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Industrial Dynamics: from Size Distribution to Productivity Analysis

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1. Regularities in growth and size distributions of firms

Aggregated Analysis

Size:

- Stationarity of size distribution
- Log-normal shape

Scaling Relation:

- Negative relation between size and growth rates variance

Growth rates:

- Unit-root nature of the growth process
- Growth rates display a Laplace shape

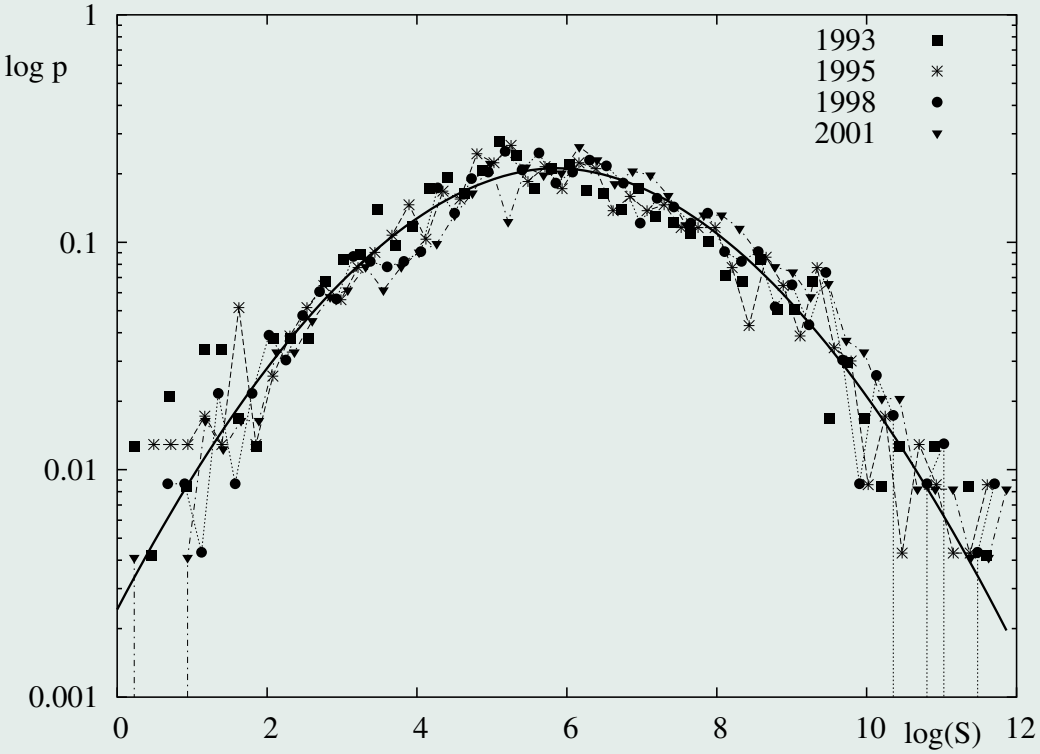

Figure 1: Empirical probability densities of (log) sales for 4 different years.

