

Chapter 14

Fixed Income Securities: The Full Measure of Behavioral Phenomena

When it comes to interest rates, investors are especially slow learners.

In 1938, Frederick Macaulay published a book that described how interest rate movements were both puzzling and notoriously difficult to predict. Little has changed since 1938, at least in this respect. But some have been slow to learn what Macaulay pointed out more than fifty years ago.

This chapter discusses the following:

- how overconfidence, gambler's fallacy, and betting on trends set the stage for disaster in the case of the Orange County Investment Pool
- how conservatism, hindsight bias, loss aversion, and regret came into play during and after the crisis that led Orange County to declare bankruptcy
- the theoretical issues that underlie the expectations hypothesis of the term structure of interest rates
- the evidence suggesting that the expectations hypothesis fails
- why underreaction to changes in inflation, stemming from anchoring and adjustment, interfere with the expectations hypothesis

This chapter covers some of the successes and failures associated with the management of fixed income securities, first by presenting a

case and then by discussing some general issues associated with yield curves. The case, which focuses on the first behavioral themes of heuristic-driven bias and frame dependence, details the experiences of the Orange County Investment Pool. It is exceedingly rich in behavioral phenomena.

The discussion of general issues focuses on the third theme, market inefficiency. Many scholars believe that in an efficient market, yield curves should satisfy a property known as the expectations hypothesis. But the evidence indicates that in practice, yield curves fail to satisfy this property, possibly because the most important behavioral element is conservatism. Specifically, anchoring and adjustment give rise to underreaction, particularly in connection with expectations about future rates of inflation. It may be that underreaction interferes with the forces that would otherwise induce yield curves to satisfy the expectations hypothesis.

Case Study: The Orange County Bankruptcy: Setting the Stage

In December 1994, Orange County, California, filed for bankruptcy. The largest municipal bankruptcy in U.S. history occurred as a result of the investment strategy followed by its treasurer, Robert Citron. The case provides an excellent vehicle for a discussion of interest rate forecasts.

One month after the bankruptcy declaration, Robert Citron appeared before California legislators. At that time, he testified that he relied almost exclusively on the advice of Merrill Lynch officials, including the interest rate outlook from its chief investment strategist, Charles Clough. Citron stated that in 1993 Clough had forecast flat or falling interest rates for three to five years.

Charles Clough was known for having made one very important interest rate prediction. Consider figure 14-1, which displays the behavior of the yield on the ten-year Treasury bond between 1985 and 1993. Focus on 1988. In that year, when Treasury bond yields were over 9 percent, Clough forecast a long period of disinflation and said long-term rates would fall further than most people thought possible. As figure 14-1 shows, his forecast turned out to be very accurate. Merrill Lynch heavily promoted the forecast, basing an advertising campaign on it.

In 1988, Robert Citron had already been county treasurer for seventeen years. In a revealing interview with the *Los Angeles Times* that year,

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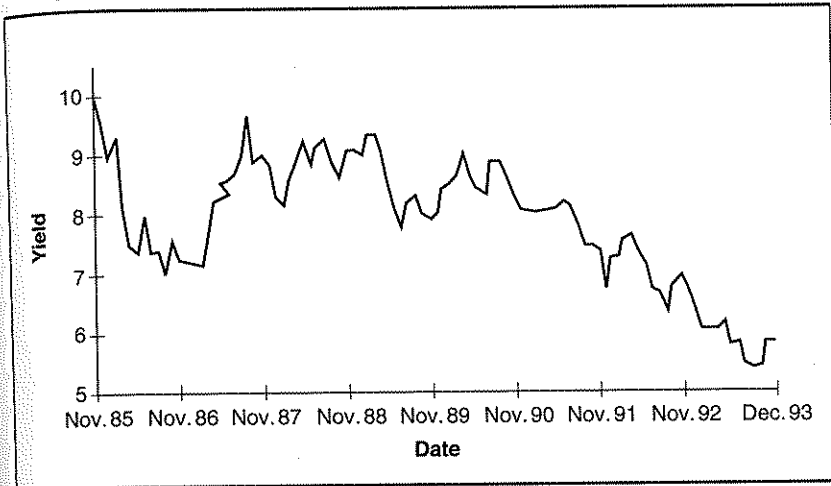
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Figure 14-1 Yield on 10-Year Treasury Bond,
November 1985–December 1993

In 1988, Merrill Lynch's Charles Clough predicted a long period of disinflation and said that long-term interest rates would fall further than most people thought at the time. This chart shows him to have been right. Robert Citron, treasurer of Orange County, California, made several leveraged bets based on his belief that interest rates would decline. The chart also shows why his bets paid off handsomely through 1993.



we learn some interesting facts about his trading strategy, and some of the behavioral biases to which he was subject.¹ In the interview, Citron indicated that he had \$2.5 billion under management, which he was investing in U.S. Treasuries (bills and two-to-five year notes), U.S. agencies, certificates of deposit, commercial paper, banker's acceptance and medium-term notes, as well as time deposits with banks and S&Ls.

In light of the subsequent bankruptcy, the interview is telling about both Citron's actions and his thinking. Two excerpts follow. In the first Citron discusses the riskiness and performance of his investment strategy.

