

ICRIOS

*The Invernizzi Center for Research on Innovation, Organization, Strategy
and Entrepreneurship*



SID

**AND OUR UNDERSTANDING OF
THE EVOLUTION OF INDUSTRIES**

Franco Malerba

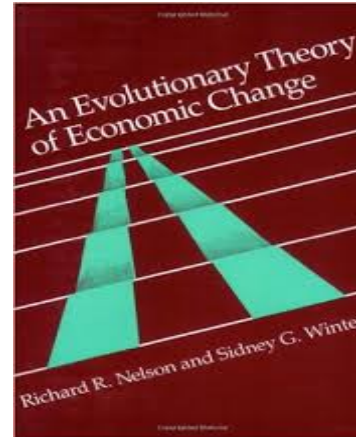


SID and the evolution of industries

This topic is a long-standing area of interest for Sid.

His interest derives from:

- His work with Dick Nelson
- His reading of Schumpeter *The Theory of Economic Development* (1934) and *Capitalism, Socialism and Democracy* (1950)
- His long-standing focus on the links between firm entry, growth and heterogeneity and the dynamics of industrial concentration



Sid forcefully moved into the analysis of industry evolution in 1984

Sidney G. Winter *Schumpeterian competition in alternative technological regimes* JEBO 1984

- Focuses on Schumpeterian competition
- Draws a distinction between new firms and established firms
- Highlights the role of technological context

Sid identifies two regimes: *entrepreneurial* and *routinized*



In JEBO (1984) Sid writes the following:

The addition of the entry model to the simulation model previously used (i.e. Nelson and Winter, 1982) opens the way to comparison of simulated industry histories with actual industry histories, and perhaps, therefore, to explanations of some quantitative patterns noted in the latter. This present paper is only a beginning along this line of enquiry. (Winter 1984, pg. 289)



YEARS LATER...



"This book offers welcome advancements to the understanding of industrial dynamics as innovation-driven evolutionary processes. Over the last forty years or so, major progress has been made both in the identification of relatively general 'stylized facts' of industrial evolution and in their account by means of evolutionary models. Much less has been done toward bringing formal theories to the specificities of particular industry histories. This is what this work does, using phenomenologically very detailed models as a sort of coherent thought experiments on the causal mechanisms, yielding the specific features of the histories of the computer, semiconductors and pharmaceutical industries. To be read by history-inclined scholars generally skeptical about any formalization. And to be read by modelers often weary of qualitative histories."

Giovanni Dosi, Professor of Economics, Scuola Superiore Sant'Anna

"Four of the world's leading evolutionary economists have combined to build this new and exciting bridge between economic theory and history. Every scholar who is interested in innovation, research and development, competition, and industrial organization will want to cross this bridge. Many will find here important challenges for their future work in economic and business history as well as economics."

Louis Galambos, Professor of History, Johns Hopkins University

"The co-authors of this volume are pioneers in the development of 'history-friendly models' of the evolution of knowledge-intensive industries. This book extends and elaborates that work, enriching our understanding of the development of the computer, semiconductor, and pharmaceuticals industries. The volume is a major contribution to economics, strategy, and policy."

David C. Mowery, William A. and Betty H. Hasler Professor of New Enterprise, Emeritus, University of California, Berkeley

Cover illustration: Images ENIAC COMPUTER
 © Pictorial Press Ltd / Alamy Stock Photo; IBM 5150 PC
 © INTERFOTO / Alamy Stock Photo; iPhone 3GS
 © Frankie Angel / Alamy Stock Photo.

