FINM3407 – Behavioral Finance

Topic 8:

Chapters 13: Behavioral Explanations for Anomalies

Reference: Ackert and Deaves, Chapter 13

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FINM3407 – Topic 8
Behavioral Explanations for Anomalies

[Behavioral Explanations for Anomalies]

- **Brief Introduction: Behavioral Explanations for Anomalies**
- **Earnings Announcements and Value vs. Growth**

  What is behind lagged reactions to earnings announcements

  What is behind the value advantage

- **What is Behind Momentum and Reversal**

  Daniel-Hirshleifer-Subrahanyam Model

  Grinblatt-Han Model and Explaining Momentum

  Barberis-Shleifer-Vishny Model and Explaining Momentum and Reversal

- **Rational Explanations**

  Important Risk Adjustment

  Fama-French Three Factor Models/Factor Zoo – Tutorial

Traditional Finance vs. Behavioral Finance

Assumptions	Traditional Finance	Behavioural Finance
Fully Rational • Belief • Preference	Implications: • Apply Bayes law correctly • Compatible with expected utility (value maximization)	Bounded rational • Heuristic biases and frame dependence • Prospect theory (loss aversion)
Unsystematic irrational	• No effect on prices (cancel out each other)	• Evidence shows systematic irrationality
Systematic irrational	• Rational arbitrageurs correct the errors	• Limits to arbitrage
Outcomes	• Efficient market • Prices are right	• Puzzles • Anomalies

EMH: Empirical Challenges

Anomalies

1. • **Excess volatility**: Shiller (1981) and Le Roy (1981)

   - Stock prices are far more volatile than would be justified by simple model in which prices are equal to the discounted expected future dividends.

2. • **Equity premium puzzle**
3. • **Time series stock market predictability puzzle**
4. • **Cross-sectional price-scaled anomalies: value premium**
5. • **Over- and under-reaction [Today's focus]**
6. • **Seasonal effects**
7. • **"Twin shares" with different prices**

Introduction: Behavioral Explanations or Anomalies

- Four key anomalies reviewed were:

1) the small-firm effect;
2) lagged reactions to earnings announcements;
3) value versus growth;
4) momentum and reversal

Part One:
With a discussion of lagged earnings announcements and of the tendency for value to outperform growth

Part Two:
we turn to momentum and reversal. Three alternative behavioral models for momentum and/ or reversal are sketched out.

Part Three:
We consider whether appropriate risk adjustment can account for apparent anomalies.

Much of the empirical evidence is consistent with the implications of these models

Behavioral Explanations or Anomalies

Review of Trading Rules that Have Shown to be Effective.

1. Small cap portfolios vs. large cap portfolios?

- **Small cap wins out!**

2. Portfolios formed based on P/Es:

- **Low P/Es do better!**

3. Earnings announcements momentum:

- Reaction to extreme announcements **is slow!**

4. Value vs. growth portfolios

- **(usually, value firm has a high book-to-market, and a growth firm has a low book-to-market):**
- **Go for value!**

5. Predictable serial correlation:

- Medium-term momentum!

6. Long-term winners vs. losers:

- Reversals: **losers become winners!**

What is Behind Value Advantage?

- **It has been suggested that there are four main reasons why retail and institutional investors have favoured glamour stocks over value stocks:**

1. They are committing judgment errors in extrapolating past growth rates too far into the future and are thus surprised when value stocks shine and glamour stocks disappoint. This is so-called "expectational error hypothesis"
2. Because of **representativeness**, investors may assume that ***good companies are good investments***

These first two reasons are mistakes of judgment. Likely individual investors are more subject to committing them than institutional investors.

What is Behind Value Advantage?

- **Next two reasons *(*Reason 3 and Reason 4*)* are due to agency considerations (rational reasons to shy away from value):**

- Because sponsors view companies with **steady earnings and buoyant growth as prudent investments**, so as to ***appear*** to be following their **fiduciary obligation to act prudently, institutional investors may shy away from hard-to-defend, out-of-favour value stocks.**

- Also because of career concerns, **institutional investors, who are evaluated over short horizons, may be nervous about tilting too far in any direction thus incurring tracking error**. A value strategy would require such a tilt and may take some time to pay off, so it is **in this sense risky**.

