

MACRODYNAMICS WITH EVOLUTIONARILY ENDOGENOUS BEHAVIORAL HETEROGENEITY

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Outline

- Microfoundations of demand-led macrodynamics: heterogeneous behavior, imperfect information, bounded rationality, strategic interactions and coordination problems.
- Some notions on and in evolutionary game-theoretic dynamics.
- Some demand-led (and even supply-led) macrodynamic models with evolutionary game-theoretic microfoundations: theoretical and empirical implications.

Evolutionary microfoundations of demand-led macrodynamics

- Empirical and experimental evidence on heterogeneity in behavior and expectations formation.
- Imperfect information and bounded rationality.
- Heterogeneity is endogenously time-varying.
- Coevolution of microdiversity and macrodynamics.
- Strategic interactions and coordination problems.
- Insufficiency of a representative agent framework.

Evolutionary game-theoretic dynamics

- Classical game theory: how instrumentally rational players should behave in order to obtain the maximum possible payoff in a formal game → stringent assumptions about everyone's beliefs (e.g. common knowledge of rationality) and their interdependent consistency.
- Evolutionary game theory: fitness of a phenotype (observable characteristics or traits) depends on the composition of the population → diversity, selection and replication.
- Emphasis on studying which behavioral phenotypes (e.g. strategies) are stable under some evolutionary dynamics, and how such evolutionary stable states are reached → successful strategies tend to spread more than unsuccessful ones, and fitness is frequency-dependent.

Replicator evolutionary dynamics

- **Replicator:** central actor in an evolutionary system → entity having some means of making approximately accurate copies of itself → it can be a gene, an organism, a strategy in a game, a belief, a technique, a convention, or a more general institutional or cultural form.
- **Replicator system:** set of replicators in a particular environmental setting with a structured pattern of interaction among agents.
- **Evolutionary dynamic of a replicator system:** process of change over time in the frequency distribution of the replicators (and in the nature of the environment and the structure of interaction), in which strategies with higher payoffs reproduce faster in some appropriate sense.
- **Replicator dynamic:** frequency of a strategy increases exactly when it has above-average payoff → the replicator dynamic is not a best-reply dynamic → agents do not adopt a best reply to the overall frequency distribution of strategies in the previous period → agents in a replicator system have limited and localized knowledge concerning the system as a whole.

Satisficing evolutionary dynamics

- Herbert Simon on bounded rationality and satisficing choice behavior.
- Agents face uncertainty about the future and costs in acquiring and processing information in the present, and such factors limit the extent to which agents may make a fully rational decision.
- **Satisficing**: choices are identified that are suitable enough by comparing their attributes to some **standard** → choices are compared to the **aspiration level** of how good a choice might be made.
- Choice as intending to meet an **acceptability threshold** rather than to select the best of all possible alternatives.
- **Satisficing** choice theory contrasts with optimization theory → contrast analogous to 'looking for the sharpest needle in the haystack' (i.e., optimizing) versus 'looking for a needle sharp enough to sew with' (i.e., satisficing) (Simon, 1987, p. 244).
- **Satisficing evolutionary dynamics**: frequency of a strategy varies with its performance relatively to some **aspiration level** or **acceptability threshold**.

Macrodynamic models with evolutionary game-theoretic microfoundations

- Silveira and Lima (RBE 2008) and Lima and Silveira (BRE 2008): extent of real effects of monetary shocks depend on frequency distribution of pricing strategies.
- Silveira and Lima (EE 2013): evolutionary dynamics of distribution of strategies to form inflation expectations affect conduct of monetary policy (e.g., extent of interest rate changes and no need to satisfy the Taylor principle).
- Lima and Silveira (EI 2015): Magnitude and duration of monetary shocks depends both on (1) the distribution of information-updating strategies across firms and (2) the dispersion in the cognitive abilities of firms playing a given information-updating strategy.

