Opening Models of Asset Prices and Risk to Non-Routine Change

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Paper develops an IKE model of asset prices and risk.

Shows how imposing qualitative and contingent restrictions on change enables us to recognize the importance of non-routine change on the individual and aggregate levels, and yet,

- deliver predictions of market outcomes that are empirically relevant.

Model can account for the central importance of fundamental factors in driving outcomes, but also accord psychological considerations a role;

- compatible with the presumption that individuals are rational.
We focus on modeling two key features of market outcomes that have been particularly difficult to explain with conventional models:

- prolonged asset price swings
- fluctuations in the market risk premium
Irregular, ultimately bounded, overshooting

Inability of REH-based models to account for prolonged swings on the basis of fundamentals has led to the bubble view

- asset prices are driven mainly by psychological considerations — crowd psychology, emotions, and manias — or technical momentum trading.
REH models relate risk to the second-moment properties of data; grossly inconsistent with time-series data.

![Figure 3](image)

Much evidence that the market premium depends on departures of price from benchmark values:

- as participants bid the price farther away from estimates of benchmark values, the riskier it becomes to gamble on an even greater gap.

Preferences and Endogenous Prospect Theory of Risk

We portray individual decision-making with the assumption of utility maximization.

Specification of individuals’ preferences is based on Endogenous Prospect Theory.

Builds on Kahneman and Tversky’s (1979) Prospect Theory:

- Reference dependence – utility depends on gains and losses in wealth relative to a reference level.

- Diminishing sensitivity – marginal utility of both gains and losses decreases with their size.

- Loss aversion – the utility of losses exceeds the utility from gains of the same magnitude.
Stocks and bonds

Return on long and short positions:

\[ R_{t+1}^L = P_{t+1} - P_t - i_t \quad \text{and} \quad R_{t+1}^S = i_t + P_t - P_{t+1} \]

In the context of our model, Tversky and Kahneman’s (1992) utility function:

\[ V(\Delta W) = \begin{cases} 
  (W | ar^g|)^{\alpha} \\
  -\lambda(W | ar^l|)^{\beta}
\end{cases} \quad (5) \]

where \( a \) is the share of non-monetary wealth, \( W \), that is held in the risky asset
Endogenous prospect theory embodies all of Kahneman and Tversky’s experimental findings, as well as the importance of imperfect knowledge. Frydman and Goldberg (2007).

One of its key assumptions is endogenous loss aversion:

- an individual’s degree of loss aversion rises as the size of her open position rises.
Individuals expect an “uncertainty premium” for holding speculative positions:

\[ \hat{u}p_{t+1}^{i,j} = (1 - \lambda_1) \hat{l}_{t|t+1}^{i,j} > 0 \]  \hfill (15)

where \( j = L, S \) and their \( \mathcal{P}^i_t (R_{t+1}) \) implies,

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

\[ \hat{l}_{t|t+1}^{i,S} = E_t^i [R_{t+1}^S < 0 | Z_t^i] < 0 \]
Momentary equilibrium condition for the price of the risky asset:

\[
\hat{P}_{t|t+1} - P_t - i_t = \hat{w}p_{t|t+1} + \lambda_2 \frac{S_t}{W_t} \tag{16}
\]

\[
\hat{w}p_{t|t+1} = (1 - \lambda_1) \hat{l}_{t|t+1}
\]

Simplifying,

\[
\hat{P}_{t|t+1} - P_t = (1 - \lambda_1) \hat{l}_{t|t+1} \tag{18}
\]

As time advances, individuals alter their \( \hat{P}_{t|t+1} \)'s and \( \hat{l}_{t|t+1} \)'s

- news on the \( Z \)-variables

- revisions of forecasting strategies
Vast majority of economists not only fully prespecifies change, but supposes that market participants never revise their strategies

- obvious irrationality

Imperfect Knowledge Economics stakes out an intermediate position:

- purposeful behavior exhibits regularities that are qualitative, context-dependent, and relevant at times that no one can fully specify in advance.

IKE portrays this behavior with qualitative and contingent conditions on change.
An IKE Gap Model of the Market Premium

\[\hat{u}p_{t|t+1} = (1 - \lambda_1)\hat{i}_{t|t+1}\]

In looking for regularities in how individuals alter their forecasts of potential losses, we are guided by the empirical record and Keynes’s (1936) account of asset markets.

