

# A Review of Design Approaches within Schumpeterian Economic Simulations

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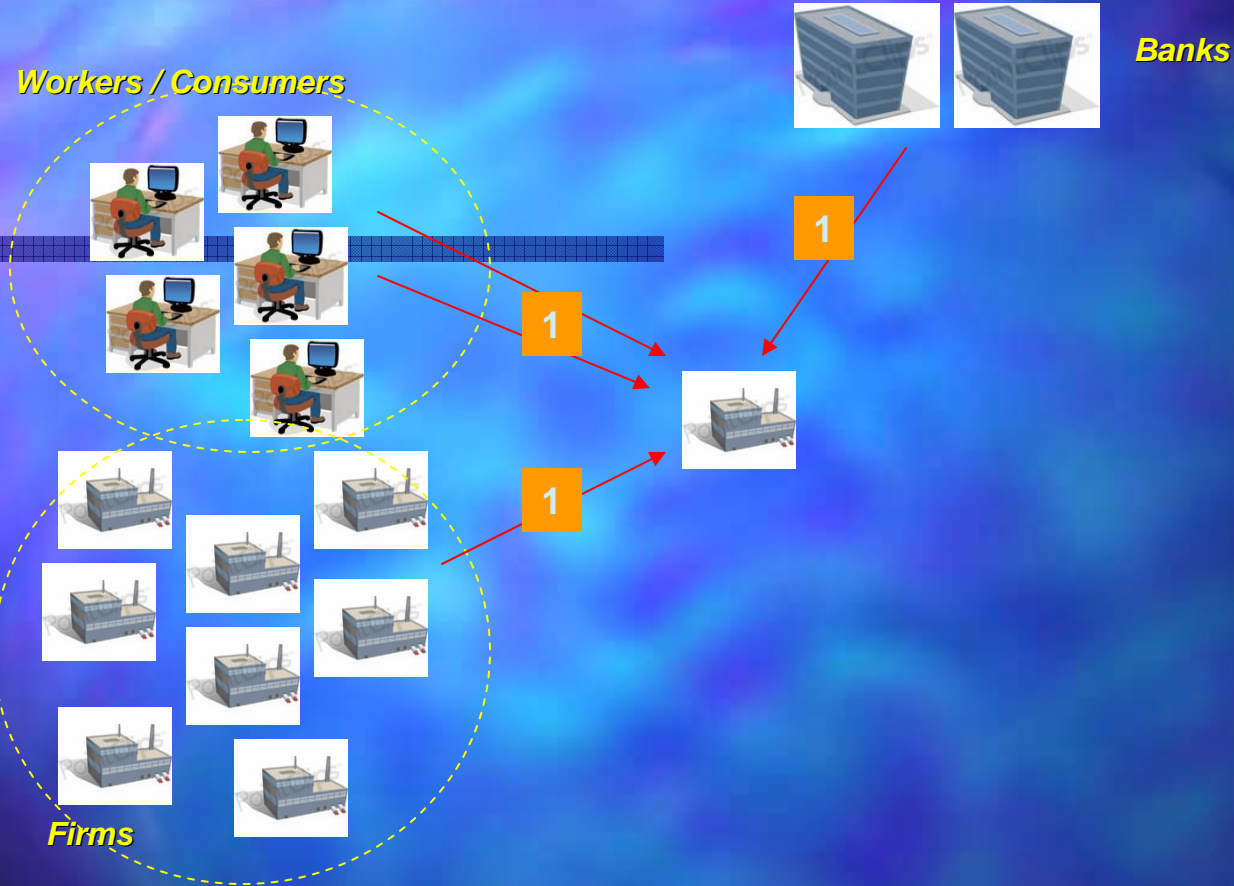
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# A Review of Design Approaches within Schumpeterian Economic Simulations

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- Introduction
- The Theory of Economic Development (TED) - a brief outline
- TED Design Requirements
- Design review of Schumpeterian models
- Implications / Comparison between ABM & CGE development frameworks