Q: Do you invest in the stock market?

A: County and city treasurers by state law are not permitted to invest in the equity markets or corporate bonds.

Q: So your money managing decisions revolve around the kinds of notes or bonds you're willing to buy?

A: Yes. I have around \$900 million in U.S. government securities, from two to five years in maturity.

Q: Do you actively trade, based on fluctuations in interest rates?

A: I'm not a trader. . . . I buy and hold, and I do matched reverse repurchase agreements. . . . It's not trading, because the spread is always locked in.

Q: How much money has this technique earned you?

A: Through the first seven months of the fiscal year, we have earned \$4.5 million on reverse repos alone.

A: From July 1, 1986, to June 30, 1987, we earned 8% on all the funds. If we hadn't been doing reverse repos, our return would have been only about 7.2%.

Q: How does that 8% return compare to other counties?

A: The state of California has a local agency investment fund in which any local agency, county, city or special district can invest money. . . . (The fund) had an average yield of 7.4% for the fiscal year.

In the second excerpt, Citron provides his predictions for interest rates and the overall economy. As you read this portion of the interview, think back to the discussion in chapter 5 about the strategists' market predictions. See whether you can spot any similarities.

Q: What is your outlook for the economy?

A: The current business cycle has already extended far beyond the average length of three to four years, to over five years. And there's little doubt that a correction is rapidly approaching in the form of a recession. . . .

Q: When can we expect to see a recession?

A: Events in the summer months of 1988 will indicate the beginning of a recessionary period. . . .

Q: What's your outlook for interest rates?

A: We are in a volatile market, so we'll have strong swings. But on average, I think rates will go up.

Q: Why?

A: Because of inflationary pressures. The Fed will react by doing more tightening than loosening.

Q: So we are going to see a recession with rising interest rates?

A: Yes.

Q: Is the Fed going to succeed in dampening inflation with this restrictive monetary policy?

A: Yes, in the summertime.

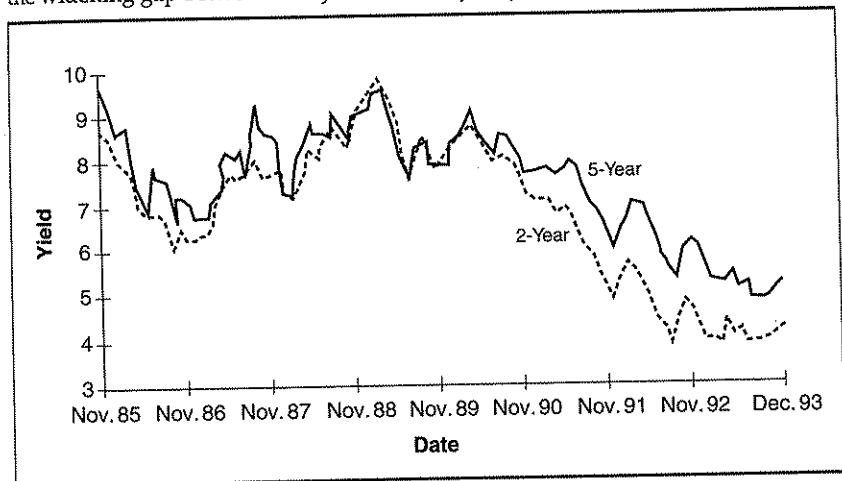
Overconfidence and Gambler's Fallacy

Were you able to spot examples of heuristic-driven bias in the second excerpt? Citron's 1988 forecast, of a coming recession with rising interest rates that will dampen inflation in the summer, appears to have been made with a great deal of confidence—some might say overconfidence. And why was Citron forecasting a recession in the summer of 1988? Because the economic expansion at that time was a year or so longer than average. Is there a classic bias underlying this forecast? How about gambler's fallacy—the law of small numbers? After tossing five heads in a row using a fair coin, is a tail due? Was a recession due? And did a recession with rising interest rates come about? Yes to rising interest rates, but no to the recession, at least not for two years more.

Well, one out of two may not seem bad. But the overconfident interest rate forecast, in combination with other issues identified in this 1988 interview, combined to produce a disaster. The other issues revolve around Citron's investment strategy. He mentions his use of two- and five-year Treasury securities. Figure 14-2 illustrates the yields on the two- and five-year securities between November 1985 and December 1993. The top curve represents the five-year Treasury yields.

Figure 14-2 Yields on 2-Year and 5-Year Treasury Bonds, November 1985–December 1993

Robert Citron borrowed at the two-year rate and invested at the five-year rate. The chart shows why, between 1990 and 1993, Orange County's portfolio profited from the widening gap between two-year and five-year yields.



As can be seen from figure 14-2, the spread was typically positive during this period. Citron used a reverse repurchase agreement strategy in which he purchased five-year Treasuries obtained with money borrowed for two years at the two-year rate. So, for example, in December 1993 Citron might have been borrowing at the two-year rate, 4.24 percent, to purchase five-year securities that were yielding 5.2 percent, thereby capturing a spread that was almost 100 basis points. Such leveraging corresponds to purchasing stock on margin.

