
A SURE THING! NO RISK AND SURE PROFITS

The Search for a Free Lunch

Linda loved getting something for nothing. She shamelessly took advantage of misprinted coupons at grocery stores and freebies at vacation resorts. She wondered whether there was a way she could apply her skills to improving her portfolio performance. Her friend, Brian, was a broker and he suggested that there might be a way to take no risk and make high returns in the stock market. Lots of foreign stocks, he argued, had listings in the United States and some of them traded at much higher prices in the U.S. markets than they did in their local markets. Using his connections, he said he could buy shares cheap in the local market while borrowing the more expensive shares listed in the U.S. market and selling them. A profit was guaranteed, he argued, since the two shares were in the same company.

Linda went along with the plan. Brian bought the shares in an Indonesian company on the Jakarta stock exchange and borrowed and sold shares in the same company in the U.S. market at a price that was 20% higher. He told Linda that the borrowed shares would have to be returned in two months but that the price difference would narrow by then, thus giving her a sure profit. Linda watched the share prices in both the Indonesian and the U.S. market in the days after. When the price difference did not narrow initially, she was not worried. When the price difference was still 20% a month after the trade, she sought out Brian but he reassured her that all was well. Doing her own research, she discovered that the U.S. listing was called an ADR and had always traded at a premium on the local listing, and that an ADR could not be exchanged for a local share. When the difference in prices reached 25%, she told Brian to settle the account to limit her losses, and decided that she her odds were much better with her local grocery store than in the stock market.

Moral: If you see easy money to be made in the stock market, you have not looked hard enough.

Despite being told repeatedly that there are no free lunches, investors never stop looking for them. If you can invest without taking risk and earn more than you could make on government bonds, you have the equivalent of a free lunch in investing. There are both institutional and individual investors who search for these elusive opportunities hoping to find them and mine them for certain profits. These riskless investments that earn more than the riskless rate represent arbitrage opportunities. In this chapter, you will look at arbitrage opportunities in their pure form first, and also in the form in which you are most likely to

encounter them where there is some residual risk. You will also examine why arbitrage opportunities, even when they present themselves, are so difficult to exploit for certain profits.

The Core of the Story

No money down, no risk and unlimited profit! Would you need to be sold on such an opportunity, if it did exist? It would sell itself. Any skeptical investor, though, would view such a sales pitch with derision, having undoubtedly been burnt by similar ones in the past. Such an investor would also want to know the reason why such an opportunity would exist in the first place. For an arbitrage sales pitch to succeed, it has to be accompanied by a reason for its existence and here are a few:

- *No one else knows about it (yet)*: This is the pitch to the truly gullible. Every great investment opportunity has to be discovered by someone and that someone conveniently happens to be you. Why the person who discovered this opportunity would share this news with anyone and why you should be the lucky recipient of this largess may not be explained to you but as with any con game, you are made to feel special.
- *It takes special skill to find it and you can acquire it (cheap)*: This is the sales pitch for the investor who wants to pay something, but not very much, for that “free” lunch. If you acquire the special skill (which may be a book, software or mantra offered by the purveyor) for a price, you will be able to establish a clear advantage over other investors in the market.
- *It will last only a short time (and you have to make up your mind quickly)*: It is true that markets sometimes make mistakes and that these mistakes can lead to arbitrage opportunities for those who happen to be at the right place at the right time. On this investment, that happens to be you if you act immediately.
- *It will work only for investors with specific characteristics (and you have them)*: This is perhaps the most effective of the sales pitches because it has the best chance of being true. If you are different from other investors (you have lower transactions costs or a different tax rate), you may very well find that what looks like the right price to others offers riskless profits for you.

The Theory on Arbitrage

To understand what makes for arbitrage, you need to distinguish between three types of arbitrage. The first is *pure arbitrage*, where you have two identical assets with different market prices at the same point in time and the prices will converge at a given point

in time in the future. This type of arbitrage is most likely to occur in derivatives markets – options and futures- and in some parts of the bond market. The second is *near arbitrage*, where you have assets that have identical or almost identical cash flows, trading at different prices, but there is no guarantee that the prices will converge and there exist significant constraints on investors forcing them to do so. The third is *speculative arbitrage*, which is really not arbitrage in the first place. Here, investors take advantage of what they see as mispriced and similar (though not identical) assets, buying the cheaper one and selling the more expensive one. If they are right, the difference should narrow over time, yielding profits. As you will see, the peril of this strategy is that the initial assessment of mispricing is usually based upon a view of the world that may not be justified.

Pure Arbitrage

The requirement that you have two assets with identical cash flows and different market prices makes pure arbitrage elusive. First, identical assets are not common in the real world, especially if you are an equity investor. No two companies are exactly alike, and their stocks are therefore not perfect substitutes. Second, assuming two identical assets exist, you have to wonder why financial markets would allow pricing differences to persist. If in addition, you add the constraint that there is a point in time where the market prices converge, it is not surprising that pure arbitrage is likely to occur very infrequently, and even if it does occur, is likely to be small and fleeting. The conditions that would cause it to occur include the following:

- *Restrictions on the flow of market information to investors in the market:* You may find the same asset trading at different prices in two different markets, if investors in one market cannot observe the price in the other market and vice versa. While this may seem outlandish in these days of CNBC and online trading, it is worth remembering that until a decade or so ago, even in the United State, only a few investors, mostly institutional, had access to real time trading prices and transactions information. In fact, there are still markets in the world where there is little or no transparency about trading and prices.
- *Restrictions on trading:* To eliminate the mispricing, you have to be able to trade. If you are prevented from doing so by market restrictions, you may very well see the mispricing continue. For example, you may need to be able to borrow shares from other investors and sell them (short selling) of stocks to create some arbitrage positions and short sales are restricted or prohibited in many markets.

Futures Arbitrage

A futures contract is a contract to buy a specified asset at a fixed price in a future time period. There are two parties to every futures contract - the seller of the contract, who

the storage costs (\$2), leaving you with an arbitrage profit of \$ 3 an ounce. To prevent arbitrage, the futures contract will have to trade at \$ 422 an ounce.

This arbitrage is based upon several assumptions. First, investors are assumed to borrow and lend at the same rate, which is the riskless rate. Second, when the futures contract is under priced, it is assumed that the buyer of the futures contract (the arbitrageur) can sell short on the commodity and that he can recover, from the owner of the commodity, the storage costs that are saved as a consequence. To the extent that these assumptions are unrealistic, the bounds on prices within which arbitrage is not feasible expand.

Options Arbitrage

As derivative securities, options differ from futures in a very important respect. They represent rights rather than obligations – calls gives you the right to buy and puts give you the right to sell an underlying asset at a fixed price (called an exercise price). Consequently, a key feature of options is that buyers of options will exercise the options only if it is in their best interests to do so and thus cannot lose more than what was paid for the options. As an example, lets assume that you pay \$ 4 to buy a six-month call option on Microsoft with an exercise price of \$ 50. In effect, you have the right to buy a share of Microsoft at \$ 50 anytime over the next 6 months. Clearly, you will exercise this right only if Microsoft's stock price exceeds \$ 50; the gross profit you will make on exercise will be the difference between the stock price and the exercise price. If Microsoft's stock price drops below \$ 50, you will not exercise your option and you will lose what you paid for the option. With a put with the same exercise price, you get a right to sell a share of Microsoft at \$ 50 and you will exercise only if the stock price drops below \$ 50.

The easiest arbitrage opportunities in the option market exist when options violate simple pricing bounds. No option, for instance, should sell for less than its exercise value.