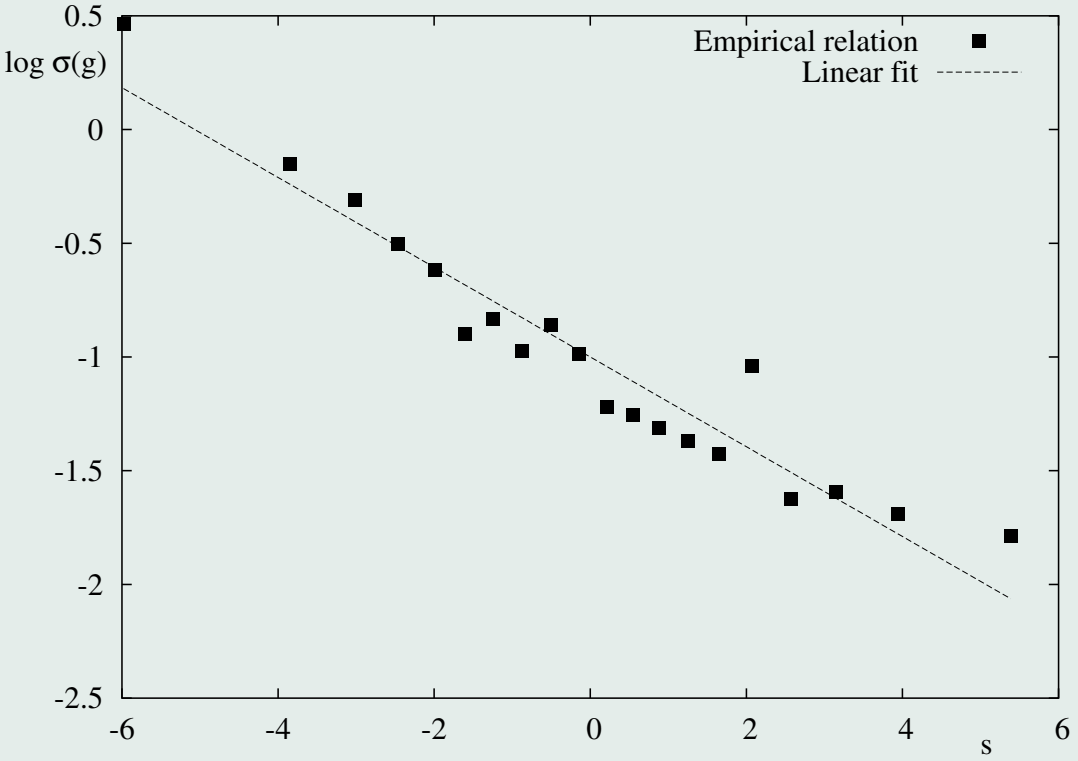

Figure 2: Log of the standard deviation of the one year growth rates as function of size.

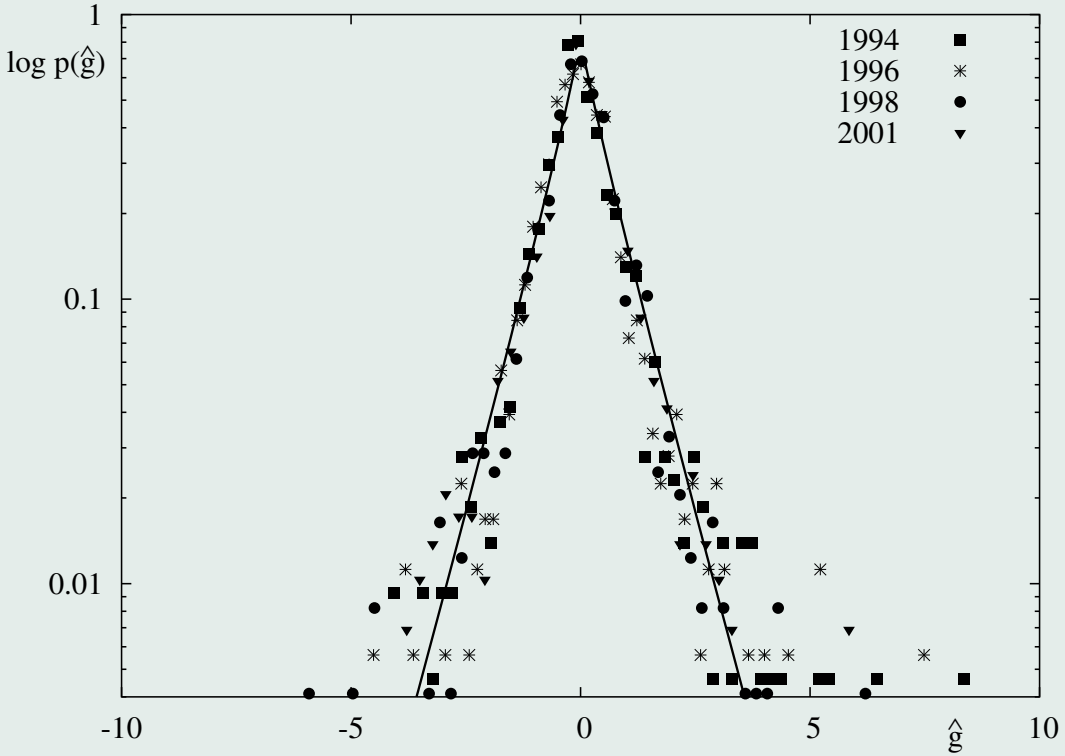

Figure 3: Log of the empirical densities of rescaled growth rates for 4 different years, together with a Laplacian fit.