Overconfidence and Hindsight Bias

The 1988 summer recession predicted by Robert Citron finally arrived in the autumn of 1990. But by 1993, the slowdown was over and the economy was again growing robustly—so much so, in fact, that the Federal Reserve Board was concerned about a rekindling of inflation. In February 1994, the Fed raised short-term interest rates for the first time in five years. It raised them again in March.

On December 6, 1993, Martin Mauro, fixed income strategist at Merrill Lynch, predicted that the Federal Reserve would tighten monetary policy modestly in 1994.² Consequently, he expected a flatter yield curve, with higher short-term rates and lower long-term rates. The forecast was way off. Indeed, 1994 was an extraordinary year for the yield curve. In a 1995 survey article that appeared in the *Journal of Economic Perspectives*, John Campbell described what made it so. As short-term interest rates rose throughout the year, so too did long-term rates. Furthermore, the spread stayed about the same.

The behavior of the spread was of considerable importance to the value of the Orange County Investment Pool portfolio. The rising yields reduced the value of both the two-year Treasuries and the five-year Treasuries. A well-known feature of bond prices is that the longer the duration of the bond, the more sensitive the bond price is to a change in yield. Specifically, the prices of five-year Treasuries are more sensitive to yield changes than the prices of two-year Treasuries. Hence, the rise in the yield curve during February and March lowered the value of the Orange County portfolio.

In July 1993, Citron had confidently predicted that interest rates would not go up. In response to a question from an investment banker about how the value of his portfolio would be affected by a rise in interest rates, he responded that interest rates would not rise. When the investment banker asked Citron how he knew this, he is reported to

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Hindsight Bias

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ly predicted that interest rates would fall from an investment banker's perspective. It could be affected by a rise in interest rates would not rise. When the Fed lowered rates, he is reported to

have replied: "I am one of the largest investors in America. I know these things."³

Citron described his outlook further in his September 1993 annual report, stating: "We will have level if not lower interest rates through this decade. Certainly, there is nothing on the horizon that would indicate that we will have rising interest rates for a minimum of three years. We believe that our comparative higher interest earning rate yields over the next three fiscal years is insured."

Interestingly, Citron later claimed to have anticipated the February interest rate jump. On March 9, responding to the administrator of the county's public employee retirement system, Citron stated: "The recent increase in rates was not a surprise to us; we expected it and were prepared for it."⁴ In light of all the public statements Citron made before February 1994, I find it difficult to believe that he was not surprised. But I do believe that, after the fact, he reconstructed his past beliefs. I believe he displayed hindsight bias. Nevertheless he went on the record that March as saying that he thought further Fed tightening to be likely, with any run-up in interest rates short-lived.

Remember Charles Clough, the Merrill Lynch strategist on whose views Citron was relying. The April 6, 1994, issue of *USA Today* reported Charles Clough's outlook on interest rates, an outlook that resurfaced in court proceedings later.

Bonds a buy: After the sharp rise in interest rates, Merrill Lynch strategist Charles Clough is bullish on the bond market again. Tuesday, he told clients to start buying 30-year Treasury bonds when their yields are higher than 7.3%. T-bond yields were 7.40% Monday but fell to 7.24 Tuesday. Clough made one of the great bond-market calls ever in 1988, when T-bond yields were over 9%. He forecast a long period of disinflation and said long-term rates would fall further than most people thought possible. . . . "This is entirely different, partly because we're still in an economic expansion so rates don't have that far to fall," Clough says of his renewed call to bonds.

Still, he believes the recent jolt in rates will slow the economy enough to force rates back down late in the year.⁵

Frame Dependence: Reference Points and Layered Pyramids

Later that April, the Federal Reserve increased interest rates again. This lowered the value of Citron's portfolio even more. Now, the

Orange County treasurer's position is an elected one, and 1994 was an election year. Interestingly, for the first time since 1970, Robert Citron found himself with an opponent. Given that the environment of the time was characterized by rising interest rates, I am not surprised that a spirited debate ensued about the merits of using leverage.

Citron's opponent was John Moorlach, later to become his successor. During the campaign, Moorlach wrote a letter to the Orange County Board of Supervisors, criticizing Citron's investment strategy. In his letter, Moorlach stated: "Every prudent investor chooses safety of principal as the top priority," he wrote. "Next comes the need for liquidity. The last priority is achieving yields. . . . Mr. Citron has these priorities inversed."⁶ Is this approach reminiscent of a layered pyramid, with a hierarchy of securities matched to a hierarchy of goals? The notion of a layered pyramid forms the behavioral basis for constructing portfolios (see chapter 10).

An article that appeared in the April 30, 1994, issue of the *Los Angeles Times* offers additional insights. The article quotes R. A. Scott, the head of the county's General Services Agency, who has known Citron for more than twenty years and paints the following revealing portrait. "He's competitive, and if he returns a greater rate on short term money than most people, he considers that winning. . . . It's pride. It's being above average. When he's trading, he's all business."⁷

Pride, being above average, and winning: is there a reference point effect here? How about overconfidence about his relative skill? Did Citron's reference point correspond to earning a higher return on short-term money than others earn? We know from chapter 9 that when the probability of ending up below a given reference point is large enough, people tend to *seek risk*. Indeed, the *Los Angeles Times* article points out that Citron "concedes he takes risks but insists they are prudent ones."