Macrodynamic models with evolutionary game-theoretic microfoundations

- Silveira and Lima (RBE 2015): complete confidence as an equilibrium emerging from rule-of-thumb behavior through an evolutionary dynamics.
- ✓ Equilibrium solution with the aggregate price level target being reached does not appear because all price setters are fully confident, but rather price setters eventually become fully confident because a best-reply monetary policy ensuring the reach of that target as an equilibrium solution has been followed for long enough.
- ✓ Relevant implication for the conduct of monetary policy in pursuit of price stability: setting a price level target matters more as a way to give monetary policy a sharper focus on price stability than as a device to conquer credibility.
- ✓ As regards the conquering of credibility, it turns out that actions speak louder than words.

Macrodynamic models with evolutionary game-theoretic microfoundations

- Lima, Setterfield and Silveira (JPKE 2014): relative importance of *confidence* in and *credibility* of an inflation and output target regime with *heterogeneous inflation expectations in satisficing evolutionary dynamics*:

(a) Full confidence or credibility (all agents eventually adopt the forecasting heuristic based on the target rate of inflation) is neither a necessary condition for realization of the inflation target, nor an inevitable consequence of the achievement of this target.

(b) Equilibrium solution consistent with the achievement of the inflation and output targets does not emerge because all agents are fully confident. Instead, all agents eventually become fully confident because the inflation and output targets are reached.

(c) *Both* targets will be reached even if monetary policy is the *only* policy instrument in use, despite the apparent violation of the Tinbergen (1952) principle.

Macrodynamic models with evolutionary game-theoretic microfoundations

- Silveira and Lima (MECA 2016): demand-led model of income distribution and economic growth in which a higher wage share in income and hence a higher growth rate in the long run may be accompanied by a larger wage differential.
- Lima and Silveira (WP IPE-USP 2014): demand-led model of income distribution and economic growth in which a higher proportion of firms sharing profits with workers can either increase or reduce economic growth in the long run.
- Lima and Silveira (WP IPE-USP 2017): classical, supply-led model of income distribution and economic growth in which a higher proportion of firms sharing profits with workers can either increase or reduce economic growth in the long run.
- Silveira and Lima (2017): wage inequality as another worker discipline device → a higher proportion of efficiency-wage firms results in a higher wage share in income, but also in a larger wage differential across workers.

Referências bibliográficas

- Gintis, H. (2009) *Game Theory Evolving: A Problem-Centered Introduction to Modeling Strategic Interaction*, second edition, Princeton, NJ: Princeton University Press, cap. 12.
- Lima, G. T., Setterfield, M. and Silveira, J. J. (2014) Inflation targeting and macroeconomic stability with heterogeneous inflation expectations, *Journal of Post Keynesian Economics*, 37(2), 255-279.
- Lima, G. T. and Silveira, J. J. (2014) Macroeconomic performance under an evolutionary dynamics of profit sharing, Department of Economics of the University of São Paulo, Working Paper Series, 2014_27, <https://ideas.repec.org/p/spa/wpaper/2014wpecon27.html>
- Lima, G. T. and Silveira, J. J. (2015) Monetary neutrality under evolutionary dominance of bounded rationality, *Economic Inquiry*, 53(2), 1108-1131.
- Lima, G. T. and Silveira, J. J. (2017) Wage inequality as another worker discipline device, Department of Economics of the University of São Paulo, mimeo.
- Silveira, J. J. and Lima, G. T. (2013) Regime monetário de meta de inflação em um ambiente de heterogeneidade de estratégias de formação de expectativas de inflação, *Estudos Econômicos*, 43(2), 213-239.
- Silveira, J. J. and Lima, G. T. (2015) Conquering credibility for monetary policy under sticky confidence, *Revista Brasileira de Economia*, 69(2), 251-261.
- Silveira, J. J. and Lima, G. T. (2016) Effort elicitation, wage differentials and income distribution in a wage-led growth regime, *Metroeconomica*, 67(1), 44-75.
- Silveira, J. J. and Lima, G. T. (2017) Employee profit sharing and labor extraction in a classical model of distribution and growth, Department of Economics of the University of São Paulo, Working Paper Series, 2017_2.
<https://ideas.repec.org/p/spa/wpaper/2017wpecon02.html>
- Weibull, J. W. (1995) *Evolutionary Game Theory*, Cambridge, MA: MIT Press, cap. 3.