# “Imperfect Knowledge Macroeconomics”

## The Contribution of R. Frydman and M. D. Goldberg

Pietro Dindo

LEM, Scuola Superiore Sant’Anna, Pisa

Alternative approaches to macroeconomics and micro-macro links
Scuola Sant’Anna, 22-23 July 2009

# Outline

Roman Frydman and Micheal D. Goldberg
**Macroeconomic Theory for a World of Imperfect Knowledge**
*Capitalism and Society*, **3**(3), 1–76, 2008.

- Background info on authors
- Summary of the paper
  1. Discourse
  2. Equations
  3. Applications to currency/assets markets
- Few personal considerations

Roman Frydman and Micheal D. Goldberg
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# Frydman and Goldberg

Roman **Frydman**, Professor of Economics, Department of Economics, New York University.

# Frydman and Goldberg

Michael **Goldberg**, Roland H. O'Neal Professor, Whittemore School of Business and Economics, University of New Hampshire.

# ... and their work


1. Frydman, R. (1982). **Towards an understanding of market processes: individual expectations, learning and convergence to rational expectations equilibrium**. *American Economic Review*, 72, 652–668.
2. Goldberg, M. and R. Frydman (1996). **Imperfect knowledge and behavior in the foreign exchange market**. *Economic Journal*, 106, 869–893.
3. Goldberg, M. and R. Frydman (1996). **Empirical exchange rate models and shifts in the co-integrating vectors**. *Journal of Structural Change and Economic Dynamics*, 7, 55–78.
4. Johansen, S., K. Juselius, R. Frydman, and M. Goldberg (2008). **Testing hypotheses in an I(2) model with applications to the persistent long swings in the Dmk/$ rate**. Forthcoming in *Journal of Econometrics*.
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# Macroeconomic Theory

Extant models

- Mathematical skeleton
- Microfounded (aggregates of individual behavior)
  1. forecasts of future market outcomes
  2. preferences that rank these forecasts
  3. constraints
  4. decision rule (e.g. maximization)

# REH Macroeconomic theory

As a result:

1. models *generate sharp predictions*, either deterministic or in terms of conditional probabilities,
2. even when change (policy, preferences) occur, the model *fully prespecify* them,
3. unless agents use Rational Expectation, that is, unless the modeler represents agents *forecasting strategies with one probability distribution generated by the aggregate model that he himself constructs* models are *internally inconsistent* (Lucas' critique)

$\Rrightarrow$ Rational Expectations Models, that is, no role for forecasts

> *"people beliefs are note inputs, but the outcomes of economists' theories"*

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# Problems with current approach:

1. On philosophical grounds because *the causal mechanism that underpins change in capitalist economies is not completely intelligible to anyone, including market participants, economists, policy officials, or social planners*.
2. Do not fit data (e.g. deviations from fundamentals in currency and assets markets).
3. No role for *diversity* in forecasts.
4. Only movement of causal factors can explain time-series data. Exogenous fluctuations as opposed to endogenous fluctuations.

Note: Behavioral economics tries to solve these problems at the expense of internal inconsistency (Lucas' critique). Not good.

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# Imperfect Knowledge Economics

Same four ingredients as extant macromodels but **IKE** recognizes that

> *knowledge is inherently imperfect: no one has access to a fully predetermined model that adequately represents the causal mechanism that underpins outcomes in all time periods, past and future.*

In particular **IKE** models

1. allow for diversity of beliefs (also in type of causal mechanism)
2. does *not fully prespecify* which causal variable my be relevant
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4. mathematical modeling, but *qualitative predictions*.

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# A benchmark model

$$P_t = a_t + b_t X_t + c_t \hat{P}_{t,t+1}\,, \tag{1}$$
$$\hat{P}_{t,t+1} = \alpha_t + \beta_t Z_t\,, \tag{2}$$

where

$$X_t = \mu^X + X_{t-1} + \varepsilon_t^X\,, \tag{3}$$
$$Y_t = \mu^Y + Y_{t-1} + \varepsilon_t^Y\,, \tag{4}$$

and, e.g.,

- $a_t = 0$, $b_t = c_t$ disc. rate, $X$ dividend (Asset Market)
- $P_t$ is log exchange rate, $X_t$ log levels of domestic minus foreign money supply and income, $b$ and $c$ depend on the interest elasticity of money demand

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# REH in the benchmark model

Applying the REH, $\hat{P}^{RE}_{t,t+1} = E[P_{t+1}|X_t]$, expectations are an output and can be computed to give

$$P^{RE}_{t+1} = \frac{a(1-c)+b\mu^X}{(1-c)^2} + \frac{b}{1-c}X_t + \frac{b}{1-c}\varepsilon^x_{t+1}\,, \tag{5}$$

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which implies that $Z_t = X_t$.