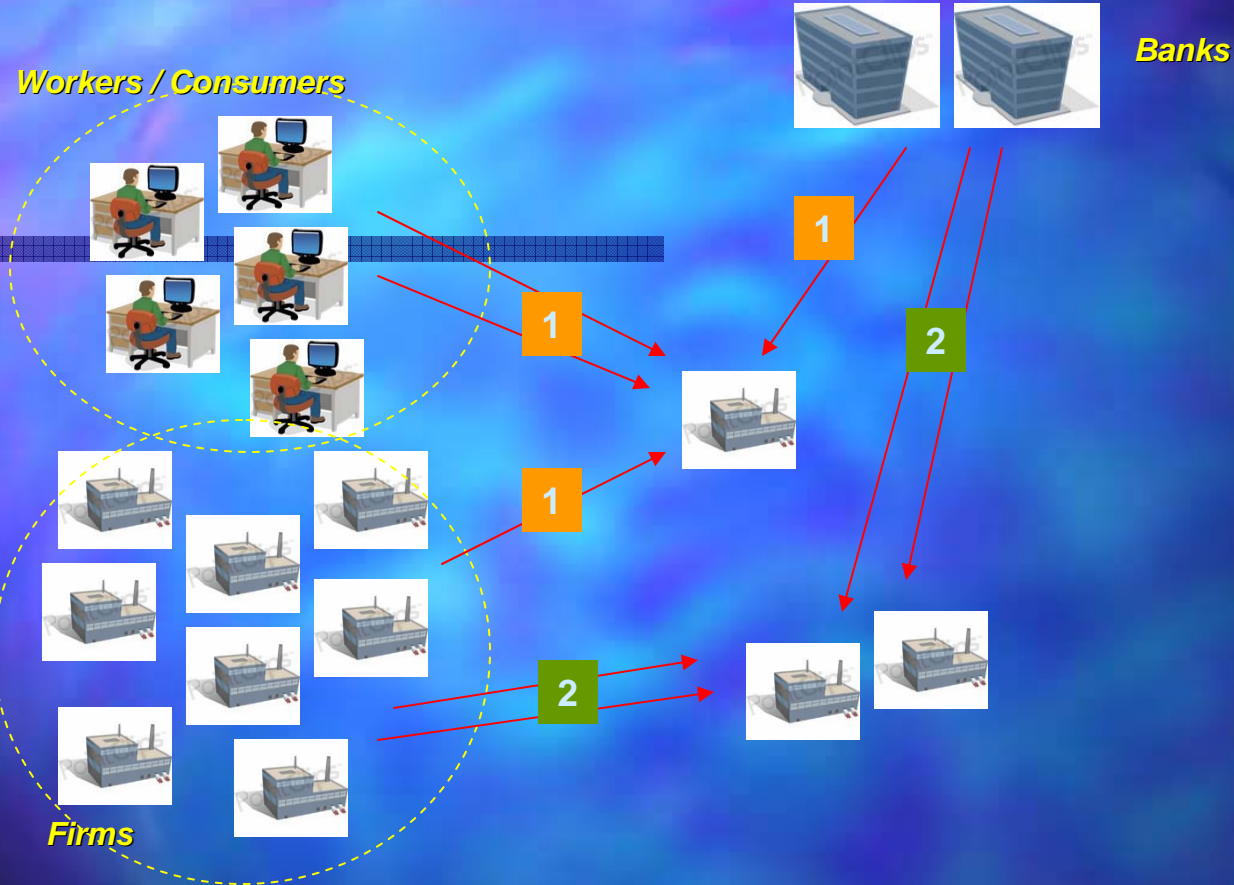
# Theory of Economic Development - Visual Representation



## Phase 1:

- \* Entrepreneur seeks, gets credit from bank (rate determined by risk)
- \* Resources drawn from existing firms
- \* Monetary expansion (higher availability of credit)