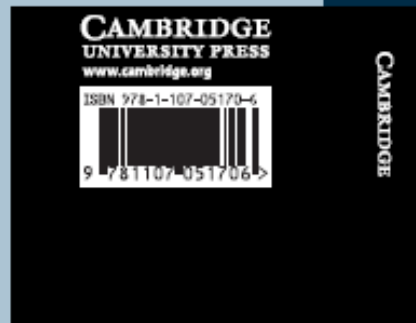
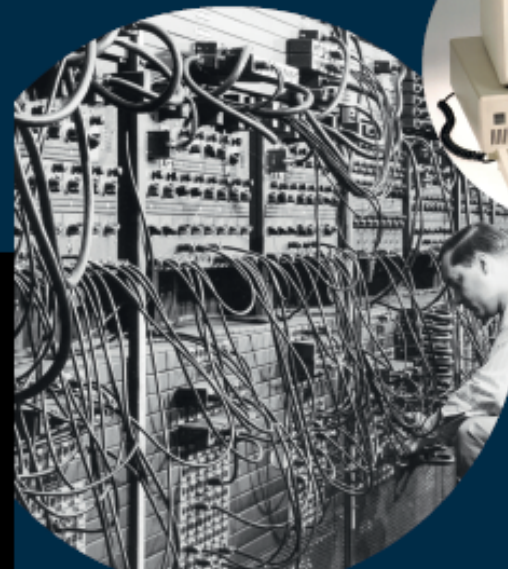
COVER DESIGNED BY HART McLEOD LTD

Malerba, Nelson,
 Orsenigo and Winter
**INNOVATION and the
 EVOLUTION OF INDUSTRIES**

INNOVATION and the EVOLUTION OF INDUSTRIES

HISTORY-FRIENDLY MODELS

Franco Malerba
 Richard R. Nelson
 Luigi Orsenigo
 Sidney G. Winter



What are history-friendly models?

History-friendly models are evolutionary models: firms are boundedly rational agents; their behavior is guided by routines; learning is a key process; heterogeneity of firms and their capabilities characterize an industry.

History-friendly models are agent based simulation models which aim to capture in stylized form qualitative theories about mechanisms and factors affecting innovation and industry evolution. These mechanisms and factors are put forth by empirical research and appreciative theorizing.



Why the need for history-friendly models?

There are a lot of in-depth studies and histories of the evolution of particular industries which show:

- a) the importance of several factors (firms' learning, capabilities and strategies, technology, demand, institutions...), the complex interaction among these factors and the role of feedbacks, dynamics and co-evolutionary processes.**
- b) major differences across industries.**

On the basis of these studies, appreciative theories have been developed regarding factors and mechanisms at work in the evolution of industries.

But there is the need to complement these appreciative theories with more formal and coherent models that explore, test and sharpen appreciative theories.



How are these models different from the earlier-generation of evolutionary models?

The first-generation of evolutionary models (Nelson and Winter, 1982, Dosi et al. 1995, Winter et al. 2000 and many others) aim to show that stylized economic phenomena can be generated by evolutionary processes.

They are at a fairly high level of generality, aggregation and abstraction and aim at a rough consistency with stylized characterization of economic phenomena.

Earlier generation of evolutionary models do not focus on the specificities and differences in industrial contexts, on the role of the variety of actors that affect innovation and on the complex evolution of industries. History-friendly models do.



How to develop a history-friendly model

Step 1. Study of the characteristics of the phenomenon under examination

Identification of the main features to be analyzed

Development of the appreciative theory

Step 2. Building of the model

Step 3. Running and calibration of the model, examination of the results and sensitivity analysis

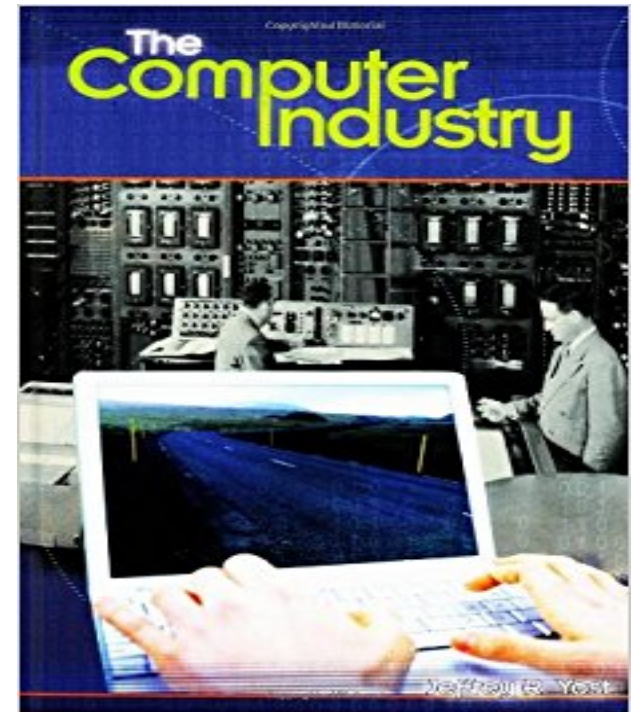
Step 4. Test for different outcomes by making changes in the parameter values of some key variables



Factors affecting the evolution of specific industries from the 2016 book

The computer industry (1950-1985)

- **Cumulativeness and increasing returns along different product trajectories**
- **Technological and market discontinuities**
- **Bandwagon effects in demand**



Emergence and consolidation of concentration in some product segments, entry and competition in others, depending on the level of bandwagon effects.



