“Imperfect Knowledge Macroeconomics”
The Contribution of R. Frydman and M. D. Goldberg

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Alternative approaches to macroeconomics and micro-macro links
Scuola Sant’Anna, 22-23 July 2009
Roman Frydman and Micheal D. Goldberg

*Macroeconomic Theory for a World of Imperfect Knowledge*  

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

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*Imperfect Knowledge Economics: Exchange Rates and Risk*  

The IKE approach (a short summary)
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*Capitalism and Society, 3(3), 1–76, 2008.*

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Imperfect Knowledge Economics: Exchange Rates and Risk

Roman Frydman, Professor of Economics, Department of Economics, New York University.
Michael Goldberg, Roland H. O’Neal Professor, Whittemore School of Business and Economics, University of New Hampshire.
... and their work


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)
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)

⇒ Rational Expectations Models, that is, no role for forecasts

“people beliefs are note inputs, but the outcomes of economists’ theories”

Sargent (2005)
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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 may be relevant
3. jettison sharp predictions (thus avoiding Lucas’ critique and REH)
4. mathematical modeling, but qualitative predictions.
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A benchmark model

\begin{align*}
P_t &= a_t + b_t X_t + c_t \hat{P}_{t, t+1}, \\
\hat{P}_{t, t+1} &= \alpha_t + \beta_t Z_t,
\end{align*}

where

\begin{align*}
X_t &= \mu^X + X_{t-1} + \varepsilon^X_t, \\
Y_t &= \mu^Y + Y_{t-1} + \varepsilon^Y_t,
\end{align*}

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

$$P_{t+1}^{RE} = \frac{a(1 - c) + b\mu^X}{(1 - c)^2} + \frac{b}{1 - c}X_t + \frac{b}{1 - c}\epsilon_{t+1}^X,$$

(5)

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

(6)

which implies that $Z_t = X_t$.

It is clear that if one assumes that

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

(7)

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

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Towards and IKE benchmark model

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

\[ P_t = P_t^{RE} + c(\hat{P}_{t,t+1}^{IK} - \hat{P}_{t,t+1}^{RE}) , \]  

(8)

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

\[ \hat{P}_{t,t+1}^{i} = \beta_t^i Z_t^i . \]  

(9)

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

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

(10)

and \( i \) is a Bull (L) or Bear (S) strategy.
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and \( i \) is a Bull (L) or Bear (S) strategy.
Conservatism and long swings

Assume forecast change

\[
\hat{P}_{t,t+1}^i - \hat{P}_{t-1,t}^i = \mathcal{D} \hat{P}_{t,t+1}^i + \varepsilon^t_i,
\]

\[
\mathcal{D} \hat{P}_{t,t+1}^i = \Delta \beta^i_t Z_t^i + \beta^i_{t-1} \mu Z_t^i.
\]

Conservatism constraints the forecast revise so that both

\[
|\Delta \beta^i_t Z_t^i| < |\beta^i_{t-1} \mu Z_t^i| = \delta_t,
\]

and

\[
|\Delta \beta^i_t \mu Z_t^i| < |\beta^i_{t-1} \mu Z_t^i| = \delta_t.
\]

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.
Conservatism and long swings

Assume forecast change

\[
\hat{P}_{t,t+1}^i - \hat{P}_{t-1,t}^i = \mathcal{D}\hat{P}_{t,t+1}^i + \varepsilon_t^Z^i, \tag{11}
\]

\[
\mathcal{D}\hat{P}_{t,t+1}^i = \Delta \beta_t^i Z_t^i + \beta_{t-1}^i \mu Z_t^i. \tag{12}
\]

Conservatism constraints the forecast revise so that both

\[
|\Delta \beta_t^i Z_t^i| < |\beta_{t-1}^i \mu Z_t^i| = \delta_t, \tag{13}
\]

and

\[
|\Delta \beta_t^i \mu Z_t^i| < |\beta_{t-1}^i \mu Z_t^i| = \delta_t. \tag{14}
\]

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Assume forecast change

\[
\hat{P}_{t,t+1}^i - \hat{P}_{t-1,t}^i = D\hat{P}_{t,t+1}^i + \varepsilon_t^Z, \quad (11)
\]

\[
D\hat{P}_{t,t+1}^i = \Delta \beta_t^i Z_t^i + \beta_{t-1}^i \mu Z_t^i. \quad (12)
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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.
Endogenous prospect theory and swing reversal

Markets populated by bulls and bears taking long and short positions

\[
\hat{R}_L^{t,t+1} = \hat{P}_L^{t,t+1} - P_t > 0, \\
\hat{R}_S^{t,t+1} = P_t - \hat{P}_S^{t,t+1} > 0.
\]

(15)

(16)

Endogenous prospect theory is based on expected loss from speculation

\[
\hat{l}_i^{L,\hat{}}_{t,t+1} = E_t[R_{t+1}^L < 0|Z_t^i] < 0, \\
\hat{l}_i^{S,\hat{}}_{t,t+1} = E_t[R_{t+1}^S < 0|Z_t^i] < 0.
\]

(17)

(18)

Reversal happens due to gap conditions, that is,

\[
\frac{\mathcal{D} \hat{l}_i^{L,\hat{}}_{t,t+1}}{\mathcal{D} \hat{g}_{\hat{}}^{i,L}_{\hat{}} < 0 \text{ and } \frac{\mathcal{D} \hat{l}_i^{S,\hat{}}_{t,t+1}}{\mathcal{D} \hat{g}_{\hat{}}^{i,S}_{\hat{}} > 0}
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where \(\hat{g}_{\hat{}}^{i,L}_{\hat{}} = P_{t,t+1}^i - \hat{P}_t^{i,PPP}\). The IKE approach must not specify when the reversal happens (if it did...).
Endogenous prospect theory and swing reversal

Markets populated by bulls and bears taking long and short positions

\[ \hat{R}_{t,t+1}^L = \hat{P}_{t,t+1}^L - P_t > 0, \]  
\[ \hat{R}_{t,t+1}^S = P_t - \hat{P}_{t+1}^S, t + 1 > 0. \]  

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(15)  
(16)  
(17)  
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Reversal happens due to gap conditions, that is,

\[ \frac{D\hat{l}_{t,t+1}^L}{D\hat{\text{gap}}_{t}^L} < 0 \quad \text{and} \quad \frac{D\hat{l}_{t,t+1}^S}{D\hat{\text{gap}}_{t}^S} > 0 \]  

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where \( \hat{\text{gap}}_t = P_{t,t+1}^i - \hat{P}_{t}^{PPP} \). The IKE approach must not specify when the reversal happens (if it did...).
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- They take seriously Lucas’ critique and rational expectations.
- IKE is a solution only as an act of faith, that is, under the belief 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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