Reference points and loss aversion operate in peculiar ways. Despite the risky investment approach he followed in managing the Orange County Investment Pool, Robert Citron never owned a single share of stock in his personal portfolio. Paradoxical? The difference reflects different mental accounts and different reference points.

Forecasts and the Illusion of Validity

What about Citron's interest rate forecast at this point, April 1994? Was it similar to Clough's April perspective? The article states the following:

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In recent weeks, Citron has received "collateral calls" that forced him to pony up an additional \$215 million in collateral, because the value of the securities he used to borrow money has skidded as interest rates have climbed. His assistant, Matthew R. Raabe, said he expects yet more collateral calls, but he is not worried because the county's \$7.5-billion investment pool has about \$1 billion in liquid assets.

Citron and Raabe . . . believe interest rates will inch up for a short time and level off. If they are wrong, they say they have a contingency or "exit" plan, although they are unwilling to share the particulars.

Raabe said the only way the county could get into trouble is if "short-term interest rates are going to continue to go up and . . . we don't react. But that's not going to happen."⁸

At this stage, Robert Citron was plagued by a lot of questions: Would he win reelection against John Moorlach? Which investors would withdraw funds from the county pool? In what direction would interest rates move? To whom did Citron turn for guidance? To psychics and a mail-order astrologer. One psychic adviser predicted that Citron would encounter financial difficulties in the month of November, but that these would be over in December.⁹ Some of these predictions turned out to be correct. Might there have been some behavioral phenomenon at work here? Indeed, yes: Try the illusion of validity.

Conservatism and Loss Aversion

Still anchored to the downward trend that had brought his investment strategy so much success, Citron appears to have been convinced that short-term rates would level off, so much so that he continued to hold inverse floaters. Inverse floaters are structured to pay lower interest as interest rates rise. The investor makes money when interest rates decline, but loses money when they rise. In fact, it appears that he actually used the inverse floaters as collateral in order to purchase medium-term securities.

Unfortunately, short rates did not level off. The Fed increased rates again in August. The losses to the Orange County portfolio were mounting. Just after Labor Day, a concerned president of one of the local water districts in the county learned that Robert Citron had not reduced the degree of leverage. In fact, quite the opposite. An article appearing in *USA Today* reports that Citron actually increased his borrowing "in a desperate bid to recoup his losses."¹⁰ A few days earlier a

piece by Ronald Picur had appeared in the *Chicago Tribune* describing this behavior in the following terms: "True to a gambler's mind-set, Citron increased the size of his 'wagers' by using leveraged funds."¹¹ According to county records, in March 1993 the principal fund run by Mr. Citron was leveraged 2.4:1. But by August 1994, its leverage had grown to nearly 3:1. By then, Mr. Citron had borrowed nearly \$13 billion, using most of the proceeds to purchase notes from Merrill Lynch. (If we needed further convincing about there being a reference point effect at work here, this should do the job.)¹²

A *Wall Street Journal* article on Citron was aptly titled "Hubris and Ambition in Orange County: Robert Citron's Story." The following excerpt describes the effect of loss aversion on Citron's behavior.

However, the losses were still only on paper, and Mr. Citron was apparently convinced that he could still weather the typhoon. For years, he had boasted about how he almost invariably held securities until maturity, when he could cash them in at face value. That way, he explained, he was able to avoid the losses that come from selling a security that has been adversely affected by a rise in interest rates.

He clung fiercely to that philosophy in his last annual report, on Sept. 26. Mr. Citron noted that there was concern over "paper losses" due to rising interest rates. But he said that the county didn't plan to record any such losses and didn't plan to sell its securities.¹³

In chapter 9 I described why, tax issues aside, the distinction between "paper losses" and "realized losses" is more psychological than real. This is a framing issue. Holding securities to maturity so as not to realize a loss does not imply that wealth has not declined. But the foregone wealth is framed as an opportunity loss, rather than an out-of-pocket loss. The "hold until maturity frame" simply obscures the opportunity loss.¹⁴

In any event, despite Citron's stated intention not to sell any securities, the reverse occurred. The Fed raised interest rates again in November. Investors who held Orange County Investment Pool securities as collateral anxiously saw those securities decline further in value. In reaction, they began to sell that collateral, thereby forcing Orange County to realize losses. On December 1, Robert Citron and assistant treasurer Matthew Raabe told reporters at a county press conference that the fund faced a \$1.5 billion paper loss.

On December 4, Robert Citron resigned as county treasurer. Two

in the *Chicago Tribune* describing Citron as "True to a gambler's mind-set, Citron 'ers' by using leveraged funds."¹¹ In 1993 the principal fund run by Citron had borrowed nearly \$13 billion in purchase notes from Merrill Lynch, Citron there being a reference point of Citron's behavior.¹²

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issues aside, the distinction be- tween "paper losses" is more psychological than real. Citron held securities to maturity so as not to let their value decline. But the fore- casted loss, rather than an out-of- "frame" simply obscures the op- portunity cost of not selling any secu- rities when interest rates again in No- vember 1993. Citron's county Investment Pool securities decline further in value. In general, thereby forcing Orange County, Robert Citron and assistant Citron, at a county press conference Citron's loss.