In discussing why an individual might hold cash rather than risky interest-bearing bonds, Keynes observed that

“what matters is not the absolute level of [the interest rate] \(r\) but the degree of its divergence from what is considered a fairly safe [benchmark] level of \(r\), having regard to those calculations of probability which are being relied on” (Keynes, 1936, p.201).
We suppose that individuals look to the gap between the asset price and their assessment of its benchmark level in forecasting potential losses.

\[ \hat{l}_{t+1} = \hat{l}_{t+1} \left( \text{gap}_t \right) \]  

(19)

\[ \text{gap}_t = P_t - \hat{P}_{t,\text{BM}} \] and \( \hat{P}_{t,\text{BM}} \) denotes an individual’s assessment at \( t \) of the benchmark price.

Over time, an individual may revise her forecasting strategy, \( \mathcal{P}_t \left( R_{t+1} \right) \rightarrow \mathcal{P}_{t+1} \left( R_{t+2} \right) \).

But, no matter how she might do so, we suppose that movements of \( \hat{l}_{t+1} \) are characterized by a “gap effect”:

- depends on which side of the market she takes.
We formalize the influence of $\text{gap}_t^i$ on $\hat{l}_{t|t+1}^{i,j}$ with qualitative "gap conditions":

\[
\frac{\Delta \hat{l}_{t|t+1}^{i,L} }{\Delta \text{gap}_t^i} < 0 \quad \text{and} \quad \frac{\Delta \hat{l}_{t|t+1}^{i,S} }{\Delta \text{gap}_t^i} > 0 \quad (20)
\]

- allow for myriad possible non-routine revisions of an individual’s forecasting strategy.

- consistent with myriad possible post-change distributions, that is, with many $\mathcal{P}_{t+1}^i (R_{t+2})$’s.

But, these conditions constrain the set of possible $\mathcal{P}_{t+1}^i (R_{t+2})$’s to share a common qualitative feature:

- they all imply a gap effect.
Qualitative conditions on the individual level imply only qualitative predictions on the aggregate level:

\[
\hat{pr}_{t|t+1} = \sigma_t \left( P_t - \hat{P}_t^{BM} \right)
\]  

(21)

where \( \sigma_t > 0 \),

\[
\frac{\Delta \hat{pr}_{t|t+1}}{\Delta \hat{gap}_t} > 0
\]  

(22)

• model predicts that \( \hat{pr}_{t|t+1} \) and \( \hat{gap}_t \) will co-vary positively over time.

However, it renders no prediction about whether the premium will rise or fall or what the exact size of the gap effect might be in the coming months.

• its predictions concerning whether \( P_t \) and \( \hat{pr}_{t|t+1} \) will rise or fall in any one period are contingent on how individuals’ price forecasts unfold.
IKE gap model implies the following momentary equilibrium condition for price:

\[ P_t = \hat{P}_t^{BM} + \frac{1}{(1 + \sigma_t)} \left( \hat{P}_{t|t+1} - \hat{P}_t^{BM} \right) \]  \hspace{1cm} (23)

- main driver of price \( P_t \) is \( \hat{P}_{t|t+1} \); swings in \( \hat{P}_{t|t+1} \) imply swings in \( P_t \).
Bubbles and Lost Fundamentals: Artifacts of the Contemporary Approach

Bubble models:

- individuals’ price forecasts are driven not by fundamentals, such as earnings and interest rates,

- but by speculative manias, crowd psychology and other psychological biases, or technical momentum trading.

REH and behavioral bubble models are inconsistent with the basic features of the price swings we actually observe in asset markets:

- insufficient persistence. Johansen et al. (2009), Frydman et al. (2010).
Technical trading is widespread, but cannot sustain long-lasting swings.

Psychological factors – optimism and confidence – play a key role,

• but they are influenced by fundamental considerations.

Implausible to suppose that pure crowd psychology could sustain long price swings:

• any confidence and optimism would quickly evaporate if, say, earnings and overall economic activity consistently moved in the opposite direction.
Bloomberg market wrap stories (Mangee, 2011):

- Psychological considerations are important, but are underpinned by movements in fundamental considerations

- Pure psychology and technical trading play a minor role.

Fundamentals play central role, but matter in non-routine ways

- Bloomberg market wrap stories

- Formal statistical analysis
Figure 5
S&P 500 Real Stock Price and Earnings
1992-2009
An IKE Account of Asset Price Swings

We portray an individuals’ point forecast of next-period’s stock price as

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

(24)

• \(Z_t^i\) represents the vector of fundamentals

• \(\beta_t^i\) represents the vector of weights that an individual attaches to them in thinking about the future.