With a call option: Value of call > Value of Underlying Asset – Strike Price

With a put option: Value of put > Strike Price – Value of Underlying Asset

For instance, a call option with a strike price of \$ 50 on a stock that is currently trading at \$ 60 should never sell for less than \$ 10. If it did, you could make an immediate profit by buying the call for less than \$ 10 and exercising right away to make \$ 10.

In fact, you can tighten these bounds for call options, if you are willing to trade on both the underlying asset and the option and hold your position through the option's expiration. The bounds then become:

With a call option: Value of call > Value of Underlying Asset – Present value of Strike Price

With a put option: Value of put > Present value of Strike Price – Value of Underlying Asset

To see why, consider the call option in the previous example. Assume that you have one year to expiration and that the riskless interest rate is 10%.

Present value of Strike Price = $\$ 50/1.10 = \45.45

Lower Bound on call value = $\$ 60 - \$45.45 = \$14.55$

The call has to trade for more than \$14.55. What would happen if it traded for less, say \$ 12? You would buy the call for \$ 12, sell short a share of stock for \$ 60 and invest the net proceeds of \$ 48 ($\$60 - 12$) at the riskless rate of 10%. Consider what happens a year from now:

If the stock price > strike price (\$ 50): You first collect the proceeds from the riskless investment ($\$48(1.10) = \52.80), exercise the option (buy the share at \$ 50) and return the share to cover your short sale. You will then get to keep the difference of \$2.80.

If the stock price < strike price (\$ 50): You collect the proceeds from the riskless investment ($\$52.80$), buy a share in the open market for the prevailing price then (which will be less than \$50) and keep the difference.

In other words, you invest nothing today and are guaranteed a positive payoff in the future. You could construct a similar example with puts.

The arbitrage bounds work best for stocks that do not pay dividends and for options that can be exercised only at expiration (European options). Most options in the real world can be exercised prior to expiration (American options) and are on stocks that pay dividends. Even with these options, though, you should not see short term options trading which violate these bounds by large margins, partly because exercise is so rare even with listed American options and dividends tend to be small. As options become long term and dividends become larger and more uncertain, you may very well find options that violate these pricing bounds, but you may not be able to profit off them.

One of the key insights that revolutionized option pricing in the early 1970s was that a portfolio created by borrowing money and buying the underlying stock, if structured right, could have exactly the same cash flows as a call. This portfolio is called the replicating portfolio. In fact, Fischer Black and Myron Scholes used the arbitrage argument to derive their option-pricing model by noting that since the replicating portfolio and the traded option have the same cash flows, they would have to sell at the same price.¹ If you can buy listed options at a price that is less than what it costs to create the replicating portfolio, you will buy the listed option, sell the replicating portfolio and essentially make a riskless profit,

¹ Black, F. and M. Scholes, 1972, *The Valuation of Option Contracts and a Test of Market Efficiency*, Journal of Finance, Vol 27, 399-417.

since the cashflows on the two positions would offset each other. If the replicating portfolio costs less than the option, you will buy the replicating portfolio and sell the option and lock in your profits.

Near Arbitrage

In near arbitrage, you either have two assets that are very similar but not identical, which are priced differently, or identical assets that are mispriced, but with no guaranteed price convergence. No matter how sophisticated your trading strategies may be in these scenarios, your positions will no longer be riskless. Consider three examples:

- *Same Security, Multiple Markets:* In today's global markets, there are a number of stocks that are listed on more than one market. If you can buy the same stock at one price in one market and simultaneously sell it at a higher price in another market, you can lock in a riskless profit. In the real world, even though the same company may be traded in different markets, it trades in different forms. For instance, many non-US companies trade in the United States as depository receipts (ADRS) while their shares trade on their local markets at the same time. If there are no restrictions on converting ADRs into local shares, then any significant price differences between the two markets should offer profit potential.
- *Closed End Funds:* In a conventional mutual fund, the number of shares increases and decreases as money comes in and leaves the fund, and each share is priced at net asset value – the market value of the securities of the fund divided by the number of shares. Closed end mutual funds differ from other mutual funds in one very important respect. They have a fixed number of shares that trade in the market like other publicly traded companies, and the market price can be different from the net asset value. In other words, a closed end fund can trade for far less or far more than the market value of the securities that it holds at that point in time. If the market price per share of a closed end fund is less than the net asset value per share, there is potential for profits but it is not clear how you would cash in these profits.
- *Convertible Arbitrage:* A convertible bond has two securities embedded in it – a conventional bond and a conversion option on the company's stock. When companies have convertible bonds or convertible preferred stock outstanding in conjunction with common stock, warrants, preferred stock and conventional bonds, it is entirely possible that you could find one of these securities mispriced relative to the other, and be able to construct a near-riskless strategy by combining two or more of the securities in a portfolio.

Pseudo or Speculative Arbitrage

The word arbitrage is used much too loosely in investments and there are a large number of strategies that are characterized as arbitrage, but actually expose investors to significant risk. Consider the following examples:

- *Paired Arbitrage*: In classic arbitrage, you buy an asset at one price and sell an exactly identical asset at a different (and higher) price. In paired arbitrage, you buy one stock (say GM) and sell another stock that you view as very similar (say Ford), and argue that you are not exposed to risk. Clearly, this strategy is not riskless since no two stocks are exactly identical, and even if they were very similar, there is no reason why their prices have to converge.
- *Merger Arbitrage*: In chapter 10, the strategy of buying shares in firms involved in an acquisition, after the acquisition was announced, was described. This strategy is called merger arbitrage, though it is difficult to see why it is called arbitrage in the first place. The profits are not riskless and the strategy is speculative.

Evidence

It should come as no surprise that there are relatively few arbitrage opportunities that have been uncovered by empirical research over the last few decades. In fact, it may surprise some that any such opportunities exist in the first place. As you will see in this section, the evidence on arbitrage opportunities is ambiguous and can be interpreted differently, depending upon your point of view. Believers in efficient markets look at the evidence and argue that they cannot be exploited to make any money, because of transactions costs and execution problems. Those who believe that there are times when markets break down argue that the mispricing of assets can be exploited perhaps not by all investors but by some investors in the market.

Pure Arbitrage

One way to test whether arbitrage opportunities exist is to look at how futures and options contracts are priced by the market. This, by itself, though is weak evidence of arbitrage because you have to trade at these prices to make the riskless profits. The second test of arbitrage is to examine the returns of investors who claim to do arbitrage and see if they succeed.

Futures and Option Markets

If futures and option arbitrage is so simple, you may ask, how in a reasonably efficient market would arbitrage opportunities even exist? In the commodity futures market, for instance, a study in 1983 found little evidence of arbitrage opportunities and those

findings are echoed in more recent studies. In the futures and options markets, there is evidence that indicates that arbitrage is indeed feasible but only to a very small sub-set of investors and for very short periods.² Differences in transactions cost seem to explain most of the differences. Large institutional investors, with close to zero transactions costs and instantaneous access to both the underlying asset and futures markets may be able to find and take advantage of arbitrage opportunities, where individual investors would not. In addition, these investors are also more likely to meet the requirements for arbitrage – being able to borrow at rates close to the riskless rate and sell short on the underlying asset.

Note, though, that the returns are small³ even to these large investors and that arbitrage will not be a reliable source of profits, unless you can establish a competitive advantage on one of three dimensions. First, you can try to establish a transactions cost advantage over other investors, which will be difficult to do since you are competing with other large institutional investors. Second, you may be able to develop an information advantage over other investors by having access to information earlier than others. Again, though much of the information is pricing information and is public. Third, you may find a quirk in the pricing of a particular futures or options contract before others learn about it. The arbitrage possibilities seem to be greatest when futures or options contracts are first introduced on an asset, since investors take time to understand the details of futures pricing. For instance, it took investors a while to learn how to price stock index and treasury bond futures.⁴ Presumably, investors who learnt faster than the market were able to take advantage of the mispricing of futures and options contracts in these early periods and make substantial profits.