# Theory of Economic Development - Visual Representation



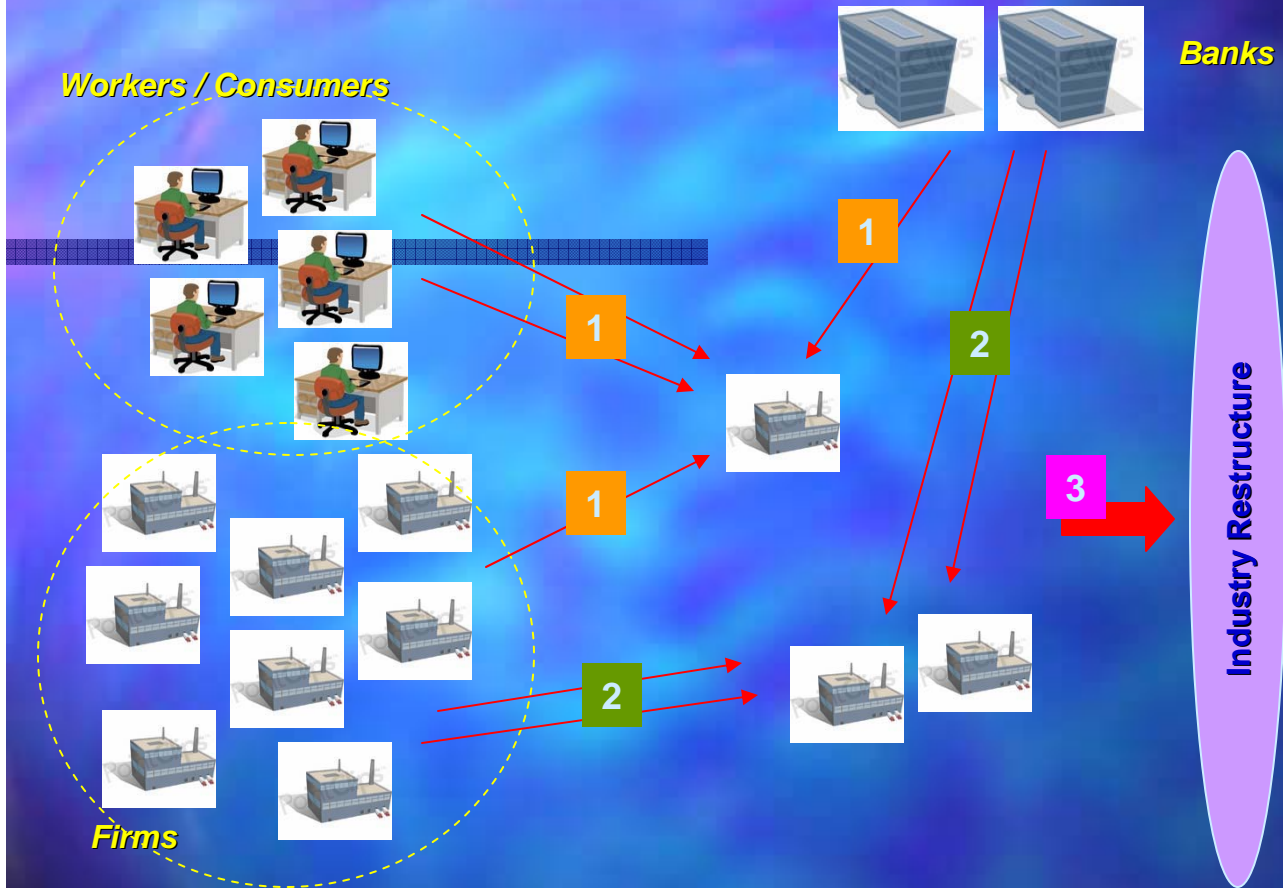
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- \* Imitation of innovation by firms in "swarm" effect
- \* More credit provided, more resources drawn from existing firms
- \* Aggregate output drops, prices rise
- \* Output from firm innovation enters the marketplace