Explaining Long-Run Value Outperformance

- **Take a growth stock with a high P/E or P/B.**

Such stocks have a period of anticipated higher-than-normal growth.

- **What if market overestimates length of supernormal growth period?**

When it becomes clear that mean reversion is occurring, ***growth stocks deteriorate***.

Similar story (in reverse) can be told for value stocks.

Introduction: Behavioral Explanations or Anomalies

- Recall the existence of intermediate-term momentum and long-term reversal.
- Putting these results together suggests that investors first underreact and then overreact.
- In essence we have a combination of the underreaction seen in the earnings announcement literature and the overreaction requiring reversal that we see in the value literature.

Model One:

[DHS Model]

In its simplest form explains reversal by incorporating overconfidence

Model Two:

[GH Model]

Explains momentum using prospect theory, mental accounting, and the disposition effect.

Model Three:

[BSV Model]

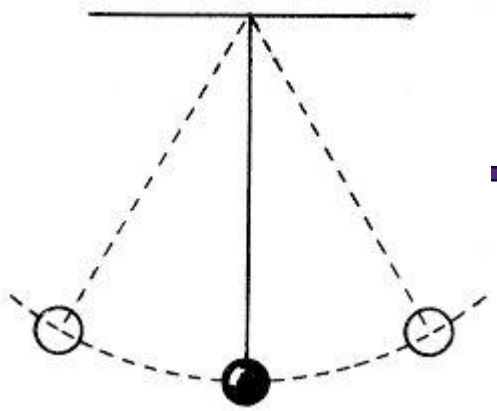
which accounts for both momentum and reversal, is based on the anchoring and representativeness heuristics.

What is Behind Momentum and Reversal

Daniel-Hirshleifer-Subrahmanyam (DHS) Model: Explaining Reversal

DHS model is based **on overconfident investors overestimating the precision of their own private signals**.

== > This leads to a **negative** **serial correlation** in **price movements (i.e., reversal).**



DHS model details

- **Begin in equilibrium at *t=0.***
  - At ***t=1*** **private noisy information appears** (one can assume informed investors undertake some analysis generating private signals).

Formally, the private information at t=1 is: $s_1 = \theta + \varepsilon$

- *where ϑ is a mean-zero random variable with variance σ_θ^2 that represents the change in the true value of the security*
- At ***t=2*** **true value of security is revealed.**

DHS Model Details Cont.

$$s_1 = \theta + \varepsilon$$

- Signal is observed imperfectly because of **a mean-zero noise term with variance σ_ε^2**.
- Overconfidence is a factor because informed traders exaggerate in their own minds the accuracy of their private signal,

$$\text{Using } \sigma_c^2 \text{ instead of } \sigma_\varepsilon^2 \text{ where, } \sigma_c^2 < \sigma_\varepsilon^2$$

- Given the risk neutrality of the informed traders, the price at t = 1 settles at the **expected value of θ conditional on s_1**.
- At t = 2, the **price reaches the true value of the security**

DHS Model: Price Response at t = 1

Consider the price at t = 1. The challenge is to separate the information from the noise.

- Intuitively, if σ_ε^2 is low relative to σ_θ^2 , **it will be rational to believe that the signal is primarily the true change in value.**
- On the other hand, if σ_ε^2 ε is high relative to σ_θ^2 , **it will be rational to believe that the signal is primarily noise.**

In the former case, **it will be rational to alter valuations almost as much as s_1.**

Rational investors,

Price *should* go to:

$$p_1 = \frac{\sigma_\theta^2}{(\sigma_\theta^2+\sigma_\varepsilon^2)}(\theta + \varepsilon)$$

where p1 is the value of the security at t = 1

Overconfident investors, on the other hand, believe that their error is less than is objectively the case.

For this reason, their perception of value at t = 1 is:

$$p_1 = \frac{\sigma_\theta^2}{(\sigma_\theta^2+\sigma_c^2)}(\theta + \varepsilon)$$

Since $\sigma_c^2 < \sigma_\varepsilon^2$ prices are more influenced by the signal than is rational.

Difference is true variance of noise is greater.