Fixed Income Arbitrage

Bonds lend themselves to arbitrage more easily than stocks because they have finite lives and fixed cash flows. This is especially so, when you have government bonds, where the fixed cash flows are also guaranteed. Consider one very simple example. You could replicate a 10-year treasury bond's cash flows by buying zero-coupon treasuries with

² Garbade, K.D. and W.L. Silber, 1983, *Price Movements and Price Discovery in Futures and Cash Markets*, The Review of Economics and Statistics, v115, 289-297.

³ A study of 835 index arbitrage trades on the S&P 500 futures contracts estimated that the average gross profit from such trades was only 0.30%.

⁴ With index futures, it took investors a while to understand the effect of uneven dividends on future prices. With treasury bond futures, the wild card feature (where you are allowed to deliver the cheapest of a menu of bonds) resulted in some early mispricing of futures contracts.

expirations matching those of the coupon payment dates on the treasury bond. For instance, if you invest \$ 1 million in a ten-year treasury bond with an 8% coupon rate, you can expect to get cashflows of \$ 40,000 million every six months for the next 10 years and \$ 1 million at the end of the tenth year. You could have obtained exactly the same cashflows by buying zero-coupon treasuries with face values of \$ 40,000, expiring every six months for the next ten years, and an additional 10-year zero coupon bond with a face value of \$ 1 million. Since the cashflows are identical, you would expect the two positions to trade for the same price. If they do not trade at the same price, you would buy the cheaper position and sell the more expensive one, locking in the profit today and having no cashflow or risk exposure in the future.

With corporate bonds, you have the extra component of default risk. Since no two firms are exactly identical when it comes to default risk, you may be exposed to some risk if you are using corporate bonds issued by different entities. In fact, two bonds issued by the same entity may not be equivalent because of differences in how they are secured and structured. There are some arbitrageurs who argue that bond ratings are a good proxy for default risk, and that buying one AA rated bond and selling another AA rated bond should be riskless, but bond ratings are not perfect proxies for default risk. In fact, you see arbitrage attempted on a wide variety of securities with promised cashflows, such as mortgage backed bonds. While you can hedge away much of the cashflow risk, the nature of the cashflow claims will still leave you exposed to some risk. With mortgage backed bonds, for instance, the unpredictability of prepayments by homeowners has exposed many “riskless” positions to risk.

Is there any evidence that investors are able to find bonds mispriced enough to generate arbitrage profits? An assessment of the treasury strips program – a program allowing investors to break up a treasury bond and sell its individual cash flows – notes that there were potential arbitrage opportunities in these markets in the early years of the program but finds little evidence of trading driven by these opportunities⁵. An analysis of the Spanish bond market may shed some light on this question.⁶ Examining default free and option free bonds in the Spanish market between 1994 and 1998, this study concludes that there were arbitrage opportunities surrounding innovations in financial markets. You would extend these findings to argue that opportunities for arbitrage with bonds are

⁵ Grinblatt, M. and F.A. Longstaff, 2000, *Financial innovation and the role of derivative securities: An empirical analysis of the U.S. treasury's strips program*, Journal of Finance.

⁶ Alejandro Balbás and Susana López, 2001, *Financial innovation and arbitrage in the Spanish bond market*, Working Paper, SSRN.

probably greatest when new types of bonds are introduced – mortgage backed securities in the early 1980s, inflation- indexed treasuries in the late 1990s and the treasury strips program in the late 1980s. As investors become more informed about these bonds and how they should be priced, arbitrage opportunities seem to subside.

Near Arbitrage

Near arbitrage is more likely to occur than pure arbitrage and it can take many forms. In this section, you will look at the evidence accumulated over time on near arbitrage strategies.

Same Security, Multiple Markets

Many large companies such as Royal Dutch, General Electric and Microsoft trade on multiple markets on different continents. Since there are time periods during the day when there is trading occurring on more than one market on the same stock, it is conceivable (though not likely) that you could buy the stock for one price in one market and sell the same stock at the same time for a different (and higher price) in another market. The stock will trade in different currencies, and for this to be a riskless transaction, the trades have to at precisely the same time and you have to eliminate any exchange rate risk by converting the foreign currency proceeds into the domestic currency instantaneously. Your trade profits will also have to cover the different transactions costs in the two markets. There are some exceptional cases, where the same stock trades in different markets in one country. An examination of 84 Czech stocks that trade on the two Czech exchanges – the Prague Stock Exchange (PSE) and the Registration Places System (RMS)- finds that prices adjust slowly across the two markets, and that arbitrage opportunities exist (at least on paper) –the prices in the two markets differ by about 2%.⁷ These arbitrage opportunities seem to increase for less liquid stocks. While the authors consider transactions cost, they do not consider the price impact that trading itself would have on these stocks and whether the arbitrage profits would survive the trading.

Many Asian, Latin American and European companies have American Depositary Receipts (ADRs) listed on the U.S. market. Depositary Receipts are issued or created when investors decide to invest in a non-US. company and contact their brokers to make a purchase. These brokers, through their own international offices or through a local broker in the company's home market, purchase the shares in the local market and request that the shares be delivered to the depository bank's custodian in that country. The broker who

⁷ Swaicki, J. and J. Hric, 2001, *Arbitrage Opportunities in Parallel Markets: The Case of the Czech Republic*, Working Paper, SSRN.

initiated the transaction will convert the US dollars received from the investor into the corresponding foreign currency and pay the local broker for the shares purchased. On the same day that the shares are delivered to the custodian bank, the custodian notifies the depository bank. Upon such notification, Depository Receipts are issued and delivered to the initiating broker, who then delivers the Depository Receipts to the investor. These depository receipts⁸ create a claim equivalent to the one you would have had if you had bought shares in the local market and should therefore trade at a price consistent with the local shares. What makes them different and potentially riskier than the stocks with dual listings is that ADRs are not always directly comparable to the common shares traded locally – one ADR on Telmex, the Mexican telecommunications company, is convertible into 20 Telmex shares. In addition, converting an ADR into local shares can be sometimes costly and time consuming. In some cases, there can be differences in voting rights as well. In spite of these constraints, you would expect the price of an ADR to closely track the price of the shares in the local market, albeit with a currency overlay, since ADRs are denominated in dollars. An examination of the link between ADRs and local share concludes that about 60 to 70% of the variation in ADR prices can be attributed to movements in the underlying share prices and that ADRs overreact to the U.S. market and under react to exchange rates and the underlying stock.⁹ However, investors cannot take advantage of the pricing errors in ADRs because convergence does not occur quickly or in predictable ways. With a longer time horizon and/or the capacity to convert ADRs into local shares, though, you should be able to take advantage of significant pricing differences.

