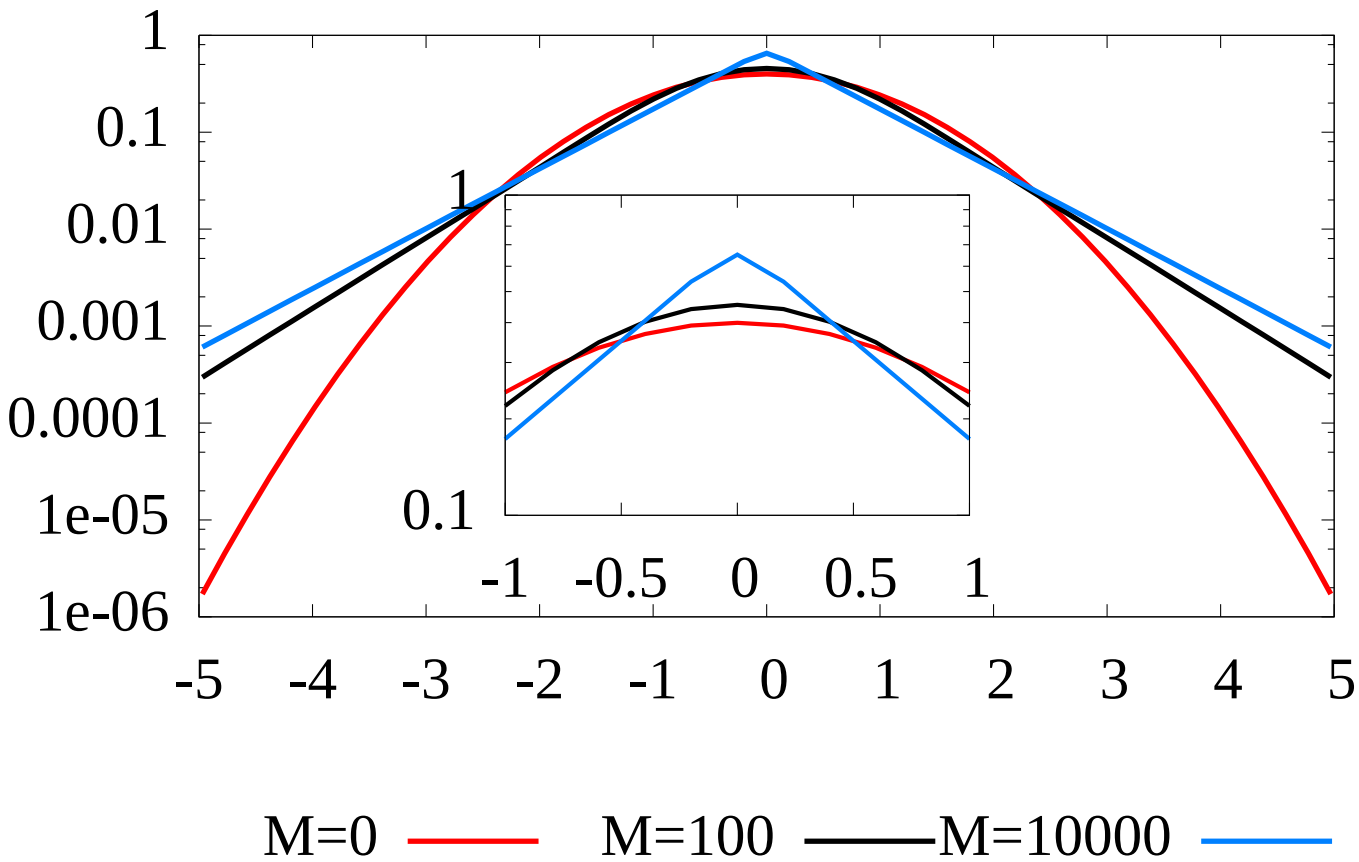
Results

Growth rates densities for $N = 100$ firms and different number of opportunities M.



Outline

Occupancy distribution

The "Census of Manufacturers and Services" (ISTAT) contains data on business units and employees, classified with respect to $L = 784$ geographical locations (local system of labor mobility) and six digits ATECO codes.

Sectoral occupancy distribution $f_j(n)$ of the N_j firms of sector j

$$f_j(n) = \text{number of locations with } n \text{ firms of sector } j$$

An even distribution would imply $f_j(n) \sim N_j/L$.