Citron was named as county treasurer. Two

days later the county filed for bankruptcy under Chapter 9 of the bank- ruptcy code, in an attempt to prevent its creditors from liquidating the collateralized securities. This was the largest municipal bankruptcy in U.S. history. At that time, the loss to the Orange County Investment Pool was estimated at \$2 billion. On April 28, 1995, Citron pled guilty to six felony counts. He was sentenced to a year in county jail and ordered to pay a \$100,000 fine. Matthew Raabe was convicted of the same charges and became the only public official sent to state prison for his role in the bankruptcy. He was sentenced to three years in prison and ordered to pay a \$10,000 fine.

Regret, Hindsight Bias, and the Illusion of Validity

Citron's appearance before state legislators in January 1995, offers an example of regret and responsibility shifting. The *Los Angeles Times* reported the issue as follows: "Here was Citron—proclaimed a finan- cial expert for years both by himself and his fawning Board of Supervi- sors—now reduced to saying how, 'in retrospect,' he would have done a lot of things differently."¹⁵

Regret is the pain felt from recognizing that one could have done things differently. The intensity of the regret depends on the degree to which a person feels responsible for the decision that was taken. One way people attempt to shift responsibility is by playing the "blame game." This game, whereby a client picks someone regarded as an ex- pert and relies on him or her for advice, is usually set up in advance. If things go well, the client takes the credit, attributing the success to his or her own skill. But if things go badly, then the client can attribute the blame to the expert, thereby reducing *regret* by shifting responsibility for the negative outcome.¹⁶ Of course, for this to work, the person to whom responsibility gets shifted must be seen to have expertise. Otherwise, the client will feel just as much regret for having relied on a novice for advice. In this regard, Citron said during his testimony: "I understood Clough to be the preeminent expert in the field of invest- ment strategy."¹⁷

In shifting responsibility to Clough, Citron mentioned that he had relied on Clough's 1993 prediction of flat or falling interest rates for three to five years. Even after the Federal Reserve boosted short-term rates in February 1994, Mr. Citron said Mr. Clough told him at a break- fast meeting on March 1 that rate increases were "not sustainable."

However, starting in 1992 officials from Merrill's risk management desk had been urging Citron to lower his leverage. They had even offered to repurchase some of the inverse floaters at a time when these would have produced a profit for the county. Moreover, in February 1994 they warned Citron that the interest rate outlook was uncertain. But Citron disregarded the warning from the risk management group, which conflicted with his own outlook. Instead, he chose Clough's forecast, which confirmed that outlook. He paid attention to confirming evidence while ignoring disconfirming evidence, thereby succumbing to the illusion of validity. When faced with cognitive dissonance, most people resolve the dissonance by choosing the comfortable route.

Subsequently, Orange County played the blame game too, suing a number of parties with whom it had had a relationship. The most notable was Merrill Lynch, against whom it filed both criminal and civil charges, arguing that the firm had provided faulty advice. Both suits were settled. In 1997, Merrill Lynch agreed to pay \$30 million to have the criminal suit dropped. In June 1998, it agreed to pay \$400 million to have the civil suit dropped, the second largest suit ever involving a brokerage firm.

Orange County also filed suit against the bond-rating agency Standard & Poor's Corp. for having given its top rating to the county. This raises the question of whether or not agencies incur legal liability for misjudgment, an interesting question indeed given the propensity for behavioral biases and errors.

The range of lawsuits filed by Orange County raises the general issue of *fairness*. Events in Orange County featured the misjudgment of Robert Citron, the aggressive sales tactics of some Merrill Lynch employees, the cautious warnings by other Merrill Lynch employees, and the mistaken opinions of bond-rating agencies. Is there a fair way to share the blame? The blame game is a fairness issue with which the investment community repeatedly struggles.

An interesting article appeared in the summer issue of the *Journal of Derivatives*. The article was written by Merton Miller and David Ross (1997) and titled "The Orange County Bankruptcy and Its Aftermath: Some New Evidence." Miller and Ross argue that it was not necessary for Orange County to have declared bankruptcy, since in December 1994 the Orange County Investment Pool was neither insolvent nor illiquid. Moreover, they point out that had the portfolio simply been held rather than liquidated, subsequent interest rate moves would actually have led to a profit. The county would have emerged ahead,

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recovering the full \$21 billion of its portfolio plus \$300 million of interest.¹⁸

Appropriate actions are always clear in hindsight. That's why the phenomenon is called hindsight bias. But Miller and Ross would not accept hindsight bias as a reason. Rather they contend that "the positive cash flows earned in 1995 are fully consistent with expectations based on historical term structure patterns." Or, to put it somewhat differently, they suggest that interest rates are predictable.

Indeed, a December 30, 1994, article that appeared in *Investor's Business Daily* concerning the Orange County fiasco stated: "There is still an incentive to leverage assets at the front end of the yield curve, where very short-term rates are at least 200 basis points lower than two-year rates."¹⁹

We move now from a discussion about the specific events surrounding the Orange County bankruptcy and the predictability of interest rates in December 1994 to a discussion about the general predictability of interest rates.