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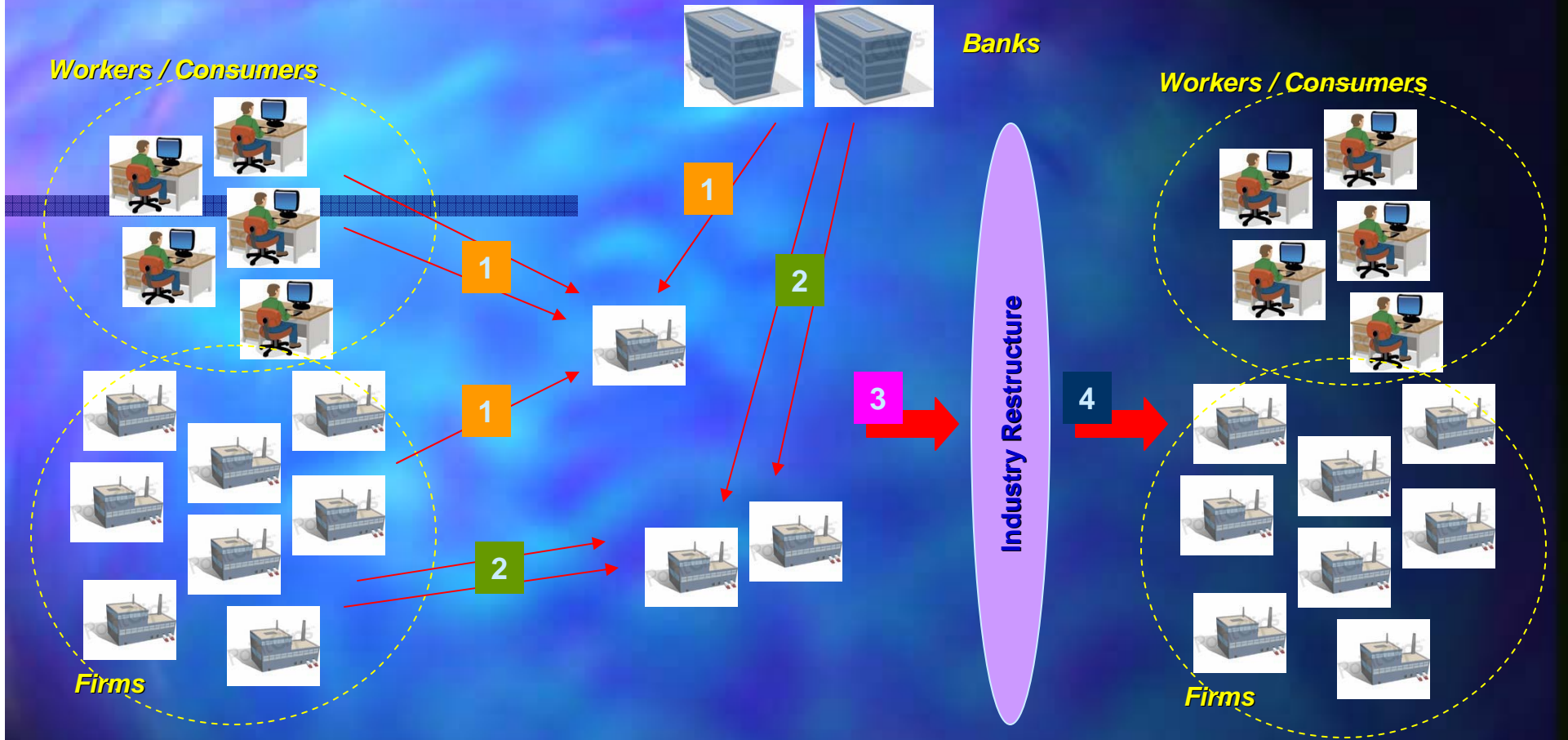
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## Phase 3:

- \* Consumer prosperity decreases
- \* Lending diminishes as opportunities for gain decrease
- \* Autodeflation as credit availability decreases (recession)
- \* Bank loans get repaid by innovating firms
- \* Entrepreneurial activity decreases
- \* Firm bankruptcy, restructure

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## Phase 4:

- \* Output of new firms increase beyond original equilibrium level
- \* A new equilibrium is established
- \* Prices decline as supply/demand equilibrates