DHS Example

Suppose that $\theta = 2$; $\sigma^2_\theta = \sigma^2_\varepsilon = 1$; and $\sigma^2_C = 0.5$. Two cases: ε=2.5 and ε=1.5

Case 1. ε=2.5

$$p_1 = \frac{\sigma_\theta^2}{(\sigma_\theta^2 + \sigma_\varepsilon^2)}(\theta + \varepsilon)$$

$$p_1 = \frac{1}{(1+1)}(2 + 2.5)$$

$$p_1 = \$2.25$$

- Even rational price goes to \$2.25 (a little above equilibrium value \$2).

(the reason is that: $\sigma_\theta^2 = \sigma^2_\varepsilon$)

- **Because logical to believe that half of signal** $(\frac{s_1}{2} = \frac{(2+2.5)}{2} = 2.25)$ **is true information.**
- **Overconfident investors believe that an even greater proportion of s_1 is information and push up prices even higher, to \$3.**

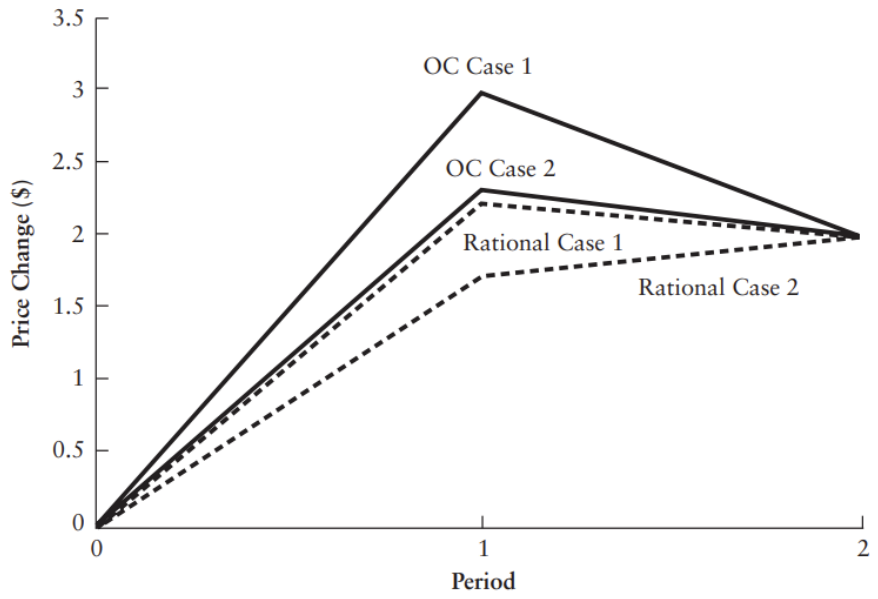
$$p_1 = \frac{1}{(1 + 0.5)}(2 + 2.5) = \$3$$

Consider Case 2: ε=1.5.

- Now the rational price goes to **\$1.75** (a little below its equilibrium value.
- When half of the ***signal is true information and half error***, as will be true on average, the rational price will immediately go to equilibrium.
- **Overreaction again occurs for the overconfident investors under Case 2.**
- They will **push prices up to \$2.3**
- When given a low enough error relative to the information, even overconfident investors may initially underprice assets. However, on average, they will overreact, which necessitates a price reversal to equilibrium

Price Path Graphs

FIGURE 13.1 Simulation Based on DHS Model



An example, illustrated in Figure 13.1, shows what this means for prices.

Solid lines in the graph show price paths **assuming that overconfident traders drive prices.**

Broken lines show price paths **assuming no overconfidence.**

The DHS model offers a number of testable implications.

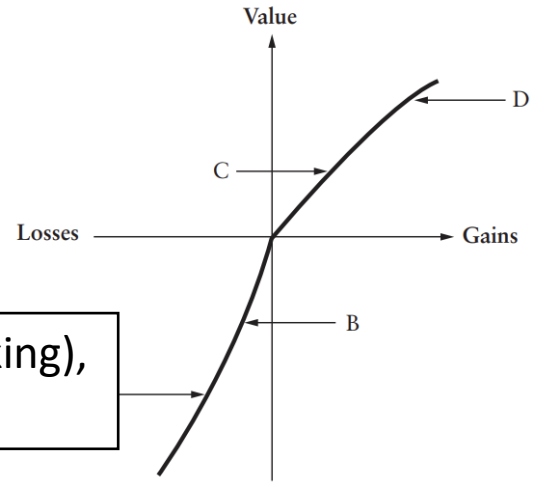
- For example, *managers should issue shares when they believe their stocks to* ***be overvalued and buy them back*** *when they believe them* ***to be undervalued.***

Grinblatt-Han Model (to explain momentum)

Grinblatt-Han model (hereafter GH), is based on **prospect theory, mental accounting, and the disposition effect**.