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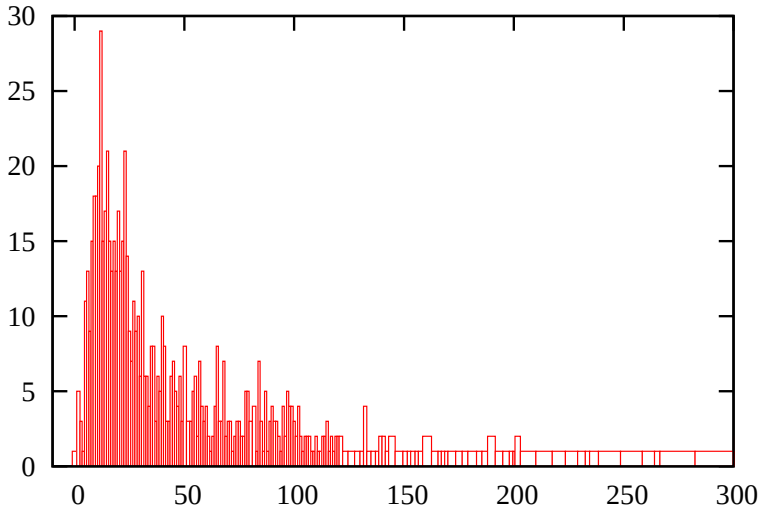
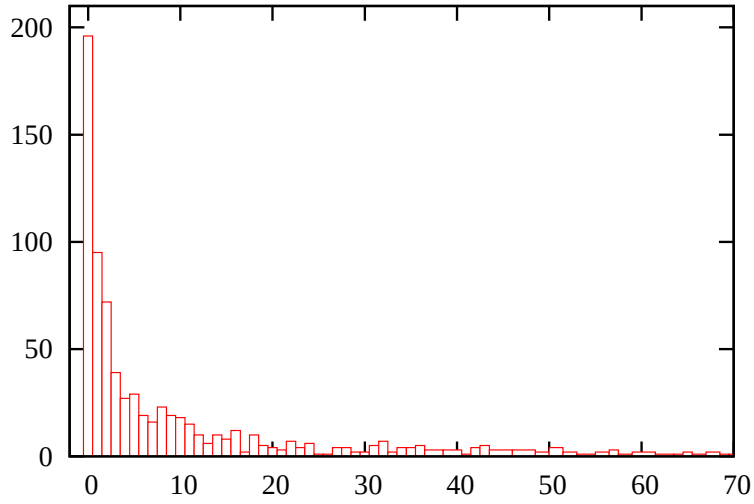
Sectoral occupancy

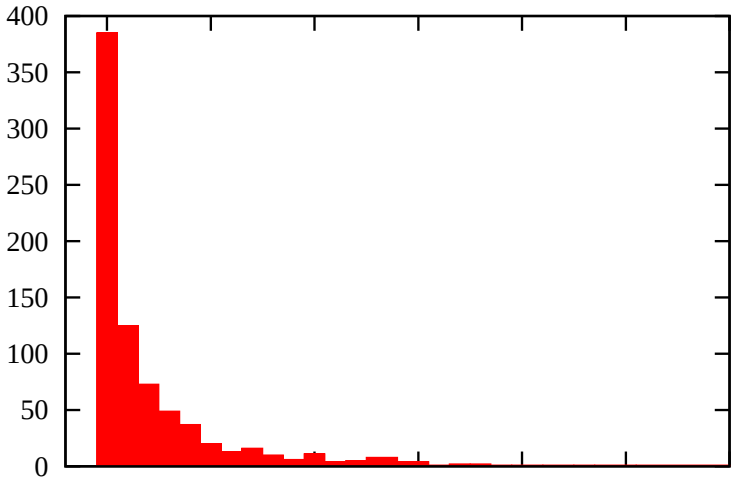
20 - Wood processing



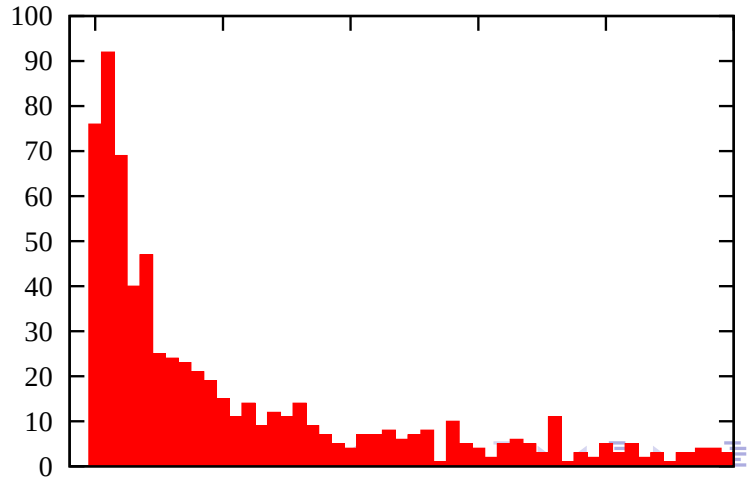
25 - Rubber and plastic products



28 - Fabricated metal products



33 - Precision instruments



Detecting the self-reinforcing effect

Assume firms choose where to locate their next plant based on

- the size of the economy (local demand, generic labour availability, infrastructures, . . .)
- number of similar plants located there (technological spillover,skilled labour availability, . . .)