Sectoral Analysis

Size:

- Heterogenous shapes in the size distribution
- Stationarity of size distributions

Scaling Relation:

- Negative relation between size and growth rates variance

Growth rates:

- Unit-root nature of the growth process
- Laplace distribution of growth rates

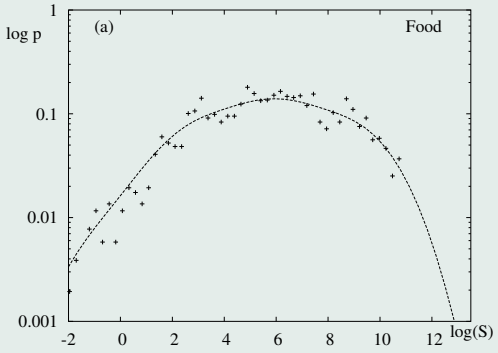

Figure 4: Log firm size in food sector.

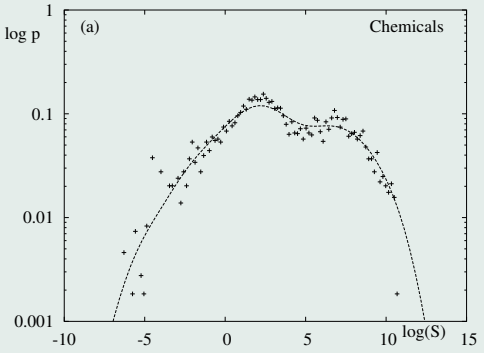

Figure 5: Log firm size in chemical sector.

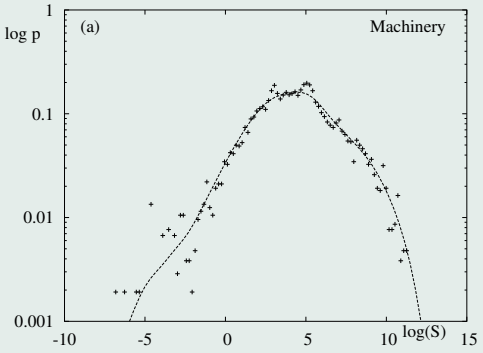

Figure 6: Log firm size in machinery sector.

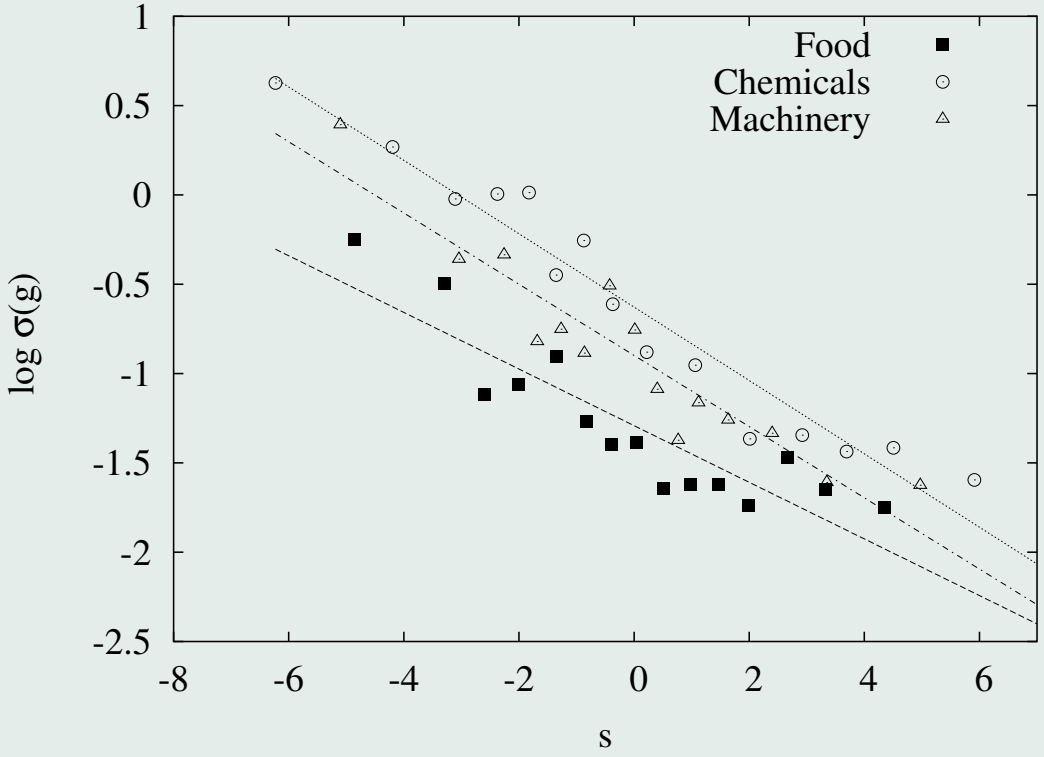

Figure 7: Log of standard deviation of the one year growth rates as function of size.