- In brief, the **tendency for winners (losers) to be sold too quickly (slowly) suggests a delayed reaction to good/bad news**, because reference-point-influenced investors have demand curves that reflect recent performance.

FIGURE 13.2 Prospect Theory Value Function and Disposition Effect



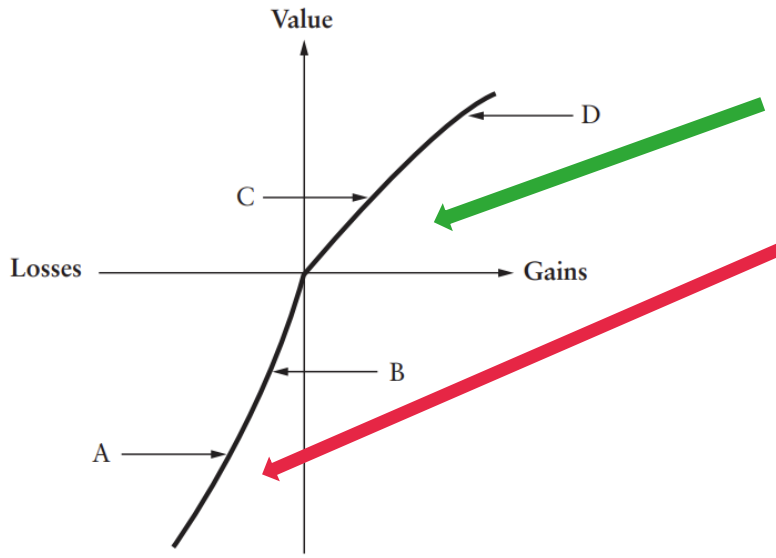
concavity of the function in the **gain domain** (consistent with risk aversion)

convexity in the **loss domain** (consistent with risk seeking), and the kink at the reference point.

Grinblatt-Han Model

- **Recall the integration versus segregation discussion**, which is related to mental accounting and closing accounts.

Prospect Theory Value Function and Disposition Effect



- If a security has **made money from the original date of purchase**, it *moves up along the prospect theory value function (to points C and D)*
- If **a security has lost money**, *it moves down along the same function (to A and B).*

This suggests that ***demand will be greater for securities that have suffered capital losses*** (the **higher the loss, the greater the demand**) vs.

- Demand will be **lower for securities that have experienced gains** (with higher gains leading to lower demands).

This is one potential explanation behind the **disposition effect** and is a key element of the GH model.

Grinblatt-Han Model – Intrinsic Value

- Consider **the (intrinsic) value (f_t) of a security in the GH model**. It follows *a random walk*, **only changing as relevant news (ε_t) arrives:**

$$f_{t+1} = f_t + \varepsilon_{t+1}$$

- Demand comes from two groups of investors: **rational investors (R)** and those who are influenced by **Prospect Theory and Mental Accounting** (PT/MA). The first group has the following demand function:

$$D(R)_t = 1 + b\,(f_t - p_t)$$

== > where $D(R)_t$ is the demand coming from rational investors at t; and pt is the share price at t. Note that b > 0 reflects the slope of the rational demand curve.

To the extent that value exceeds price, rational investors will demand more units.

- **PT/MA investors** account for the second component of overall market demand:

$$D(PT/MA)_t = 1 + b\,(f_t - p_t) + \lambda\,(ref_t - p_t)$$

== > D(PT/MA)t is demand at t arising from those investors who are influenced by prospect theory and mental accounting. Here, ref_t is the reference point and λ (>0) denotes the relative importance of the capital gain component to PT/MA investors.

Note that, if $ref_t > p_t$, demand is higher since the price is in the risk-seeking domain.