Probabilistic interpretation

$$\text{Prob. locate in } l \sim \beta\,(\text{size of site } l) + b\,(\text{similar firms in } l)$$

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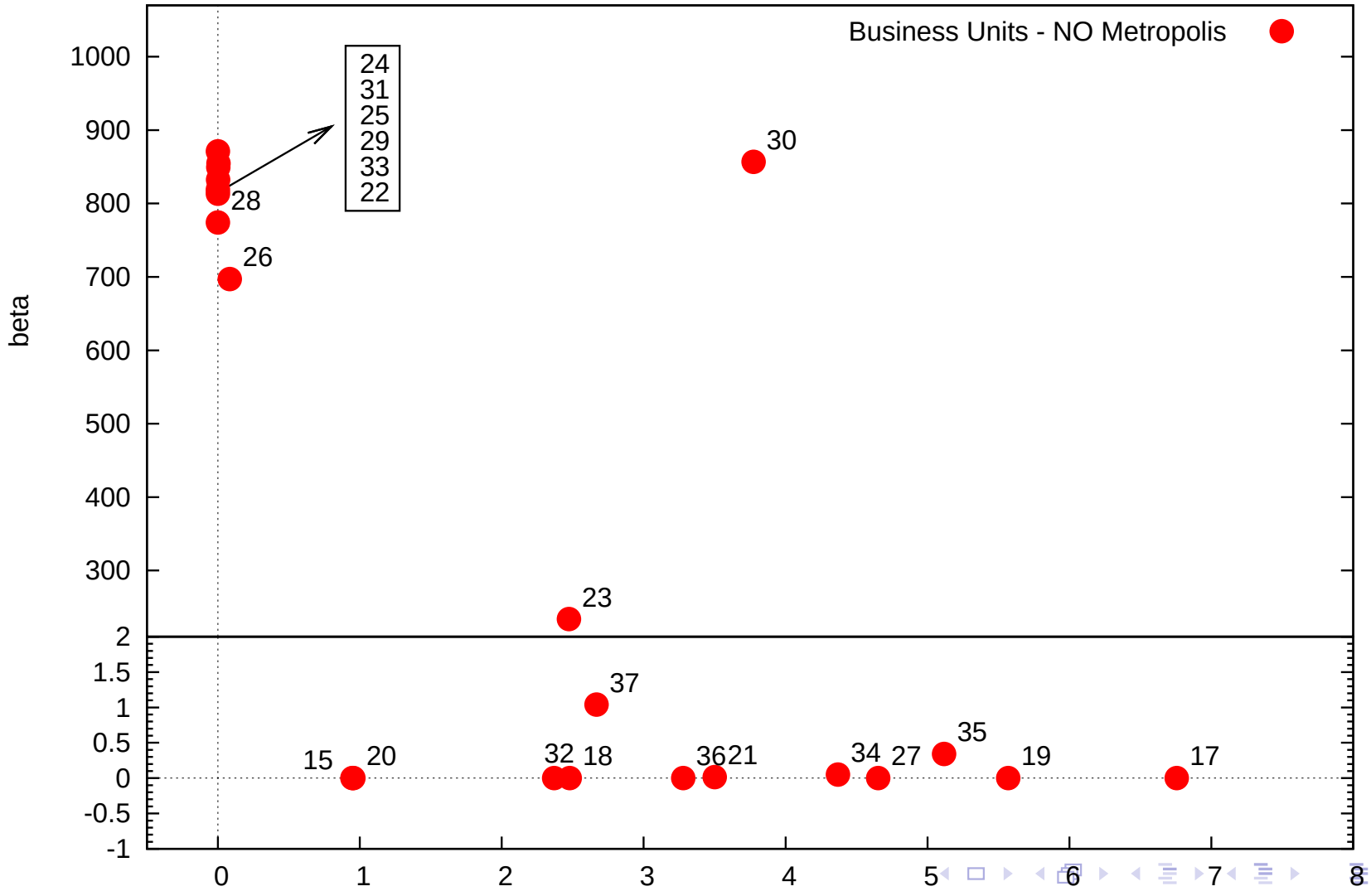
Sectoral estimates (no metropolitan areas)



The model is the policy

Empirical investigation detect regularities emerging from heterogeneous behaviour.

These regularities suggest the presence of self-reinforcing effects

Capturing these effect we obtain more reliable description of economic aggregate behaviour.

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Q&A

Q: Firm crisis prediction: if risk rating does not help, what to use?

A: Don't stick to short-term financial conditions, but use also mid-term economic indicators.

Q: How economic downturns affect small and large firms?

A: Study the evolution of the easily-to-parametrize growth rates distribution and its relation with general economic behaviour . Few firms lead the growth, many absorb negative shocks.

Q: How globalization affects the distribution of economic activities?

A: Demand-driven or market-driven location decisions are differently affected than decision based on technological advantages.

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