Invariances and Diversities in the evolution of business firms

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Sketching the research framework

Pervasive heterogeneity
  in size
  in production structure
  in growth
  in profitabilities

Self-reinforcing mechanisms
  in growth processes
  in diversification processes
  in location processes (No time)

Conclusions
Outline

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Major research question

Fundamental drivers of the evolution of contemporary economies are the activities of

- search
- discovery
- economic exploitation

of new products, new production processes, new organizational arrangements within and amongst business firms

Given that, what are the statistical properties that such processes might possibly display?
3 operative questions

■ **First**, are there distinct characteristics of the micro-entities (in primis, business firms) and their distributions which systematically persist over time?

■ **Second**, how do such possible heterogeneous characteristics within the population of competing firms affect their relative evolutionary success over time?

■ **Third**, amongst the foregoing statistical properties and relations between them, which ones are invariant across industries, and, conversely, which ones depend on the technological and market characteristics of particular sectors?
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Empirically based Industrial Dynamics

Main building block:

- we are well aware of a continuing movement of the elements which make up the population as it appears

- still certain economic distributions are stable over time

This point at the idea of **steady-state equilibrium**: “a state of macroscopic equilibrium maintained by a large number of transitions in opposite directions” (Feller, 1957).
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FSD - Firm size distribution

Italian manufacturing industry, 1997
FSD - Firm size distribution

Italian manufacturing industry, 1997
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Single input productivity distributions

- Widespread heterogeneity again persistent over time

- We do not find evidence of a simple relation predicting that financial conditions should map on to one with efficiency in production. Two tentative interpretations.

- Results are robust to sectoral disaggregation at 2-digit level.
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FGRD - Firm growth rates distribution

Let us consider again the normalized (log) firm size $s_i(t)$. We then define growth rates as its first difference:

$$g_i(t) = s_i(t + 1) - s_i(t)$$
Italian Manufacturing industry, 1997
FGRD - Firm growth rates distribution

Aggregate

Pharmaceuticals

Cutlery, tools and general hardware

Footwear
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Firms profitability distribution

Consider the variable

$$GM_i(t) = (VA_i(t) - W_i(t))/VA_i(t)$$

where $GM_i$ is gross operating margins; $VA_i$ is value added; $W_i$ is the total wage cost.
Figure: Empirical densities of (log) Gross Margin by sector. Thousands of euro, deflated with production price index. Italian data.
Most robust findings on profitability

A sum up of the most robust findings on profitability

- wide distributions of probabilities across firms characterize all sectors
- stability over time
- some (mild) regression to the mean tendencies
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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 \( \epsilon_j \) are independent from size \( s \)
- opportunities \( G \) progressively captured by firms

Suppose to have \( M \) opportunities to be assigned to \( N \) firms. One possibility is to assign each opportunity with the same probability **BUT this implies a Gaussian growth rate distribution.**
1. Consider an urn with \( N \) different balls, each representing a firm.

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

2. Repeat this procedure \( M \) times.

RESULT: partition of \( M \) events on \( N \) firms.
Convergence result

When the number of opportunities is very low the FGRD generated by the model is almost gaussian. When $M$ increases
Convergence result

M=1

Firm Growth Rates
Convergence result

M=10

Firm Growth Rates
Convergence result

M=50

Firm Growth Rates

M=10

M=20

M=50

M=100

M=200

M=500

M=1000

M=2000

M=5000

M=10000

M=20000

M=50000

M=100000
### Convergence result

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Convergence result for different values of M (M=1, M=10, M=20, ..., M=100000) showing Firm Growth Rates.