# Theory of Economic Development - Design Requirements

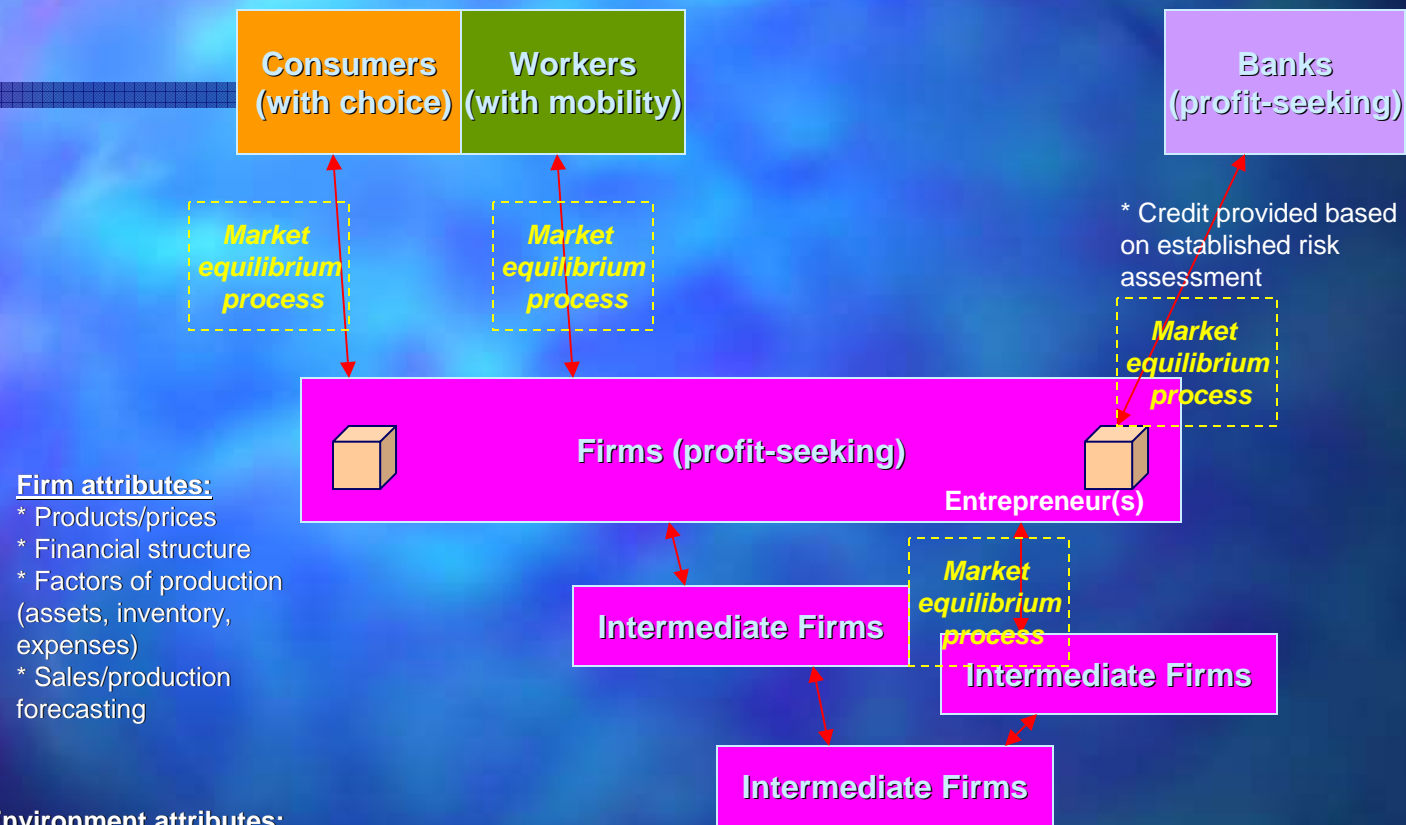
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## Ideal Objectives:

- Treat Schumpeterian economic development, as a complete, integrated concept
- Ensure that all financial transactions are part of an endogenous monetary environment
  - Detailed financial status of each agent is a consequence
- Treat all “agents” as discrete, decision-making entities, i.e. Be able to focus at the micro-level
- Encompass an entrepreneur role as a critical catalyst in the development process



# Theory of Economic Development - Design Requirements



- Firm attributes:**
- \* Products/prices
  - \* Financial structure
  - \* Factors of production (assets, inventory, expenses)
  - \* Sales/production forecasting

- Environment attributes:**
- \* Signalling between firms wrt innovation opportunity, confidence levels
  - \* Financial structure
  - \* Factors of production (assets, inventory, expenses)

- Industry attributes:**
- \* Competitive strategy devt by firms
  - \* Ongoing evolution of structure

**PLUS (non-Schumpeterian):**

- \* Firm ability to learn & adapt (RBV concepts)