Closed End Funds

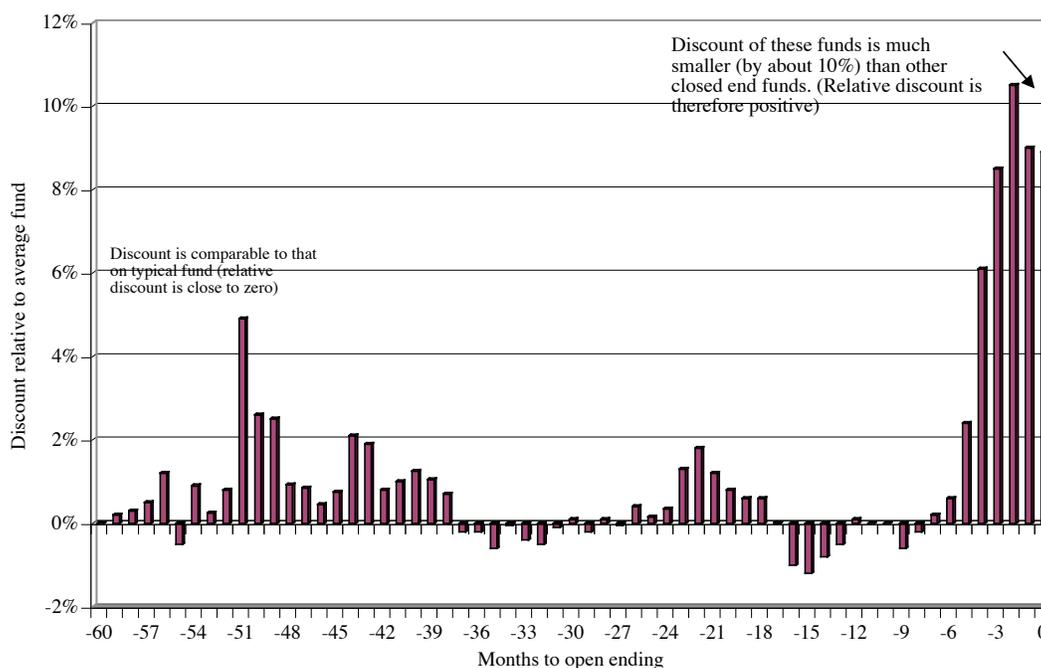
In both the United States and the United Kingdom, closed end mutual funds have shared a very strange characteristic. When they are created, the price is usually set at a premium on the net asset value per share. As closed end funds trade, though, the market price tends to drop below the net asset value and stay there. In any given time period that they have been examined, about 60-70% of closed end funds trade at a discount on the net asset value. Some of these discounts are substantial and exceed 20%.

⁸ Depository receipts can be sponsored by the company, in which case they can be used by the company to raise capital, or unsponsored, in which case they are issued by intermediaries (like banks) to meet market demand.

⁹ Kin, M. A.C. Szakmary and I. Mathur, 2000, *Price Transmission Dynamics between ADRs and Their Underlying Foreign Securities*, Journal of Banking and Finance, v24, 1359-1382.

So what, you might ask? Lots of firms trade at less than the estimated market value of their assets. That might be true, but closed end funds are unique for two reasons. First, the assets are all traded stocks and the market value is therefore known at any point in time and not an estimate. Second, liquidating a closed end fund's assets should not be difficult to do, since the assets are traded stocks or bonds. Thus, liquidation should neither be costly nor time consuming. Given these two conditions, you may wonder why you should not buy closed end funds that trade at a discount and either liquidate them yourself or hope that some one else will liquidate them. Alternatively, you may be able to push a closed-end fund to convert into an open-end fund and see prices converge on net asset value. Figure 11.1 reports on the performance of closed-end funds when they convert to open end, based upon an examination of 94 UK closed-end funds that open ended:¹⁰

Figure 11.1: Relative Discount on Closed End Funds that Open End



Data from Dimson and Minio-Kozerzki. These are the average relative discounts of closed end funds that open end in the UK.

Note that as you get closer to the open-ending date (day 0), the discount becomes smaller relative to the average closed-end fund. For instance, the discount goes from being on par with the discount on other funds to being about 10% lower than the typical closed-end fund.

¹⁰ Dimson, E. and C. Minio-Kozerzki, 1998, *Closed-end Funds, A Survey*, Working Paper, London Business School.

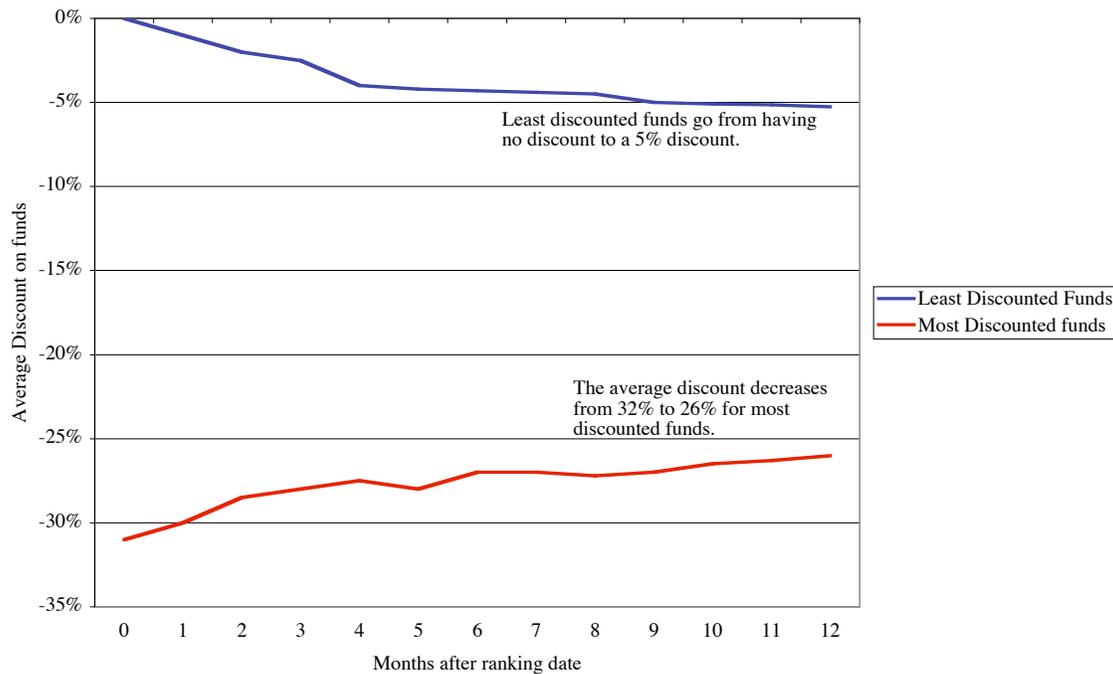
So what is the catch? In practice, taking over a closed-end fund while paying less than net asset value for its shares seems to be very difficult to do for several reasons- some related to corporate governance and some related to market liquidity. There have been a few cases of closed end funds being liquidated, but they remain the exception. What about the strategy of buying discounted funds and hoping that the discount disappears? This strategy is clearly not riskless but it does offer some promise. One of the first studies of this strategy examined closed end funds from 1940 to 1975 and reported that you could earn an annualized excess return of 4% from buying discounted funds.¹¹ An analysis in 1986 reports excess returns from a strategy of buying closed end funds whose discounts had widened and selling funds whose discounts had narrowed – a contrarian strategy applied to closed end funds. An examination of closed end funds reported that funds with a discount of 20% or higher earn about 6% more than other closed end funds.¹² This, as well as research in the UK, seem to indicate a strong reversion to the average in discounts at closed funds. Figure 11.2, which is from a study of the discounts on closed end funds in the UK, tracks relative discounts on the most discounted and least discounted funds over time:¹³

¹¹ Thompson, Rex, 1978, The Information Content of Discounts and Premiums on Closed-End Fund Shares, *Journal of Financial Economics* 6, 151-186.

¹² Pontiff, Jeffrey, 1997, *Excess Volatility and Closed-End Funds*, *American Economic Review* 87, 155-169.

¹³ Minio-Paluello, Carolina, 1998, *The UK Closed-End Fund Discount*, PhD thesis, London Business School

Figure 11.2: Discounts on most discounted and least discounted funds over time



Data from Minio-Paluello. The discounts on the most discounted and least discounted funds are followed for 12 months after the funds are selected.

Note that the discounts on the most discounted funds decrease whereas the discounts on the least discounted funds increase, and the difference narrows over time.