The Expectations Hypothesis of the Yield Curve

In his 1995 survey article, John Campbell describes some of the main features associated with yield curves. The most well-known theoretical property is the *expectations hypothesis*. This hypothesis concerns the question of whether future interest rate movements can be predicted based on the yield spread.

To explain the expectations hypothesis, consider a situation like the one that prevailed in 1993 when long-term rates were higher than short-term rates. Look at the right side of figure 14-2. If investors expected the yield curve to remain unchanged through time, they would have an incentive to do what Robert Citron did: Sell the short-term securities short and use the proceeds to purchase the long-term securities.

If all investors thought along these lines, then they would all be following what I'll call a "Citron strategy." So, what expectations would prevent them from behaving in that manner? For one, investors would have to believe that the yield curve would move. But in what direction? Consider an investor with a short time horizon. What kind of expectations would this investor have to hold in order to think twice about a Citron strategy? One possibility is that he would expect long-term

yields to rise: The expected capital loss on his long-term securities would provide the disincentive. Another possibility is that although he does not expect long term yields to rise, he perceives the risk that they might as a sufficient deterrent. In other words, he perceives the term premium as insufficient compensation for bearing this risk.

How about an investor with a long time horizon? If she were to think twice about a Citron strategy then she would be expecting short-term rates to rise enough to offset any advantage to the current spread.

Putting the last two points together leads to the following implications. An upward-sloping yield curve reflects investors' expectations that both short-term rates and long-term rates will rise, but long-term rates will rise more. Moreover, the expected return difference between holding long-term bonds and holding three-month Treasury bills would have to be zero. This implication is testable.

The evidence reported by Campbell in connection with this implication is portrayed in figure 14-3, for the period 1952-1991. The upward-sloping curve shows the average yield spread between Treasuries of various maturities and the three-month Treasury bill. The higher the maturity, the greater the spread. The second curve shows how the average holding return varied across different maturities relative to the yield on three-month Treasury bills. According to the expectations hypothesis, the excess return should be zero for all maturities. But in reality, the excess return was positive for most maturities, declining with longer maturities. For the ten-year maturity, the excess return was actually negative.

Campbell also reports that wider spreads tended to be followed by long-term yields moving down rather than up, as the expectations hypothesis predicts. In this respect, he offers the following comment:

This is exactly the behavior noted by Macaulay (1938) in a classic work on the movements of asset prices in the late nineteenth and early twentieth centuries. Macaulay wrote (p. 33): "The yields of bonds are higher if the highest grade should *fall* during a period in which short-term rates are higher than the yields of the bonds and *rise* during a period in which the short-term rates are lower. Now experience is more nearly the opposite." It is particularly impressive that this finding in the late nineteenth century appears in the late twentieth century as well as in Macaulay's data. (p. 139)

In order to understand why the expectations hypothesis fails, we need to examine investors' expectations, not just the subsequent be-

Froot confirms that the expectations hypothesis indeed fails. Yields move significantly less in response to forward rates than they would in a one-for-one relationship. Moreover, Froot finds evidence that biased forecasts and varying term premia are both involved. He concludes that for short-term securities, the spread's bias may be entirely due to term premia. However, he also concludes that the "inability of the spread to forecast future long-rate changes is attributable entirely to systematic expectational errors. . . . [E]xpected future rates underreact to changes in the short-rate" (p. 304).

Money Market Services (MMS) is one of the major firms that track interest rate forecasts. MMS surveys investors and economists weekly to obtain forecasts for three maturities and two time horizons. The maturities are three months, two years, and thirty years. The horizons are one week and four weeks. Using weekly data from 1988 through 1997, I find that the forecasts obtained by MMS display the same characteristics reported by Froot.²⁰

The MMS interest rate forecasts display a number of interesting features. Suppose we look at the implied forecasts of interest rate changes over the ten-year period 1988–1997. One striking pattern is that for the three-month and thirty-year maturities, forecasted changes were too high relative to actuals. The consensus expectation was that interest rates would be higher than turned out to be the case. For example, forecasters predicted that on average the three-month Treasury bill rate would go up by 13.7 basis points every four weeks, whereas it actually declined by 0.46 basis points. But for the two-year maturity, the reverse was true: the two-year yield fell by less than was expected.

This pattern did not hold in 1994, when interest rates were higher than predicted no matter what the maturity or time horizon. For example, forecasters predicted that on average the three-month Treasury bill rate would go up by 14.5 basis points every four weeks, whereas it actually rose by 19.4 basis points.

And how about expectations about long rates, whose sharp rise throughout 1994 led to the Orange County bankruptcy? Remember that in December 1993 Merrill Lynch fixed income strategist Martin Mauro had predicted that long yields would fall in 1994. Well, Mauro was not alone. This is also what the MMS forecasters predicted for both two-year and thirty-year yields.