Two key factors that underpin the unfolding of \(\hat{P}_{t|t+1}^i\)

• movements in fundamentals and revisions of the individual’s forecasting strategy
We assume that the $Z^i_t$-variables follow random walks with constant drifts:

$$\Delta Z^i_t = \mu^i_t + \epsilon^i_t$$  \hspace{1cm} (25)

A more complete IKE model would allow for non-routine change in the social context.
In modeling revisions of forecasting strategies, we look for regularities that can account for the irregular swings that characterize asset prices.

We again rely on Keynes’s (1936) account of asset markets.

In using their “knowledge of the facts” to form forecasts, participants

“fall back on what is, in truth, a convention... [which] lies in assuming that the existing state of affairs will continue indefinitely, except in so far as we have specific reasons to expect a change.”

(Keynes, 1936, p. 152)
Guardedly moderate revisions:

- there are stretches of time during which participants either maintain their strategies or revise them gradually

- such revisions do not generally alter, in substantial ways, the set of fundamentals that participants consider relevant and/or their interpretation of these fundamentals’ influence on future outcomes.

But, the tendency toward guardedly moderate revisions is a qualitative regularity that occurs in irregular ways.

- occasions when news about fundamentals and price movements leads participants to revise their forecasting strategies in non-moderate ways.

- can have a dramatic impact on prices and spell the end of a price swing in one direction and the start of a new one in the opposite direction.
We express the total change in an individual’s price forecast as:

\[ \hat{P}_{t+1}^i - \hat{P}_{t-1}^i = T \hat{P}_{t+1}^i + \epsilon_t^i \]  

(26)

where \( T \hat{P}_{t+1}^i \) is the “trend change” in the individual’s forecast between \( t - 1 \) and \( t \),

\[ T \hat{P}_{t+1}^i = \Delta \beta_t^i Z_t^i + \beta_{t-1}^i \mu Z_t^i \]  

(27)

- \( \beta_{t-1}^i \mu Z_t^i \) is the baseline drift: trend change in \( \hat{P}_{t+1}^i \) if individual were to leave her strategy unaltered,

- baseline change used in defining guardedly moderate revisions
Guardedly moderate revisions:

\[ |\Delta \beta_t^i Z_t^i| < \delta_t^i \]  
(28)

\[ |\Delta \beta_t^i \mu Z_t^i| < \delta_t^i \]  
(29)

where \( |\cdot| \) denotes an absolute value and \( \delta_t^i = |\beta_{t-1}^i \mu Z_t^i| \).

If these conditions held over some stretch of time, and trends in fundamentals remained unchanged,

- the individual’s price forecast would undergo a swing in one direction or the other over the period.

Irregular swings: revisions could be non-moderate and non-reinforcing at any point in time

- reversals in \( \hat{P}_t^i |t+1 \).

Compatible with the forecasting behavior of bulls and bears.
Some aggregation issues, which add the contingent nature of model.

Despite its contingent character and openness to non-routine change,

- our IKE representation of bulls’ and bears’ decision-making places sufficient structure on the analysis.

Model does not produce sharp predictions:

- its predictions are qualitative and contingent on how participants alter their forecasting strategies over time.
Contingent Predictions of Long Swings:

- Price swings will occur during stretches of time in which trends in $Z_t$ are persistent, and participants, on the whole, revise their strategies in guardedly moderate ways.

- Irregular swings are an inherent feature of asset markets.

- If a swing is toward benchmark levels, and qualitative conditions endure, price will overshoot benchmark.

- Account of risk implies that long swings away from these levels cannot last forever.

- Contingent nature of representation implies compatibility with coexistence of bulls and bears.
An Intermediate View of Markets and the Role of the State

We show in Frydman and Goldberg (2011) how this model leads to an intermediate view of swings in asset prices and risk

- play an integral role in the process by which financial markets evaluate prior investments and foster new companies and projects – the key to modern economies’ dynamism.

- and yet, owing to the imperfection of knowledge, swings can sometimes become excessive, implying huge economic and social costs.
This intermediate view contrasts sharply with the polarized positions that are implied by fully predetermined models of macroeconomics and finance:

• asset price swings are based either on “rational” decision-making that enables society to allocate its scarce capital nearly perfectly or on crowd psychology and technical trading that allocates capital haphazardly.

Our IKE model leads to a new way of thinking about the relationship between the market and the state.

• opens up new channels for policy officials to limit the magnitude of long price swings in asset markets and a new tools with which regulators can assess systemic and other financial-sector risks.