Grinblatt-Han Model – Intrinsic Value

- If PT/MA investors; are μ% of all investors; we aggregate demand over the two groups; normalize supply at one unit; and clear the market; the resulting equilibrium price is:

$$p_t = \omega f_t + (1-\omega)\, ref_t\,;\ \omega = \frac{1}{1+\mu\lambda}$$

To interpret, the market price is ***a weighted average of value and the reference point.***

- Underreaction to news is clear. Say, beginning from a steady state (where $f_t = p_t = ref_t$), positive news pushes up value.
- **Price will react in the same direction**, but it will be held back somewhat by the reference point (which, as will be shown, moves more slowly).
- ***Only over time will price reach the right level.*** Because this takes time, we have **momentum.**
- Further, the **more PT/MA investors there are (higher μ),** and the more important is the **capital gain component to them (higher λ),** the more influential is the reference point and the greater is the underreaction.

Grinblatt-Han Model – Intrinsic Value

- This enters the model in the following reference point adjustment equation, where the **speed of adjustment is v**:

$$ref_{t+1} = v\, p_t + (1\text{-}v)\, ref_t$$

Clearly v will be related to turnover.

- For example, assume **that a particular PT/MA investor bought shares at $5 (so her reference point is $5).**
- **The price now rises to $7 for a capital gain of $2, but her reference point remains at $5.**
- **Suppose she needs cash and sells her shares to another PT/MA investor for $7.**
- **His reference point will be $7, which is his purchase price (not hers).**
- Therefore, over time because of trading, the reference point moves toward the ***market price.***

Grinblatt-Han Model – Simulation Based on GH Model

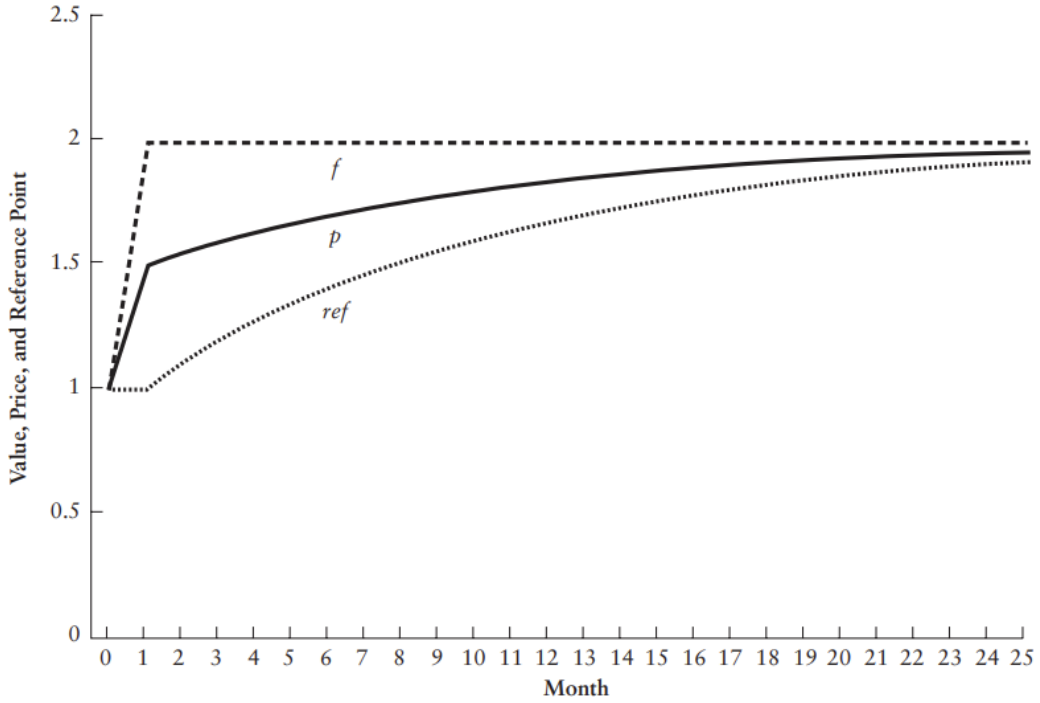


Figure 13.3 shows the evolution of prices and reference points over the next 24 months (to t = 25).

- **Price moves toward value, but it does so gradually *because PT/MA investors fixate on the reference point, which moves more slowly.***

- The reader will of course realize **that real-world securities never exhibit momentum as "clean" as in this example**. The reason is that ***new additional information (affecting ft) is often arriving.***

Grinblatt-Han Model – Intrinsic Value

- It is straightforward to show that the expected return (R_t) at any point in time is equal to

$$E_t\, R_{t+1} = (1-\omega)\, v\, \frac{p_t - ref_t}{p_t}$$

This equation does not **relate *future expected returns* to *past returns* (momentum) directly.**

Nevertheless, **a stock's unrealized capital gain is likely to be highly correlated with past returns, so standard momentum is easily implied by the model.**

Capital gain should be a better predictor of future returns than past returns.