It is clear that if one assumes that

$$\hat{P}^{RE}_{t,t+1} = \omega(\alpha^1 + \beta^1 X_t) + (1-\omega)(\alpha^2 + \beta^2 X_t) \tag{7}$$

then, unless $\omega = 0$, the model presumes gross irrationality, that is, persistent forecasting errors.

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# Towards and IKE benchmark model

Autonomous revisions of forecasting strategies play a key role. Market price equations become

$$P_t = P_t^{RE} + c(\hat{P}_{t,t+1}^{IK} - \hat{P}_{t,t+1}^{RE}), \tag{8}$$

where $\hat{P}_{t,t+1}^{IK}$ is the aggregation of

$$\hat{P}_{t,t+1}^{i} = \beta_t^i Z_t^i . \tag{9}$$

In the context of currency (asset) market, (8) becomes

$$P_t = P_t^{PPP(Gordon)} + c(\hat{P}_{t,t+1}^{IK} - \hat{P}_{t,t+1}^{RE}), \tag{10}$$

and $i$ is a Bull (L) or Bear (S) strategy.

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# Conservatism and long swings

Assume forecast change

$$\hat{P}^i_{t,t+1} - \hat{P}^i_{t-1,t} = \mathcal{D}\hat{P}^i_{t,t+1} + \varepsilon^{Z^i}_t \,, \tag{11}$$

$$\mathcal{D}\hat{P}^i_{t,t+1} = \Delta\beta^i_t Z^i_t + \beta^i_{t-1}\mu^{Z^i} \,. \tag{12}$$

Conservatism constraints the forecast revise so that both

$$|\Delta\beta^i_t Z^i_t| < |\beta^i_{t-1}\mu^{Z^i}| = \delta_t \,, \tag{13}$$

and

$$|\Delta\beta^i_t \mu^{Z^i}| < |\beta^i_{t-1}\mu^{Z^i}| = \delta_t \,. \tag{14}$$

These restriction predict persistent swings. Can be tested, once a baseline-drift is established, whatever magnitude it has, it “continues” for at least two periods.

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# Endogenous prospect theory and swing reversal

Markets populated by bulls and bears taking long and short positions

$$\hat{R}^{L}_{t,t+1} = \hat{P}^{L}_{t,t+1} - P_t > 0\,, \tag{15}$$

$$\hat{R}^{S}_{t,t+1} = P_t - \hat{P}^{S}t, t+1 > 0\,. \tag{16}$$

*Endogenous prospect theory* is based on expected loss from speculation

$$\hat{l}^{i,L}_{t,t+1} = E^i_t[R^L_{t+1} < 0 | Z^i_t] < 0\,, \tag{17}$$

$$\hat{l}^{i,S}_{t,t+1} = E^i_t[R^S_{t+1} < 0 | Z^i_t] < 0\,. \tag{18}$$

Reversal happens due to gap conditions, that is,

$$\frac{\mathcal{D}\hat{l}^{i,L}_{t,t+1}}{\mathcal{D}g\hat{a}p^{i,L}_t} < 0 \quad \text{and} \quad \frac{\mathcal{D}\hat{l}^{i,S}_{t,t+1}}{\mathcal{D}g\hat{a}p^{i,S}_t} > 0 \tag{19}$$

where $g\hat{a}p^i_t = P^i_{t,t+1} - \hat{P}^{i,PPP}_t$. The IKE approach must not specify when the reversal happens (if it did...).

# Endogenous prospect theory and swing reversal

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# My view

- They take seriously Lucas' critique and rational expectations.
- IKE is a solution only as an act of faith, that is, under the believe that economic actors jettison sharp predictions too.
- Their lesson seems to be: if we do not know, better to be cautious.
- Lots of what they say (e.g. mean reversion) is left out of the model.
- In this modeling tradition, issues of learning RE, costs of learning, rational to use heuristics when they work fine, asymmetric information etc... seem to me more convincing.
- Otherwise other, seemingly Lucas-proofed, approaches seems preferable.

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