Inflation Expectations and the Yield Curve

How important is inflation as a factor in determining yields?²¹ In chapter 3, I reported on a study by Eldan Shafir, Peter Diamond, and

expectations hypothesis indeed fails. Yields tend to be higher than they would in a world of perfect capital markets. Froot finds evidence that biased expectations and learning are both involved. He concludes that the spread's bias may be entirely due to learning. He concludes that the "inability of the market to adjust to changes in inflation expectations is attributable entirely to the fact that expected future rates underreact to changes in current rates" (1994).

Figure 14-4 is one of the major firms that track interest rates. It provides investors and economists weekly data on yields for various maturities and two time horizons. The maturities are one, three, and thirty years. The horizons are weekly and monthly. The weekly data from 1988 through 1997, and the monthly data from MMS display the same characteristics.

Figure 14-4 displays a number of interesting characteristics of implied forecasts of interest rate changes for various maturities from 1988–1997. One striking pattern is that for short-term maturities, forecasted changes in interest rates are generally in line with the consensus expectation that interest rates will fall. For example, for the three-month Treasury bill, interest rates fell every four weeks, whereas it actually fell by less than was expected.

For longer maturities, when interest rates were higher, interest rates fell by less than was expected. For example, for the two-year maturity, interest rates fell by less than was expected.

Figure 14-4, when interest rates were higher, interest rates fell by less than was expected. For example, for the three-month Treasury bill, interest rates fell every four weeks, whereas it actually fell by less than was expected.

The Yield Curve

What is the major factor in determining yields?²¹ In this section, we discuss the work of Alan Shafir, Peter Diamond, and

Amos Tversky (1997), which found that although people understand the difference between real and nominal changes, framing issues in nominal terms is more natural for them. Therefore, real changes tend to be less salient.

As far as the yield curve is concerned, appreciating the role of inflation is crucial. In a most insightful article, Werner De Bondt and Mary Bange (1992) discuss how the yield curve is affected by expectations about inflation. Their study is based on inflation forecasts for the period 1953 through 1987 that were collected by Joseph Livingston of the *Philadelphia Inquirer*. Beginning in 1946, Joseph Livingston conducted a biannual survey in which he asked respondents to estimate the future rate of inflation over both the next six months and the next twelve months. I have updated the De Bondt–Bange data through June 1998.

A critical question for the determination of yields concerns expectations about inflation. If investors expect high future inflation, they will bid yields up. Hence, a major issue involves the question of accuracy. How accurate have inflationary expectations been?

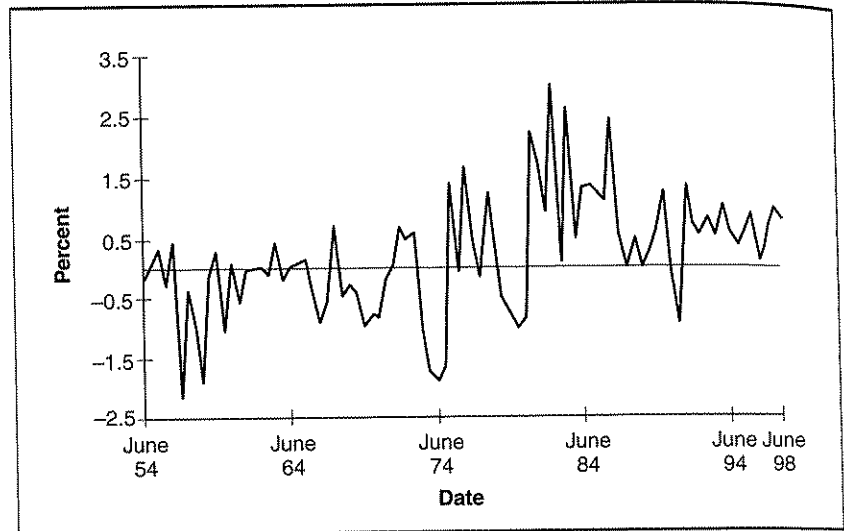
Figure 14-4 portrays the time series of the six-month-ahead consumer price index (CPI) forecast error, expressed as a percentage of the CPI. The predictable component of an efficient forecast should, of course, be zero. But De Bondt and Bange find that the forecast error in the Livingston survey has a very strong predictable component. It tended to be negative during the 1950s and 1960s, indicating that forecasters underestimated future inflation during this time. The error turned positive in the early 1970s, at the time President Nixon imposed wage and price controls. It turned negative again in the late 1970s, and then entered a phase where it has been positive most of the time. Since 1980, forecasters have consistently overestimated the rate at which the CPI would rise.

Notice that in figure 14-4, inflation forecast errors tend to be negative during periods of rising inflation and positive during periods of falling inflation. De Bondt and Bange argue that this is an underreaction phenomenon. That is, investors underreact to the most recent decline in the inflation rate. Instead, they place too much weight on historical rates.