# Models Reviewed

#	Title	Author(s)	Year
1	The Microfoundations of Business Cycles - An Evolutionary, Multi-Agent Model	Dosi, G., Fagiolo, G. & Roventini, A.	2005
2	Market structure and Schumpeterian growth	Lambson, V. & Phillips, K.	2007
3	Innovation waves, self-organized criticality and technological convergence	Andergassen, R., Nardini, F. & Ricottilli, M.	2006
4	Agent-Based Modeling - A Methodology for Neo-Schumpeterian Economics	Pyka, A. & Fagiolo, G.	2005
5	New Directions in Schumpeterian Growth Theory	Dinopoulos, E. & Sener, F.	2007
6	Production Structure and Economic Fluctuation	Ciarli, T. & Valente, M.	2005
7	Competition and Growth in a Neo-Schumpeterian Model	Denicolo, V. & Zanchettin, P.	2005
8	The dynamic effects of general purpose technologies on Schumpeterian growth	Petsas, I.	2003
9	A Schumpeterian model of endogenous innovation and growth	Englemann, F.	1994
10	Growth Cycles and Firm Dynamics in an Agent-Based Model with Financial Market Imperfections	Napoletano, M., Delli Gatti, D., Fagiolo, G. and Gallegat, M.I	2005

<b>Model Design Features – Covered (Yes/No) or Partially</b>	1	2	3	4	5	6	7	8	9	10
Consumer choice between products/firms	YES	YES	NO	N/A	NO	NO	NO	YES	NO	NO
Multiple products	YES	NO	YES	N/A	YES	YES	NO	YES	NO	NO
Multiple resource types / different skill levels	NO	NO	NO	N/A	NO	NO	NO	NO	NO	YES
Dynamic price-setting	YES	YES	YES	N/A	NO	NO	YES	YES	NO	YES
Equilibrium between Consumers/Households (Demand) & Firms (Supply of consumer goods)	YES	YES	NO	N/A	NO	YES	NO	YES	NO	YES
Equilibrium between Firms (Demand for resource labour) & Resources (Supply of labour)	YES	YES	YES	N/A	YES	NO	NO	YES	YES	YES
Equilibrium between Firms (Demand for credit) & Banks (Supply of credit) related to entrepreneurial reasons	YES	Part	NO	N/A	NO	NO	NO	NO	NO	Part
Profit & Loss capability at firm level, leading to dynamic inventory/resourcing decisions & need for supply of intermediate goods (& intermediate firms)	Part	NO	NO	N/A	NO	YES	NO	NO	NO	Part
Dynamic competitive decision-making by firms, e.g. acquisition, imitation, R&D investment, vertical/horizontal joint ventures	YES	YES	YES	N/A	YES	Part	YES	YES	YES	YES
Facility for aggregate (environment) & agent-level signalling, to be used in behavioural rules/decision-making	Part	Part	NO	N/A	NO	NO	NO	NO	NO	Part
Random/planned innovation events, with links to signalling between agents	Part	YES	YES	N/A	Part	Part	YES	Part	NO	YES
Movement of resources between firms, with links to entrepreneur/innovation events	NO	NO	NO	N/A	NO	NO	NO	NO	NO	NO
Business Cycle output measures	YES	NO	Part	N/A	NO	NO	NO	NO	NO	Part

# Key Trends from Model Design Reviews

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- Aspects from Schumpeter's theory have been a focus, but generally not the complete theory
- The concept of an entrepreneur with an imitation swarm is largely missing
- Credit provision from the banking system driven by innovation is rare
- Competition is focused on cost reduction (and hence price reduction) with a focus on labour efficiency (via R&D expenditure)
- Simplicity assumptions that remove elements of the theory are common

# Implications / Comparison between ABM & CGE development frameworks

Key design / execution issues:

- Incorporation of traditional economic components
  - ABM: Reasonable effort in definition and building classes
  - CGE: Straightforward to define
- Evolution of agents & flexibility in changing business rules
  - ABM: Flexible through object orientation & inheritance
  - CGE: Programatically intense
- Effort in multi-market optimisation/equilibrium calculations
  - ABM: Programatically intense
  - CGE: Intrinsic capability (multiple methods)
- Learning curve
  - ABM: Intensive for the non-programmer
  - CGE: More straightforward
- Cost
  - ABM: Free
  - Reasonable cost