Industry Specificities (2)

The pharmaceutical industry (from the early period to molecular biology)

- Low cumulativeness of technological advance
- Technological regimes with IPR and imitation
- Fragmented demand



Generation of low level of overall concentration, with higher level of concentration in individual market segments.

Coexistence of large innovators and small imitators.

Industry Specificities (3)

The co-evolution of the semiconductor and computer industries (1950s-1985)

- High technological opportunity
- Major technological and market discontinuities
- Vertically linked industries

Specialization and vertical integration as co-determined by the dynamics of capabilities, technology and firm size in the upstream and downstream Industries



So, are history-friendly models suitable only for examining the evolution of specific industries?

No.

History-friendly models may be used also to identify and examine generic mechanisms that drive industry evolution:

- firm growth and changing industry structure**
- innovation and increasing returns**
- technological regimes and demand regimes**
-**

and to explore more general issues relevant for broader contexts or that cut across different industries:

- entry**
- public policy**

....



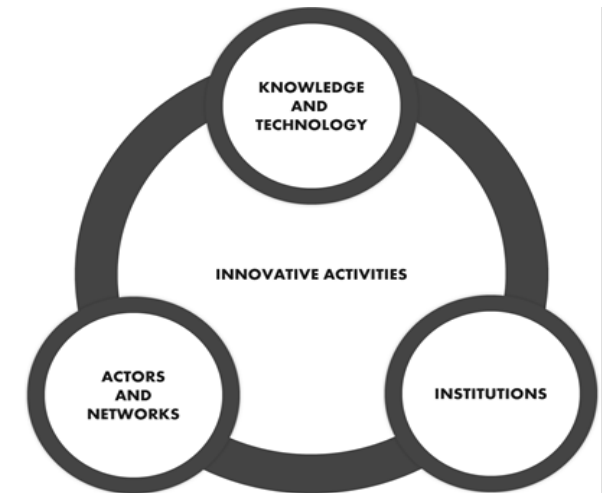
Which way forward?

Here is my set of idyosincratic challenges

- *Use HFMs to Investigate the evolution of other industries*
 - Traditional industries
 - Services
 -
- *Examine the working of sectoral systems*

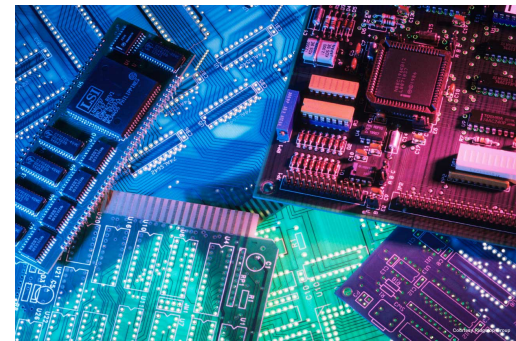
This means looking at the co-evolution of

 - knowledge and technology
 - actors (focal firms, users, universities.....)
 - and institutions



The way forward (2)

- *Examine the performance of alternative firm strategies in the evolution of an industry*
- *Look at the co-evolution of two vertically related industries*



The way forward (3)

- *Link the emergence and performance of spinoffs to their sectoral contexts*
- *Examine the catching-up by firms from emerging economies in specific industries*



- ***And so many other interesting topics to be examined by history-friendly models!***



These challenges can be met if we follow Sid's fundamental principles of evolutionary economics

- 1. Realism**
- 2. Dynamic first**
- 3. No free calculation**
- 4. Firms are profit seeking**
- 5. Innovation is always an option**
- 6. Firms are historical entities**
- 7. Firms are repositories of productive knowledge**
- 8. Progress is co-evolutionary**
- 9. Anything can happen for a while**