- Indeed, Grinblatt and Han find this to be true: the return-based momentum effect disappears once the PT/MA disposition effect is controlled for.
- *Still, one weakness of the GH model is that it only explains momentum, not reversal.*

For this reason, we turn to the final model, which explains both momentum and reversal. **BSV model: Explaining momentum/reversal**

Barberis-Shleifer-Vishy (BSV) Model: Explaining Momentum/Reversal

Recall sun and clouds example:

- At first people were **too anchored**.
- Then they were too influenced by **new evidence**.

What about earnings?

- Anchoring and conservative adjustment dictates that investors are slow to change views on earnings.
- First surprise tends to be followed by ***a few more***.
- Eventually **recency and base rate underweighting take over** and past performance is extrapolated into the future.
- **Overreaction: The** *current* ***high-growth****/****low-growth*** *period is viewed as longer than is logical.*

Their Model leads to a world where investors at first underreact, and then overreact to salient news.

➔ ***Markets overreact slowly!!!***

BSV Model Formalises This Story

- Earnings follow a random walk:
  - Changes in earnings are *+y* or *–y* with equal probability
- But investors, being coarsely calibrated, believe that stocks switch between two regimes.

- Suppose we assume that **a random walk holds for earnings (n_t):**

$$n_{t+1} = n_t + \varepsilon_{t+1}$$

- **Regime 1. Earnings mean-revert:**

  Given a positive (negative) earnings change, there is **a low probability** of another positive (negative) earnings change in the next period. **Underreaction.**

- **Regime 2. Earnings are persistent:**

  Given a positive/negative earnings change, there is ***a high probability*** of another positive/negative earnings change in the next period. **Overreaction**

BSV Model Formalises This Story

Recalled:
Regime 1: Mean-reverting
Regime 2: Trend/Persistent

At all points in time, individuals must guess whether the world is in Regime 1 or 2.

Estimated probabilities will rise and fall as events unfold:

- **Alternating changes** (e.g., ***+y, –y, +y, –y***) will lead people to believe that **Regime 1** is in effect.
- While a sequence of like earnings changes (e.g., ***+y, +y, +y, +y;*** or ***-y, –y, -y, –y***)) will lead people to believe that **Regime 2** is in effect.

Recalled:
Regime 1: Mean-reverting
Regime 2: Trend/Persistent

BSV Model Formalises This Story

- It can be shown that if earnings changes are the same at both **t and t + 1**, the perceived probability ***that regime 1 is in place is the following function of the parameters of the model:***

$$q_{t+1} = \frac{[(1-\lambda_1)q_t + \lambda_2(1-q_t)]pr_L}{[(1-\lambda_1)q_t + \lambda_2(1-q_t)]pr_L + [\lambda_1 q_t + (1-\lambda_2)(1-q_t)]pr_H}$$

It is possible to prove that $q_{t+1} < q_t$.

- In other words, after continuation it is less likely than before that we are in Regime 1. Hence, it is in Regime 2.

If on the other hand the earnings changes at both **t and t + 1** have been different, then the perceived probability that Regime 1 is in place is:

$$q_{t+1} = \frac{[(1-\lambda_1)q_t + \lambda_2(1-q_t)](1-pr_L)}{[(1-\lambda_1)q_t + \lambda_2(1-q_t)](1-pr_L) + [\lambda_1 q_t + (1-\lambda_2)(1-q_t)](1-pr_H)}$$

It is possible to prove that $q_{t+1} > q_t$.

- In other words, after reversal it is more likely that we are in Regime 1.