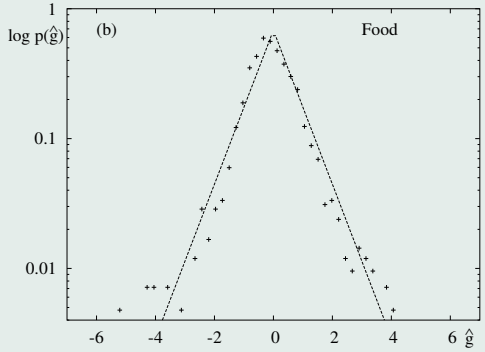

Figure 8: Rescaled growth rates for the food sector.

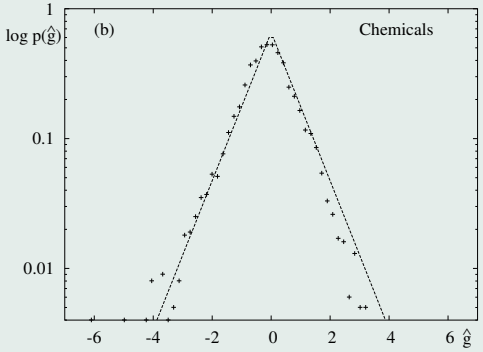

Figure 9: Rescaled growth rates for the chemical sector.

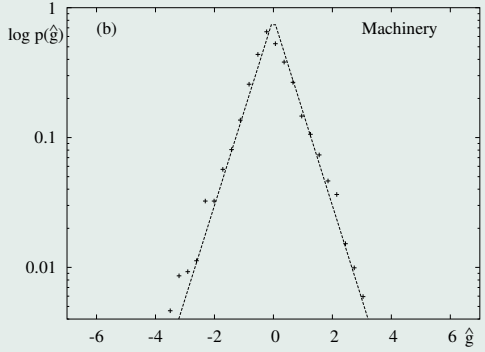

Figure 10: Rescaled growth rates for the machinery sector.

2. Gibrat's Law – Law of Proportionate Effect

The Expected growth rate of a firm is independent of its size.

Gibrat's framework:

- Growth process is multiplicative.
- Firms histories are different realization of the same process.

Stronger Form:

The probabilities of the size changes of any specified percentage magnitudes are independent of a firm's present absolute size.

Weaker Form:

The expected percentage change in size of the totality of firms in each size stratum is independent of stratum.

Drawbacks:

- No competition among firms.
- Growth rates of individual firms in one period are uncorrelated with growth rates in preceding periods.

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3. Islands' Approach

Ijiri and Simon (1964) proposed a model consistent with what they referred to as *well-known facts:*

- Negative relationship between size and variance of growth rates.
- Different expected rate of change at firm level.
- Serial correlation in growth rates over at least short time periods.

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The Model:

The probability of growth in the next period is proportional to a weighted sum of past increments. Weights decrease geometrically at a rate β, with the lapse of time since their occurrence.

Features of the model:

Competition:

- At each time period there is one opportunity of growth to be assigned.
- Growth constraint due to pace of expansion of the economy.

Growth process:

1. The unit is allocated to a new firm with probability α. If this is the case the process stops here.
2. In determining to which existing firms to allocate the unit, the model keeps track of two factors: current size and current *growth potential* of the firm.

4. Focus on growth rates distribution

- So far, much of the emphasis in the literature laid on size distribution.
  Gibrat $\longrightarrow$ Log-N Simon $\longrightarrow$ Yule distribution
- Stanley et al. (1996) find tent-shape distribution in growth rates at aggregate level
- Growing interest in investigating this regularity
- Bottazzi and Secchi (2003) obtain the same result at aggregate/disaggregate level and propose a stochastic model consistent with this *stylized fact*

5. Bringing Productivity into the picture

Starting Point:

- Bottazzi et al. (2002)

The dataset:

- MICRO.1 (Italian Statistical Office).
- Longitudinal data for about 8000 firms with number of employees greater than 19. Period 1989 – 1996.
- Focus on *internal growth*: "super firms" aggregating data of merging firms from the beginning.
- Balanced panel: ignoring firms that cross the 20 unit boundary.