Diagram for M=500 showing the convergence result.
Convergence result

M=1000

Firm Growth Rates
Convergence result

Firm Growth Rates

M=2000

0.0001 0.001 0.01 0.1 1
-5-4-3-2-1 0 1 2 3 4 5
Convergence result

M=5000
Convergence result

M=10000

Firm Growth Rates
Convergence result
Convergence result

For different values of M, the graph shows the firm growth rates. The x-axis represents the firm growth rates, while the y-axis shows the convergence result for each value of M:

- M=1
- M=10
- M=20
- M=50
- M=100
- M=200
- M=500
- M=1000
- M=2000
- M=5000
- M=10000
- M=20000
- M=50000
- M=100000

The graph illustrates the convergence of growth rates for various M values, with 10^-5 to 1 on the y-axis and -5 to 5 on the x-axis.
Convergence result

![Graph showing firm growth rates for different values of M.]
Convergence result

M=500000

Firm Growth Rates

1e-05 0.0001 0.001 0.01 0.1 1
-5-4-3-2-1 0 1 2 3 4 5
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Conclusions
Dividing firms in size classes and computing the Log(Std.Dev) for their growth rates

\[ \ln \sigma(G_i) = \beta \ln S_i \]

\[ \beta = -0.21(0.02) \]
\[ G_i(t) = \sum \frac{\tilde{S}_{ij}(t + 1)}{\tilde{S}_i(t)} - 1 = \sum_j \frac{1}{N_i(t)} \cdot G_{ij}(t) \cdot \Delta_{ij}(t) \quad (1) \]

where

- \[ G_{ij}(t) = \frac{\tilde{S}_{ij}(t + 1)}{\tilde{S}_{ij}(t)} - 1 \] Growth in a given sub-market

- \[ \Delta_{ij}(t) = \frac{N_i(t) \cdot \tilde{S}_{ij}(t)}{\tilde{S}_i(t)} \] Corporate Coherence

- \[ N_i(t) \] Diversification
\[ G_i(t) = \sum \frac{\tilde{S}_{ij}(t + 1)}{\tilde{S}_i(t)} - 1 = \sum_j \frac{1}{N_i(t)} \quad G_{ij}(t) \cdot \Delta_{ij}(t) \quad (1) \]

where

- \( G_{ij}(t) = \frac{\tilde{S}_{ij}(t + 1)}{\tilde{S}_{ij}(t)} - 1 \)  \text{Growth in a given sub-market}  
  \text{No observed relation with S!}

- \( \Delta_{ij}(t) = \frac{N_i(t) \cdot \tilde{S}_{ij}(t)}{\tilde{S}_i(t)} \)  \text{Corporate Coherence}

- \( N_i(t) \)  \text{Diversification}
\[ G_i(t) = \sum \frac{\tilde{S}_{ij}(t + 1)}{\tilde{S}_i(t)} - 1 = \sum_j \frac{1}{N_i(t)} \cdot G_{ij}(t) \cdot \Delta_{ij}(t) \quad (1) \]

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- \( N_i(t) \) Diversification
\[ G_i(t) = \sum \frac{\tilde{S}_{ij}(t + 1)}{\tilde{S}_i(t)} - 1 = \sum_j \frac{1}{N_i(t)} G_{ij}(t) \Delta_{ij}(t) \quad (1) \]

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- \( G_{ij}(t) = \frac{\tilde{S}_{ij}(t + 1)}{\tilde{S}_{ij}(t)} - 1 \) Growth in a given sub-market

No observed relation with \( S \)

- \( \Delta_{ij}(t) = \frac{N_i(t) \tilde{S}_{ij}(t)}{\tilde{S}_i(t)} \) Corporate Coherence

No observed relation with \( S \)

- \( N_i(t) \) Diversification

It must have a relation with \( S \)
Random diversification: random arrival of independent diversification events during the firms’ history

Linear relation between $N$ and $S$
Random diversification: random arrival of independent diversification events during the firms’ history

Linear relation between N and S

Scope economy to diversification: the capability of a firm to enter a new market increases with its past successful diversification events

Exponential relation between N and S
Clear exponential relation between $N_i \sim S_i$

The sole diversification explains the relation $\text{var}_{it}[G_i(t)] \sim S_i$!
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The model is the policy

1. Empirical investigations detect regularities emerging from heterogeneous behavior;

2. these regularities suggest the presence of self-reinforcing mechanisms possibly operating at different levels (growth, diversification, ...)

3. capturing these effects is a necessary condition to obtain more reliable models of industrial dynamics,

4. in turn offering (perhaps) interesting insights also for more aggregate models.