Convertible Arbitrage

In the simplest form of convertible arbitrage, since the conversion option is a call option on the stock, you could construct its equivalent by combining the underlying stock and the treasury bond (a replicating portfolio). Adding a conventional bond to this should create the equivalent of the convertible bond – this is called a synthetic convertible bond. Once you can do this, you can take advantage of differences between the pricing of the convertible bond and synthetic convertible bond and potentially make arbitrage profits. In the more complex forms, when you have warrants, convertible preferred and other options trading simultaneously on a firm, you could look for options that are mispriced relative to each other, and then buy the cheaper option and sell the more expensive one.

Pseudo or Speculative Arbitrage

In Chapter 10, you looked at some of the empirical evidence on merger arbitrage. Summarizing the findings, merger arbitrage does generate healthy returns for investors who

use it but it is certainly not riskless. In fact, it is a strategy where failure can lead to large negative returns while success takes the form of small positive returns. Consider now the evidence on paired arbitrage, where you find two similar stocks that are mispriced relative to each other and buy (sell) the cheaper (more expensive) one. The conventional practice among those who have used paired arbitrage strategy on Wall Street has been to look for two stocks whose prices have historically moved together – i.e., have high correlation over time. This often leads to two stocks in the same sector, such as GM and Ford. Once you have paired the stocks, you compute the spread between them and compare this spread to historic norms. If the spread is too wide, you buy the cheaper stock and short the more expensive stock. In many cases, the strategy is self-financing. For example, assume that Ford has historically traded at a third of GM's price. If Ford is currently trading at \$ 20 and GM is trading at \$ 40, GM is overpriced relative to Ford. You would buy two shares of Ford and sell short one share of GM; this position would be self financing and would require no investment from you. If you are right, and the spread narrows between the shares, you will profit on your paired position.

Can such a simplistic strategy, based entirely upon past prices, make excess returns? In 1999, a study tested a variety of trading rules based upon pairs trading from 1982-1997, using the following process:¹⁴

- Screening first for only stocks that traded every day, the authors found a matching partner for each stock by looking for the stock that moved most closely with it.¹⁵ Once they had paired all the stocks, they studied the pairs with the smallest squared deviation separating them.
- With each pair, they tracked the normalized prices of each stock and took a position on the pair, if the difference exceeded the historical range by two standard deviations, buying the cheaper stock and selling the more expensive one.

Over the 15 year period, the pairs trading strategy did significantly better than a buy-and-hold strategy. Strategies of investing in the top 20 pairs earned an excess return of about 6% over a 6-month period, and while the returns drop off for the pairs below the top 20, you continue to earn excess returns. When the pairs are constructed by industry group (rather than just based upon historical prices), the excess returns persist but they are smaller.

¹⁴ Gatev, E.G., W.N.Goetzmann and K.G. Rouwenhorst, 1999, *Pairs Trading, Performance of a Relative Value Arbitrage Rule*, Working Paper, SSRN.

¹⁵ To find this stock, they look for the minimum squared difference between the returns of two stocks. If two stocks move in lock step, this difference will be zero.

Controlling for the bid-ask spread in the strategy reduces the excess returns by about a fifth, but the returns are still significant.

While the overall trading strategy looks promising, there are two points worth emphasizing that should also act as cautionary notes about this strategy. The first is that the study quoted above found that the pairs trading strategy created negative returns in about one out of every six periods, and that the difference between pairs often widened before it narrowed. In other words, it is a risky investment strategy that also requires the capacity to trade instantaneously and at low cost. The second is a quote from a well-known quantitative analyst, David Shaw, who bemoaned the fact that by the late 1990s, the pickings for quantitative strategies (like pairs trading) had become slim because so many investment banks were adopting the strategies. As the novelty has worn off, it seems unlikely that the pairs trading will generate the kinds of profits it generated during the 1980s.

Crunching the Numbers

Given the wide range of arbitrage strategies available, your portfolio will look very different depending upon the strategy you pick. In the first part of this section, you will look at one futures market (gold) and one options markets (stock index) to see if you can find any obvious candidates for pure arbitrage. In the second part of this section, portfolios of heavily discounted closed end funds and depository receipts will be constructed and put under the microscope for potential profits.

Futures and Options Arbitrage

Do futures contracts on commodities and financial assets obey the pricing rules preventing arbitrage? Consider, as an illustration, futures contracts on gold, a commodity with small storage costs and a high price. Table 11.1 lists the prices on futures contracts on gold listed on the Chicago Board of trade on April 4, 2003. At the time, the spot price of gold was \$ 324.9 an ounce and the riskless rates are listed in the table. Assuming that the storage costs are zero, the predicted or theoretical prices are estimated as follows:

Theoretical price = Spot price of gold $(1 + \text{Riskless rate})^{\text{Time to expiration}}$

Table 11.1: Gold Futures Contracts: Actual and Predicted Futures Prices

<i>Month</i>	<i>Actual Futures Price</i>	<i>Time to maturity</i>	<i>Riskless rate</i>	<i>Predicted price</i>	<i>Price difference (%)</i>
Apr '03	325.3	0.08333333	1.25%	325.24	0.02%
May '03	325.6	0.16666667	1.26%	325.58	0.01%
Jun '03	326	0.25	1.27%	325.93	0.02%
Aug '03	326.7	0.41666667	1.27%	326.61	0.03%
Oct '03	327.2	0.58333333	1.28%	327.32	-0.04%
Dec '03	327.7	0.75	1.35%	328.18	-0.15%

Feb '04	328.3	0.91666667	1.38%	329.01	-0.22%
Apr '04	328.8	1.08333333	1.41%	329.87	-0.32%
Jun '04	329.3	1.25	1.43%	330.72	-0.43%
Aug '04	330	1.41666667	1.45%	331.59	-0.48%
Oct '04	331.1	1.58333333	1.48%	332.55	-0.44%
Dec '04	331.9	1.75	1.51%	333.53	-0.49%
Feb '05	332.8	1.91666667	1.52%	334.43	-0.49%
Jun '05	334.6	2.25	1.56%	336.42	-0.54%
Dec '05	337.6	2.75	1.50%	338.48	-0.26%
Jun '06	341.6	3.25	1.58%	341.88	-0.08%
Dec '06	346.2	3.75	1.70%	346.10	0.03%
Jun '07	351.1	4.25	1.84%	351.08	0.01%
Dec '07	355.9	4.75	1.93%	355.78	0.03%

Note that the actual prices are very close (within half of one percent) to the theoretical prices for every one of the futures contracts.

As another exercise, Table 11.2 lists call and put options on the S&P 500 with different exercise prices and their prices on April 4, 2003. The spot price of the index at the time that this table was extracted was 876.04.

Table 11.2: S&P 500 Index Options – April 4, 2003

Exercise Price	Calls			Puts		
	April	May	June	April	May	June
865	23.9	35.8	45.1	15.6	27.5	36.8
870	21	32.9	42.2	17.7	29.6	38.9
875	18.3	30.2	39.5	20	31.9	41.2
880	15.8	27.6	36.9	22.5	34.3	43.6
885	13.6	-	34.4	25.3	-	46.1
890	11.6	23	32	28.3	39.7	48.6

There are a number of tests that you can run for simple arbitrage opportunities. Consider, for example, the call and put options due in June 2003. In Table 11.3, the prices of the call and put options are compared to the exercise values of these options.