Productivity

Productivity is defined as value added over number of employees:

$$\Pi_t(t) = \frac{VA_i(t)}{L_i(t)}$$

Findings:

- Quite weak relations between productivity and firm growth.
- Negative relation between productivity and increase in productivity

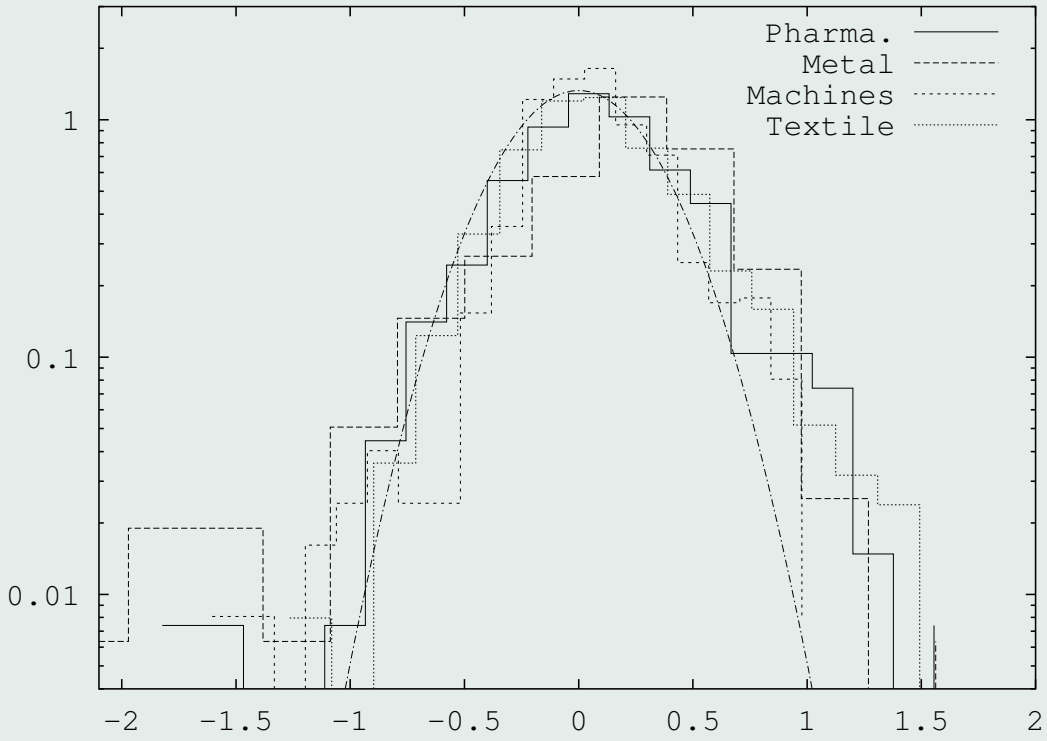

Figure 11: Probability densities of the productivity for four sectors (the normal distribution is plotted as guide for the eyes).