Recalled:
Regime 1: Mean-reverting
Regime 2: Trend/Persistent

BSV Model Formalises This Story

- **Turning to valuation**, it is assumed that all earnings are returned to investors in the form of dividends. Using a standard dividend discount model, value is:

$$p_t = \frac{E_t d_{t+1}}{(1+R)^1} + \frac{E_t d_{t+2}}{(1+R)^2} + \frac{E_t d_{t+3}}{(1+R)^3} + \dots$$

where p_t is the time-t price, dt is the time-t dividend and R is the discount rate

If investors correctly perceive a random walk, Equation 13.13 is simply ***a perpetuity and reduces*** to:

$$p_t = n_t / R$$

It can be shown that the ***nature of investor beliefs about regimes*** and switching between them is such that the actual price will be:

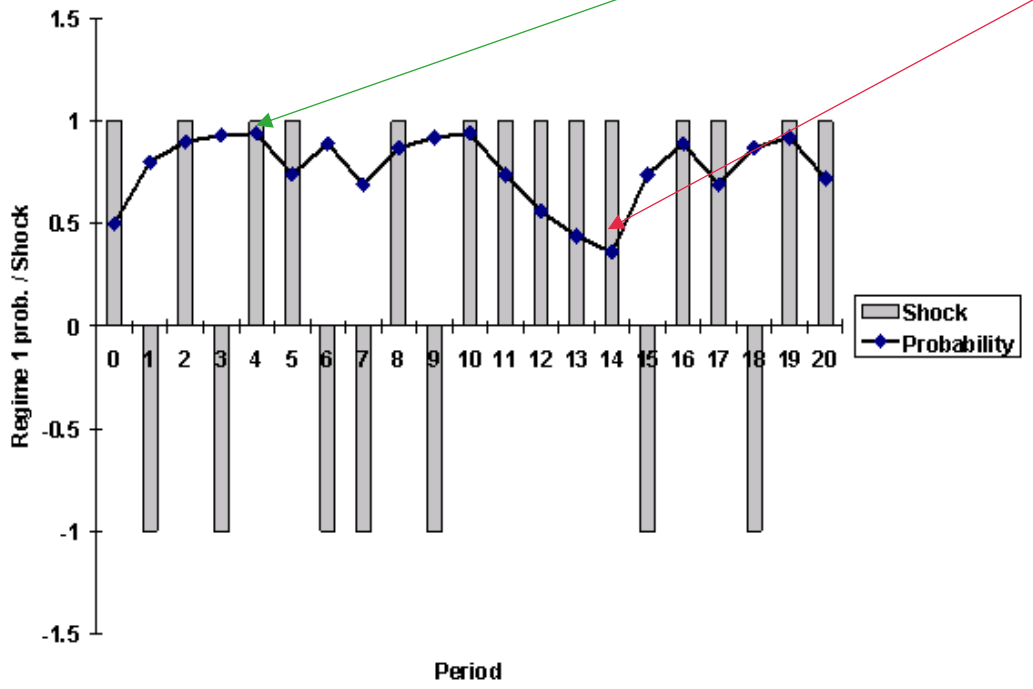
$$p_t = n_t / R + k_t \varepsilon_t$$

While the factor **k_t is a complicated function of q_t**, it can be shown that it is ***negative when q_t is fairly high***, which means that after a positive/negative earnings change, while prices react in the right direction, they do not react enough—**underreaction**.

- When qt reaches a low enough level, the second term is positive/negative after a positive/negative earnings change—**overreaction.**

Recalled:
Regime 1: Mean-reverting (underreaction)
Regime 2: Trend/Persistent (overreaction)

Simulation Based on BSV Model



Source: Barberis, N., A. Shleifer, and R. Vishny, 1998, "A model of investor sentiment,"*Journal of Financial Economics* 49, 307-44.

To see how the model works in terms of the revision over time of the probability that the world is in regime 1, refer to Figure 13.4.

Here it is assumed that

$$\mathcal{pi}_H = 3/4;\ \mathcal{pi}_L = 1/3;\ \lambda_1 = 0.1;\ \text{and}\ \lambda_2 = 0.3.$$

Note that q_t rises after a sign switch but falls after a sign continuation.

Explaining Momentum and Reversal

Recalled:
Regime 1: Mean-reverting (underreaction)
Regime 2: Trend/Persistent (overreaction)

Investor beliefs about regime will dictate prices:

- When investors think **Regime 1,** they **underreact** to earnings changes
- When investors think **Regime 2,** they **overreact** to earnings changes

So, this model can explain both underreaction and overreaction.

And momentum and reversal empirical regularities can be simulated.