Table 11.3: Market Prices versus Exercise Values – June 2003 Options

Exercise Price	Calls		Puts	
	Market Price	Simple Exercise: S - K	Market Price	Simple Exercise: K - S
865	\$45.10	\$11.04	\$36.80	\$0.00

870	\$42.20	\$6.04	\$38.90	\$0.00
875	\$39.50	\$1.04	\$41.20	\$0.00
880	\$36.90	\$0.00	\$43.60	\$3.96
885	\$34.40	\$0.00	\$46.10	\$8.96
890	\$32.00	\$0.00	\$48.60	\$13.96

For example, exercising a call option with an exercise price of 865 will generate an exercise value equal to the difference between the current level of the index (876.04) and the exercise price. Exercising a put option with an exercise price of 885 will generate a profit equal to the difference between the exercise price and the current index level. None of the June options trade at less than exercise value. In fact, reverting back to the Table 11.2 that lists out all the traded options on the index, there is not a single option that violates simple arbitrage. While this is a weak test of arbitrage opportunities, you can expand these tests to cover more involved arbitrage opportunities and you will not find any (or at least any that look easy to exploit).

In general, you can scan the futures and options pages every day for weeks without finding obvious arbitrage opportunities. Even if you do find an obvious mispricing, odds are that you are finding a misprint, that you are missing a critical ingredient in your pricing formula or that you cannot execute at that price. In other words, pure arbitrage opportunities if they exist in markets are likely to take on more subtle forms and will require more research.

Depository Receipts

There are hundreds of non-US companies that have depository receipts listed on them in the United States. To find evidence of mispricing in this market, Table 11.4 lists the ADR price and the dollar value of the local listing price of the twenty most liquid ADRS on March 4, 2003:

Table 11.4: Most Liquid ADRs in the United States: April 4, 2003

<i>DR ISSUE</i>	<i>ADR price</i>	<i>Local Share Price (\$)</i>
NOKIA CORPORATION	\$14.70	\$14.71
ERICSSON LM TELEPHONE COMPANY	\$6.99	\$6.98
SAP AG	\$19.82	\$19.83
TAIWAN SEMICONDUCTOR MANUFACTURING CO.	\$7.55	\$7.55
BP PLC	\$39.01	\$38.95
ROYAL DUTCH PETROLEUM CO.	\$42.06	\$42.04
TEVA PHARMACEUTICAL INDUSTRIES LTD	\$44.07	\$44.07

VODAFONE GROUP PLC	\$19.00	\$18.99
AMERICA MOVIL SA DE CV- SERIES 'L'	\$14.50	\$14.52
STMICROELECTRONICS N.V.	\$18.64	\$18.64
TELEFONOS DE MEXICO S.A. DE C.V.-SERIES 'L'	\$30.67	\$30.66
BUSINESS OBJECTS S.A.	\$18.33	\$18.33
GOLD FIELDS LIMITED	\$10.19	\$10.19
TELE NORTE LESTE PARTICIPACOES S.A.	\$9.29	\$9.30
ASTRAZENECA PLC	\$34.85	\$34.86
HSBC	\$52.87	\$52.89
UNITED MICROELECTRONICS CORPORATION	\$3.27	\$3.26
CEMEX S.A. DE CV	\$18.25	\$18.25
ASML HOLDING NV	\$6.91	\$6.91
PETROLEO BRASILEIRO S.A. - PREFERRED	\$15.28	\$15.26

The prices were obtained from the US and the foreign exchange at the same point in time and the local listing price is converted into dollars at the prevailing exchange rate at that time. You can see that the prices are within a cent or two of each other. That should come as no surprise for two reasons. One is that these ADRs can be converted into local shares are relatively low cost. The other is that there is heavy trading in both the local and ADR markets on these shares. Any significant difference between the ADR and the local share price would be almost instantaneously arbitrated.

There are some countries that impose significant restrictions on converting ADRs into local shares. This is true, for instance, with Indian companies that have ADRs listed in the United States. These ADRs often trade at prices that are very different from the local share price. Table 11.5 summarizes the prices in U.S. dollars of some of the most heavily traded Indian companies in the United States.

Table 11.5: ADR and Local Share Prices – Indian Companies

<i>Company</i>	<i>ADR Price</i>	<i>Local Price (Rs)</i>	<i>Local Price (\$)</i>	<i>Premium (Discount)</i>	<i>Market Cap in \$ (Local market)</i>
DR REDDY (RDY)	\$19.60	915.2	\$19.35	1.30%	1,629.60
HDFC BANK (HDB)	\$17.30	240	\$15.35	12.70%	1,427.90
ICICI BANK (IBN)	\$6.60	136.8	\$5.77	14.40%	1,768.60
INFOSYS TECH. (INFY)	\$62.90	4,226.80	\$44.58	41.10%	5,903.70
MTNL (MTE)	\$4.20	97.5	\$4.09	2.60%	1,295.90
SATYAM COMP (SAY)	\$9.10	186	\$7.82	16.40%	1,234.00
SILVERLINE TECH. (SLT)	\$1.50	7.2	\$0.30	400.30%	13
VSNL (VSL)	\$3.40	76.8	\$3.25	4.70%	461.5

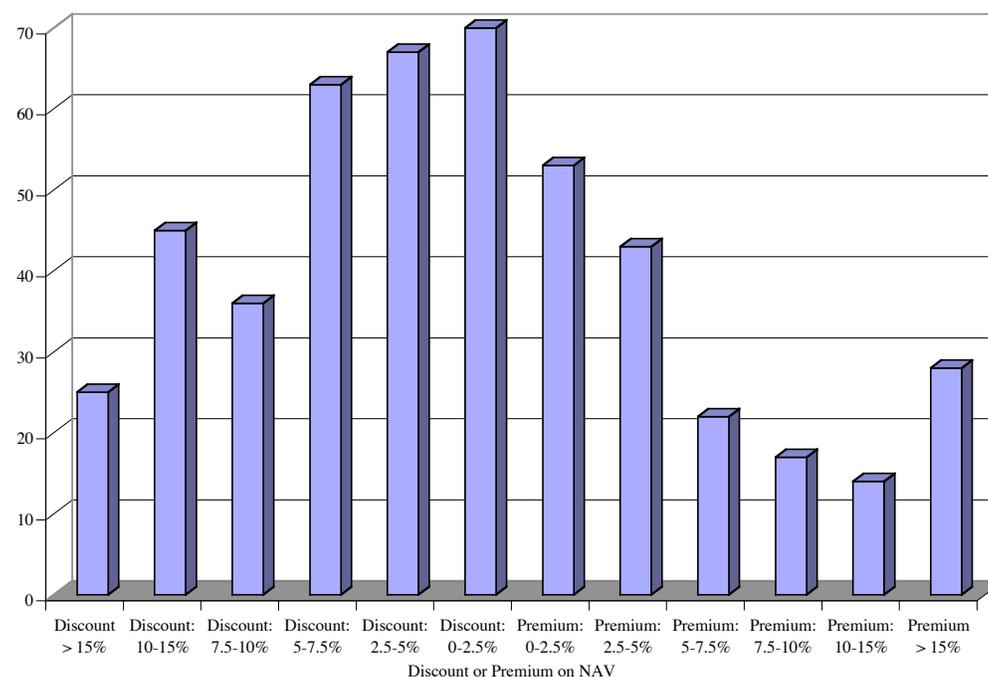
WIPRO (WIT)	\$29.50	1,251.50	\$26.36	11.90%	6,139.70
-------------	---------	----------	---------	--------	----------

Every one of the ADRs trades at a premium on the local share price. For instance, the ADR of Infosys, which is one of India's largest and best known technology companies, trades at a premium of 41% over the local shares. If you were not restricted in terms of trading, you would buy the local shares on the Bombay stock exchange and sell short the ADRs. You could then convert the local shares into ADRs and deliver them, thus capturing the profits.

Closed End Funds

In March 2003, there were hundreds of closed end funds listed in the United States. Figure 11.3 provides the distribution of price to net asset value for all closed end funds in the United States in June 2002.