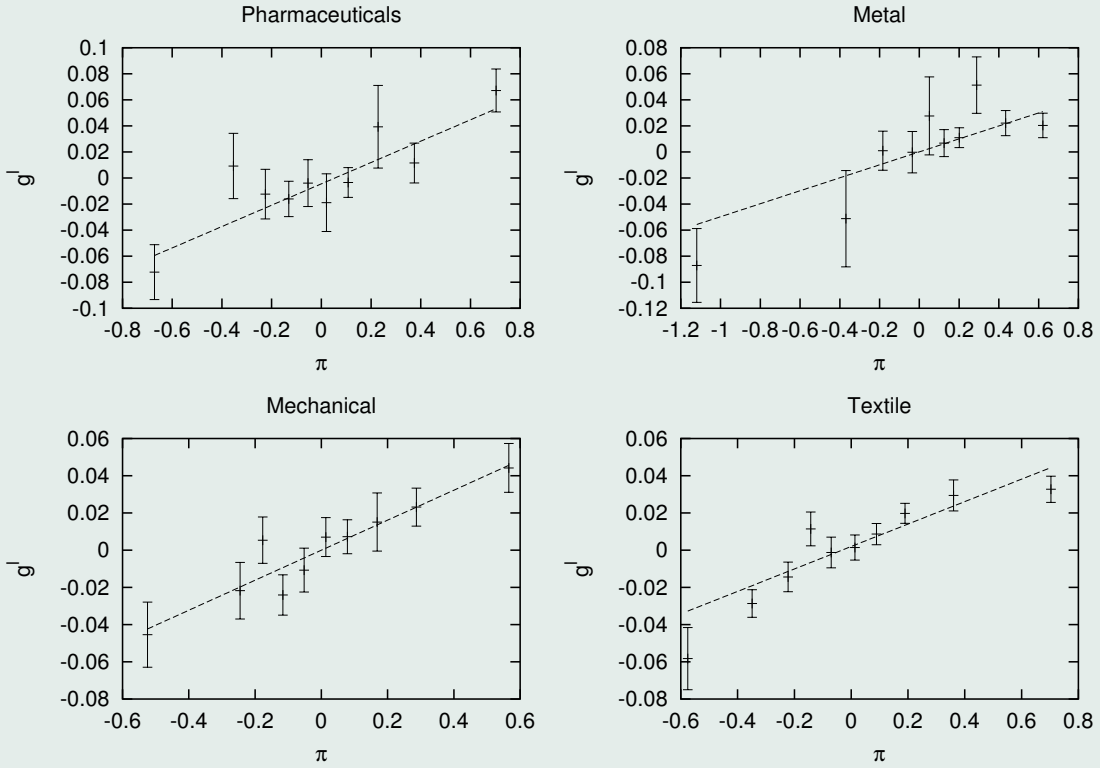

Figure 12: Regression of the employees growth g^l against productivity.

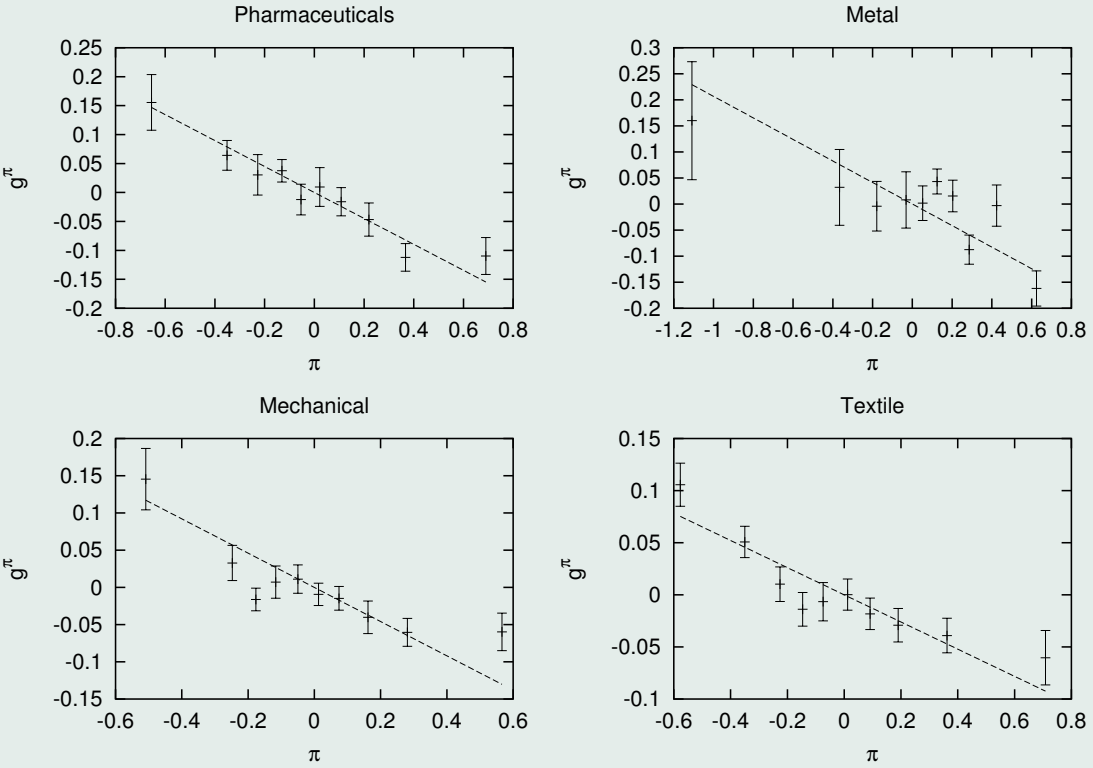

Figure 13: Regression of productivity growth g^π on the average productivity.

Essential References

Bottazzi G., E. Cefis, G. Dosi (2002) “Corporate Growth and Industrial Structure. Some Evidence from the Italian Manufacturing Industry” *Industrial and Corporate Change* 2,4.

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Ijiri Y., Simon H. A. (1964) “Business Firm Growth and Size” *American Economic Review*, Vol. 54, 77-89.

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