De Bondt and Bange make a convincing case that errors in inflation forecasts are the major reason why the expectations hypothesis fails. In particular, they focus on the effect of inflation forecast errors. During the 1980s, both long-term rates and spreads were high because investors were too pessimistic about inflation. As investors received positive but *surprising* news about declining inflation, yields on long

Figure 14-4 CPI Forecast Error as Percent of Actual CPI,
June 1954–June 1998

The time path of the percentage CPI forecast errors between 1954 and 1998 in the Livingston survey. Efficient forecasts fluctuate randomly about zero. But the Livingston errors stray from zero for long periods. During periods of declining inflation they tend to be positive, while during periods of rising inflation they tend to be negative. The pattern suggests that investors underreact to changing inflation: Their predictions for the CPI are too high when inflation is declining, and too low when it is rising.



maturities declined. But because investors continued to underreact, and inflation rates continued to decline, yields on long-term securities tended to fall, not rise, as the expectations hypothesis would predict. Moreover, short-term rates fell over the life of long-bonds issued in the 1980s.

Did investors in the 1990s continue to be surprised by how quickly inflation declined? As can be seen from figure 14-4, the answer is yes. Here are the opening paragraphs from an article that appeared in the *Wall Street Journal* on September 17, 1998.

Investors sent stock and bond prices soaring in one of Wall Street's strongest days this decade.

The U.S. Treasury market had its biggest rise this year, with the bellwether 30-year bond soaring 2 5/32 points, or \$21.563 for each \$1,000 face amount. The yield on the issue, which moves in the opposite direction of the price, fell to 6.40%. That was the second-largest single-day decline in the yield in the 1990s.

The plunge in interest rates unleashed a torrent of buying among the big blue-chip stocks that have been out of favor for the past six weeks. . . .

Behind the powerful rallies was the August consumer-price report, which erased any fears that inflation was about to spring up. This ignited what some traders called a "buying panic" in both stocks and bonds.²²

Think about this excerpt within the context of figure 14-4. Does it seem like investors continued to underreact to the decline in inflation? It's not that people don't learn. It's that they learn very slowly.

Full Circle

We are coming full circle. What about a Citron strategy? Did it make sense? De Bondt and Bange's findings provide an answer, but it depends on both the magnitude of the spread and past forecast errors about inflation. When spreads are high *and* investors have been underreacting to declining inflation, then a Citron strategy indeed does make sense. This was the case throughout the 1980s and 1990s.

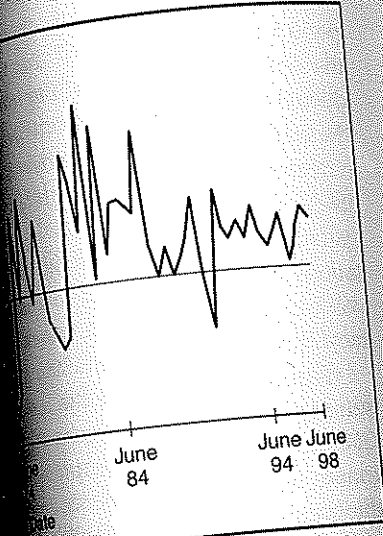
De Bondt and Bange report that there are three important features concerning the link between predictable interest rate movements and inflation forecast errors. First, when the yield spread is above average, inflation forecasts tend to be too high. Second, when the twelve-month-ahead inflation forecast exceeded the six-month-ahead forecast, investors subsequently earned positive excess returns by holding long-term bonds. Third, past inflation errors are positively correlated with future excess returns. This means that not only are excess returns forecastable, they can be predicted by the extent to which investors misjudged recent inflation.

A Citron strategy makes sense because it capitalizes on investor errors. But as we saw very clearly, the strategy is also risky. Why? Not because of uncertainty about what the Federal Reserve might do, but because the strategy's success relies on particular investor errors. In his 1995 survey article, Campbell emphasizes that the 1994 surprise exceeded the extent of Federal Reserve tightening at the short end of the yield curve. In addition, long yields rose by about the same amount as short yields. What hurt the Orange County Investment Pool was the fact that Citron both guessed wrong and chose to be highly leveraged.

Of course, this begs the question as to why long-term rates rose in 1994. Was it heuristic-driven bias? Both Froot and De Bondt-Bange

Percent of Actual CPI,

errors between 1954 and 1998 in the
randomly about zero. But the
periods. During periods of declining
periods of rising inflation they tend
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investors continued to underreact,
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rations hypothesis would predict.
the life of long-bonds issued in the

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from figure 14-4, the answer is yes.
from an article that appeared in the
1998.

soaring in one of Wall Street's

biggest rise this year, with the
5/32 points, or \$21.563 for each
issue, which moves in the oppo-
10%. That was the second-largest
1990s.

state that as a general matter, long yields do not overreact to changes at the short end. I suppose you could say that 1994 was the exception that proved the rule.

Summary

The first half of this chapter focused on instances of heuristic-driven bias and frame dependence. The second half focused on inefficient markets. In the first half, I discussed events pertaining to the Orange County Investment Pool. These events are replete with behavioral phenomena. At the beginning of the case, gambler's fallacy, betting on trends, and overconfidence figure prominently. As the case progresses, conservatism, the illusion of validity, regret, and loss aversion come to dominate.

Underlying the events associated with Orange County bankruptcy is a general issue—the longtime puzzle concerning the expectations hypothesis of the yield curve. In the second half of the chapter, I explained why the failure of the hypothesis reflects market inefficiency, largely stemming from underreaction to changes in the rate of inflation.