Figure 11.3: Discounts/Premiums on Closed End Funds- June 2002



Data from Morningstar. This is the discount or premium at which the closed end fund shares trade, relative to net asset value.

Note that almost 70% of the closed end funds trade at a discount to net asset value and that the median discount is about 5%.

Some of these funds trade at significant discounts, and the 20 most heavily discounted funds are listed in table 11.6:

Table 11.6: Most Discounted Closed End Funds in the US – March 2003

<i>Fund Name</i>	<i>Discount</i>	<i>Trading Volume</i>	<i>Assets: \$ Million</i>
Equus II (EQS)	-44.33%	3,881	171
meVC Draper Fisher Jurvetson I (MVC)	-27.77%	36,565	109
Bexil Corporation (BXL)	-25.03%	2,349	9
Indonesia Fund (IF)	-22.28%	28	11
Thai Capital (TF)	-22.20%	473	19
Singapore Fund (SGF)	-20.76%	14,794	66
New Ireland (IRL)	-19.95%	7,517	96
Morgan Funshares (MFUN)	-19.84%	533	6
First Israel (ISL)	-19.64%	5,651	75
New Germany (GF)	-19.27%	39,393	124
Morgan Stanley India Investment Fund (IIF)	-18.61%	32,567	172
Latin America Equity (LAQ)	-17.68%	9,409	89
Latin American Discovery (LDF)	-17.63%	12,821	85
Scudder New Asia (SAF)	-16.80%	11,506	84
Malaysia Fund (MF)	-16.67%	13,049	46
Emerging Mkts Telecommunications (ETF)	-16.61%	12,365	112
Central Securities (CET)	-16.37%	11,511	366
Swiss Helvetia (SWZ)	-16.36%	21,471	287
John Hancock Bank & Thrift (BTO)	-16.29%	189,085	804
Brazil Fund (BZF)	-16.27%	26,316	168

The closed end funds range the spectrum but emerging market funds dominate. If you could buy these funds at their discounted market prices and liquidate their assets at market value, you could generate substantial profits. With the Equus II fund, for instance, you could have bought all of the shares in the fund for about \$ 100 million, sold the marketable securities for \$171 million and claimed a profit of \$ 71 million.

The Rest of the Story

If you are a skeptical investor, you are probably waiting for the other shoe to drop. After all, investing would be easy if arbitrage opportunities abounded. In this section, you will consider why it is so difficult for investors to find and take advantage of arbitrage opportunities.

Pure Arbitrage

The nature of pure arbitrage – two identical assets that are priced differently – makes it likely that it will be short lived. In other words, in a market where investors are on the look out for riskless profits, it is very likely that small pricing differences will be exploited quickly, and in the process, disappear. Consequently, the first two requirements for success

at pure arbitrage are access to real-time prices and instantaneous execution. It is also very likely that the pricing differences in pure arbitrage will be very small – often a fraction of a percent. To make pure arbitrage feasible, therefore, you can add two more conditions. The first is access to borrowing at favorable interest rates, since it can magnify the small pricing differences. Note that many of the arbitrage positions require you to be able to borrow at the riskless rate. The second is economies of scale, with transactions amounting to millions of dollars rather than thousands. Institutions that are successful at pure arbitrage often are able to borrow several times their equity investment at or close to the riskless rate to fund arbitrage transactions, using the guaranteed profits on the transaction as collateral.

With these requirements, it is not surprising that individual investors have generally not been able to succeed at pure arbitrage. Even among institutions, pure arbitrage is feasible only to a few, and even to those, it is a transient source of profits in two senses. First, you cannot count on the existence of pure arbitrage opportunities in the future, since it requires that markets repeat their errors over time. Second, the very fact that some institutions make profits from arbitrage attracts other institutions into the market, reducing the likelihood of future arbitrage profits. To succeed in the long term with arbitrage, you will need to be constantly on the lookout for new arbitrage opportunities.

Near Arbitrage

Studies that have looked at closed end funds, dual listed stocks and convertibles all seem to conclude that there are pockets of inefficiency that can be exploited to make money. However, there is residual risk in all of these strategies, arising sometimes from the fact that the assets are not perfectly identical and sometimes from the fact that there are no mechanisms for forcing the prices to converge.

Not perfectly identical assets

In convertible arbitrage, investors attempt to create synthetic convertibles by combining stocks and bonds issued by the firm and compare the costs of these synthetic convertibles to the prices of actual convertible bonds. While, in theory, synthetic and actual convertible bonds are identical, there can be significant constraints in the real world that prevent this from occurring. First, many firms that issue convertible bonds do not have straight bonds outstanding, and you have to substitute in a straight bond issued by a company with similar default risk. Second, companies can force conversion of convertible bonds, which can wreak havoc on arbitrage positions. Third, convertible bonds have long maturities. Thus, there may be no convergence for long periods, and you have to be able to maintain the arbitrage position over these periods. Fourth, transactions costs and execution problems (associated with trading the different securities) may prevent arbitrage.

What does this imply? You can create what look like an arbitrage position by buying (selling) the convertible bond and selling (buying) the synthetic convertible bond but the differences between the bond and its synthetic counterpart may generate unexpected losses. These losses will be exaggerated when you use borrow money to fund these positions.

Absence of convergence mechanisms

In the last section, you saw evidence of potential arbitrage opportunities in closed end funds and some ADRs. Closed end funds trade at a discount to the market value of the securities that they hold and there are sometimes significant price differences between ADRs and local shares. In both cases, though, you may find yourself stymied in your search for arbitrage by real world constraints.

- With closed end funds, you will need to buy the fund at the discounted market price, liquidate its marketable securities and claim the difference as a certain profit. There are problems at each stage. Many closed end funds are lightly traded and you may very well push the price up to net asset value as you accumulate shares in these funds. Many closed end funds also are tightly controlled and gaining control of them may prove difficult. Even assuming that you do accumulate the shares of the closed end fund at the discounted price and are able to liquidate the assets, you will have to pay capital gains taxes when you sell stocks and these taxes may well wipe out the potential gains. Finally, your transactions costs have to be small enough to leave you with a profit at the end. Note that of the 25 most heavily discounted closed end funds listed in Table 11.6, roughly half were emerging market funds where transactions costs are much higher. It should come as no surprise that so few closed end funds are forced into liquidation.
- With ADRs, there are two potential roadblocks on the way to your arbitrage profits. Consider, for instance, the Infosys ADR that was highlighted in table 11.5. To make a profit, you would have to convert the local shares into ADRs and sell short the ADRs. You would be restricted from doing the former and the ADRs are often very difficult to sell short for long periods. Even if you are able to sell short the ADRs for a few months and you buy the local shares, there is no guarantee that the premium will decrease or disappear over those months and it may, in fact, increase.

Speculative Arbitrage

The fact that the strategies in this section are classified as speculative arbitrage is not meant to be a negative comment on the strategies. These are promising investment strategies that have a history of delivering excess returns but they are not risk free. More ominously, it is easy for those who have successfully done pure arbitrage in the past to drift into near

arbitrage and then into speculative arbitrage as they have funds to invest. In some cases, their success at pure or near arbitrage may bring in funds which require this shift. As they make the shift, though, there are some potential dangers that they have to consider.

Too much leverage (borrowing)

The use of financial leverage has to be scaled to reflect the riskiness of the strategy. With pure arbitrage, you can borrow 100% of what you need to put the strategy into play. In futures arbitrage, for instance, you borrow 100% of the spot price and borrow the commodity. Since there is no risk, the leverage does not create any damage. As you move to near and speculative arbitrage, this leverage has to be reduced. How much it has to be reduced will depend upon both the degree of risk in the strategy and the speed with which you think prices will converge. The more risky a strategy and the less certain you are about convergence, the less debt you should take on.