- Consistent with momentum papers, Barberis, Shleifer, and Vishny find intermediate-term (1 & 2 years) momentum, and reversal for longer-term intervals (3 & 4 years)

Simulated Returns from Earnings and Returns Sorts Based on BSV Model

	Earnings sort	Returns sort
1 year	0.0391	0.0280
2 years	0.0131	0.0102
3 years	-0.0072	-0.0094
4 years	-0.0309	-0.0181

Reprinted from the Journal of Financial Economics, Vol 49, Issue 3, Barberis, N., A. Shleifer and R. Vishny, "A model of investor sentiment," pp. 307-44, © September 1998. With permission from Elsevier.

- Deciles are **formed each year on the basis of returns**.
- In the second numerical column of Table 13.1, ***best and worst decile differences for the following year are shown***.
- As in previously cited momentum papers, we see persistence when we condition on **intermediate-term intervals (one and two years)** and **reversal conditioning on longer-term intervals (three and four years).**

- The model was able to produce results consistent **with the value versus growth phenomenon as well**. Since there were no accounting numbers for the simulated firms (and hence no book values),
- The authors ***worked in terms of P/E ratios***, which, given the assumptions of the model, were the same as prices over dividends.
- Deciles were also *formed on P/E and the authors calculated the average difference in returns* going forward between the **lowest P/E firms** and the **highest P/E firms.**

Rational Explanation - Inappropriate Risk Adjustment

- Early tests only assume that appropriate risk adjustment only considers market or beta risk (as in CAPM).

- **Joint-Hypothesis Problem Illustrated with a Casino Example:**
  - Slot machines at a casino advertise a -2% return, but a true loss is -5%.
  - Over time, gamblers adjust their expectations to this 5% loss, making it the new norm.
  - An economist testing for efficiency might mistakenly use the advertised -2% as the benchmark, leading to incorrect conclusions about market efficiency.

Inappropriate Risk Adjustment.

- **Fama and French's 1992 Paper:**

Challenged the then-accepted CAPM model, suggesting it didn't work anymore.

CAPM indicates only a security's beta should impact expected returns.

Their data (from 1963-1990) contradicted this, showing no positive relation between stock returns and market betas.

- **Multi-dimensional Stock Risks:**

Findings suggest that stock risks have multiple dimensions, including size and the book-to-market equity ratio.

This led to the development of the Fama-French three-factor model.

- **Anomalies' Interpretation:**

Anomalies in stock returns either indicate investor errors or improper risk adjustment.

Fama-French Three Factor Model

$$R_t^i - R_{f,t} = \alpha^i + \beta_1^i (R_{m,t} - R_{f,t}) + \beta_2^i SMB_t + \beta_3^i HML_t + \varepsilon_t^i$$

- **Where the return on security or portfolio I at t is R_t^i :**
- **The risk-free rate at t is $R_{f,t}$**
  - ***Market Return: $R_{m,t}$***
  - ***Value vs. growth***
  - ***Small cap vs. large cap***

- One issue is what underlies the second and third Fama-French risk factors. **Fama and French suggest that different aspects of so called "distress risk" are being captured.**

- But, these distressed stocks do not perform appreciably worse in bad times.

Conclusion

1. **Post-announcement earnings drift appears** to be driven by **anchoring on the part of investors and analysts**.
2. **The value premium** is likely due to both ***behavioral and agency-related institutional factors***.
3. **A number of theoretical models** have **been formulated to account for momentum and reversal**.
4. **The DHS model** explains ***reversal using overconfidence***; **the GH model** explains ***momentum using prospect theory, mental accounting, and the disposition effect***; **and the BSV model accounts** for ***both momentum and reversal and is based on the anchoring and representativeness heuristics.***
5. **Much of the empirical evidence** is consistent with the implications of these models.
6. Another view is that **risk has been improperly accounted for in the research that has identified these anomalies**, and a proper treatment of risk will render these anomalies as merely risk premiums.
7. The Fama-French three-factor model has value and small cap as risk factors over and above market risk.
   - Under Fama-French, value is a risk factor, not an anomaly. Some have questioned whether greater exposure to the value factor really does entail additional risk.
8. Momentum is not credibly accounted for by any risk-adjustment technique.

Reference Reading – Three Models (What is Behind Momentum and Reversal)

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FINM3407 – Behavioral Finance

Topic 8:

Thank you very much