Price Impact

Speculative arbitrage strategies work best if you can operate without a market impact. As you get more funds to invest and your strategy becomes more visible to others, you run the risk of driving out the very mispricing that attracted you to the market in the first place. In other words, this strategy will work best for smaller investors who can operate under the radar and not very well for larger investors who draw attention to their strategies when they trade.

Small Upside, Big Downside

While it may be dangerous to extrapolate from just two strategies, both merger arbitrage and paired trading share a common characteristic. You win most of the time with both strategies but the returns when you win are modest. You lost infrequently, but your losses are large when they occur. These unequal payoffs can create problems for careless investors. For instance, investors can be lulled by a long string of successes into thinking that their strategies are less risky than they truly are. If they then proceed to borrow more money to fund these strategies, they risk dramatic losses.

Long Term Capital Management

Investors considering speculative arbitrage as their preferred investment philosophy should pay heed to the experiences of Long Term Capital Management (LTCM). The firm, which was founded in the early 1990s by ex-Salomon trader, John Merriweather, promised to bring together the best minds in finance to find and take advantage of arbitrage opportunities around the world. Delivering on the first part of the promise, Merriweather

lured the best bond traders from Salomon and brought on board two Nobel prize winners – Myron Scholes and Bob Merton. In the first few years of its existence, the firm also lived up to the second part of the promise, earning extraordinary returns for the elite of Wall Street. In those years, LTCM was the envy of the rest of the street as it used low cost debt to lever up its capital and invest in pure and near arbitrage opportunities. As the funds at their disposal got larger, the firm had to widen its search to include speculative arbitrage investments. By itself, this would not have been fatal but the firm continued to use the same leverage on these riskier investments as it did on its safe investments. It bet on paired trades in Europe and decreasing spreads in country bond markets, arguing that the sheer number of investments in had in its portfolio would create diversification – if it lost on one investment, it would gain on another. In 1997, the strategy unraveled as collapses in one market (Russia) spread into other markets as well. As the portfolio dropped in value, LTCM found itself facing the downside of its size and high leverage. Unable to unwind its large positions without affecting market prices and facing the pressures of lenders, LTCM faced certain bankruptcy. Fearing that it would bring down other investors in the market, the Federal Reserve engineered a bailout of the firm.

What are the lessons that you can learn from the fiasco? Besides the cynical one that it is good to have friends in high places, you could argue that the fall of LTCM teaches that

- (a) Size can be a double-edged sword. While it gives you economies of scale in transactions costs and lowers the cost of funding, it also makes it more difficult for you to unwind positions that you have taken.
- (b) Leverage can make low-risk positions into high-risk investments, since small moves in the price can translate into large changes in equity
- (c) The most brilliant minds in the world and the best analytical tools cannot insulate you from the vagaries of the market.

In many ways, the rise and fall of Long Term Capital Management should stand as testimony to how even the brightest minds in investing can sometimes either miss or willfully ignore these realities. Long Term Capital Management's eventual undoing can be traced to many causes but the immediate cause was the number of speculative arbitrage positions they put in place – pairs trading, interest rate bets – with tremendous leverage.

Lessons for Investors

This chapter should act as a cautionary note for those investors who believe that they have found the proverbial free lunch in investing. If you seek pure arbitrage – two identical assets that you can buy at different prices and lock in the profits – you will generally not

find it in liquid markets. In illiquid markets, you may come across such mispricing but your transactions costs will have to be small for you to earn arbitrage profits.

Your chances of success are greater if you look for near arbitrage, where you have two assets that are almost identical which are mispriced. If you choose to pursue these opportunities, you will improve your odds of success if you do the following:

- *Identify your differential advantage (if any):* A little introspection may be a valuable first step. You have to identify the special characteristic you possess that will allow you to take advantage of arbitrage opportunities while other investors cannot. If you are an institutional investor, you may have better and more timely information and lower transactions costs than other investors and use this advantage to earn arbitrage profits. If you are a smaller individual investor, your advantage may be that you control the time horizon of your investment and that you do not have to respond to impatient clients.
- *Be aware of the residual risk:* Near arbitrage is not riskless and you need to be aware of both the source and the magnitude of the risk that you are exposed to in your strategy. This will allow you to be realistic in the funding and design of your investment strategies.
- *Use leverage prudently:* Since deviations from arbitrage tend to be small, investors often borrow substantial amounts to magnify their profits. There is a trade off, though, that you have to keep in mind. As you borrow money, you also magnify your risks. The extent to which you use borrowed money has to reflect the risk associated with your investment strategy; the more risk there is, the less you should borrow. Cookbook arbitrage strategies, where you borrow the same amount for all strategies, can be a recipe for disaster.
- *Execute your strategy efficiently:* Arbitrage opportunities tend to be fleeting and you have to execute promptly to take advantage of them. Execution has to be speedy while transactions costs are kept under control, a difficult combination to achieve.

In general, near arbitrage strategies will not work for very small investors or for very large investors. Small investors will be stymied both by transactions costs and execution problems. Very large investors will quickly affect prices when they trade and eliminate excess returns. If you decide to adopt these strategies, you need to refine and focus your strategies on those opportunities where convergence is most likely. For instance, if you decide to try to exploit the discounts of closed-end funds, you should focus on the closed end funds that are most discounted and concentrate especially on funds where there is the potential to bring pressure on management to open end the funds. You should also avoid

funds with substantial illiquid or non-traded stocks in their portfolios, since the net asset values of these funds may be significantly overstated.

If you decide to go after speculative arbitrage opportunities, do so with open eyes. Recognize that there is really nothing riskless about these strategies and that they really represent bets that pricing relationships between assets will return to long term norms. The biggest danger in this strategy is that while you may be right most of the time, you can lose very large amounts when you are wrong. There are two keys to success with speculative arbitrage:

- *Research*: Establishing the long term normal relationship between assets is important, since this is the number to which you assume prices will ultimately converge. This will require not only access to data over long periods but enough statistical skill to separate facts from noise.
- *Downside protection*: Since one losing position can wipe out the profits generated over several winning positions, your expected returns from this strategy will improve dramatically if you can develop signals that allow you to identify and get out of losing positions early.

The overall message will be a disappointment for those investors who still seek free lunches. It is difficult to find and even more difficult to take advantage of arbitrage opportunities, but that is to be expected in a world where there are millions of investors seeking out ways of making money. The good news is that investors who do their homework and work at establishing differential advantages over others can still hope to generate substantial profits from these strategies.

Conclusion

Invest no money, take no risk and make profits. While this sounds like the recipe for a money machine, this is how you can describe pure arbitrage. For pure arbitrage to exist, you need two assets with exactly the same cash flows trading at different prices. Buying the lower priced asset and selling the higher priced asset will allow an investor to lock in the price difference as a certain profit; the cashflows on the two assets exactly offset each other, resulting in a riskless investment. Pure arbitrage opportunities, if they exist, are most likely to be found in futures and options markets, and will almost certainly be small and fleeting. Only investors with significant information or execution advantages are likely to be able to take advantage of them.

In near arbitrage, you have two almost identical assets trading at different prices but there are significant restrictions that prevent the prices of the two from converging. A closed end fund that trades at a significant discount on the market value of the securities that it

owns would be one example. If you could buy the entire fund at the market price and liquidate its securities, you should be able to make a hefty profit. Unfortunately, restrictions on liquidating the fund may reduce you to holding shares in the fund and hoping that the discount gets smaller over time.

Speculative arbitrage, where you have similar but not identical assets trading at prices that are not consistent with their historical norms, provides investors with the illusion of a free lunch. In reality, these are risky positions that generate profits (albeit small ones) most of the time but generate large losses when they fail.