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Convergence trading, arbitrage and systemic risk in the United States

Convergence trading, especially arbitrage, is used on a large scale by investment banks and hedge funds, and contributes to the smooth integration of financial markets. However, it is also a source of systemic risk, as the transactions involve short-term debt that can be cut off by the creditor in times of market stress. In this case, arbitrageurs are forced to rapidly unwind their positions, leading to abnormal falls and divergences in asset prices. This risk materialised in the US Treasury market during the crises of 1998 – with the collapse of the hedge fund Long Term Capital Management (LTCM) – and of 2008, but ultimately proved contained in the 2020 health crisis. The intervention or non-intervention in the market of the US Federal Reserve can be linked to the severity of the financial crises.

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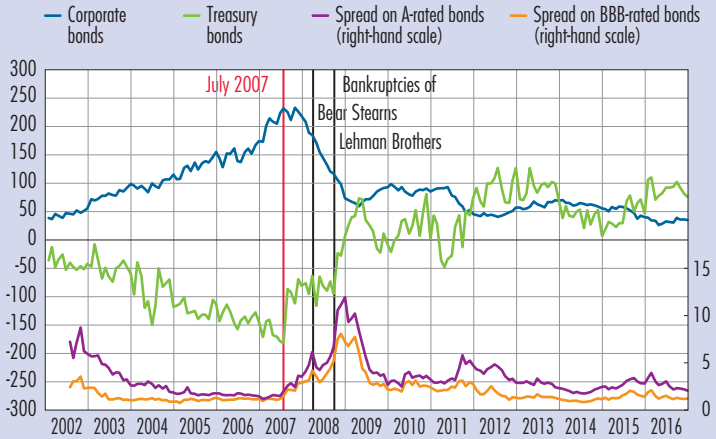
JEL codes:
G01,
G23, G28

3
number of major financial crises
in the past 25 years
involving convergence trading

USD 200 billion
net stock of US Treasury bonds
shorted by primary dealers
as at end-June 2007

Convergence trading by US primary dealers and corporate bond spreads

(outstanding amounts in USD billions; spread in %)



Sources: Federal Reserve Bank of New York, FINRA (TRACE database); Dastarac (2020).
Note: Stocks of corporate bonds held by primary dealers and stocks of Treasury bonds shorted by primary dealers. Median spreads between corporate bonds with a residual maturity of between 4 and 6 years and rated A or BBB by the strictest agency, and an equivalent Treasury bond (Gilchrist and Zakrajsek, 2012).

1 What are convergence trading and arbitrage?

Convergence trading consists in exploiting the difference between two asset prices in the expectation that they will converge over the short or medium term. The strategy is mainly used by investment banks and hedge funds.[1] Another term for convergence trading is relative value trading or pairs trading.

When the two assets involved are almost identical, the practice is known as arbitrage.

How do you profit from price divergences?

To illustrate, take the example of two bonds from the same issuer, with similar maturities and equivalent contract terms (same seniority, option for early redemption by the issuer, same coupon, etc.). The strategy consists first in buying the cheaper bond, which we shall call A, and short selling the more expensive bond, called B; short selling a bond means borrowing it from an investor and selling it onwards in the market. In the second step of the strategy, bond A is sold and bond B is bought back in order to return it to its owner.

The strategy is profitable if the prices of A and B converge. If, for example, the price[2] of bond A falls, the convergence between the two prices will mean that the price of bond B falls even further; the loss on the purchase/resale of bond A is therefore more than offset by the gain on the sale/repurchase of bond B. The same applies if the price of bond B rises.

In general, convergence trading can be just as risky as gambling on whether the price of any asset will rise or fall. In the case of arbitrage, bonds A and B are almost identical. An investor looking to buy one of the bonds will most likely choose the cheaper one, causing its price to rise. The prices of the two bonds should thus converge over time and the risk should remain limited; however, the price divergences and potential profits in this case are small. In order to generate acceptable returns for the shareholder, arbitrageurs sometimes have to use massive leverage, which creates substantial risks (see below).

LTCM's strategy

Launched in 1994, the hedge fund Long Term Capital Management (LTCM) used arbitrage to exploit the divergence between recently issued (on-the-run) US Treasury bonds, which are more liquid and more expensive, and those issued a few months earlier (off-the-run), which are less liquid and cheaper. LTCM shorted on-the-run securities and went long in off-the-run securities, in the expectation that their prices would converge over the next few months, as had generally been observed.

US banks' strategy in the 2000s for Treasury and corporate bonds

In the 2000s, primary dealers[3] in the United States built up long positions in corporate bonds while simultaneously shorting US Treasury bonds (see Chart 1 below). The corporate bonds they purchased were rated investment grade,[4] meaning that the associated default risk was moderate to low (Dastarac, 2020).

The strategy was as follows: all other things being equal, Treasury bonds are more liquid and therefore cost more than corporate bonds; as a result, it appeared profitable to short sell Treasury bonds and buy top-rated corporate bonds with similar maturities.

1 Investment banks provide services for businesses: lending, cash management, securities issuance and market making, arbitrage, etc. Hedge funds are investment funds that use leverage to hedge certain components of their assets and increase their exposure to other components (as described in this article).

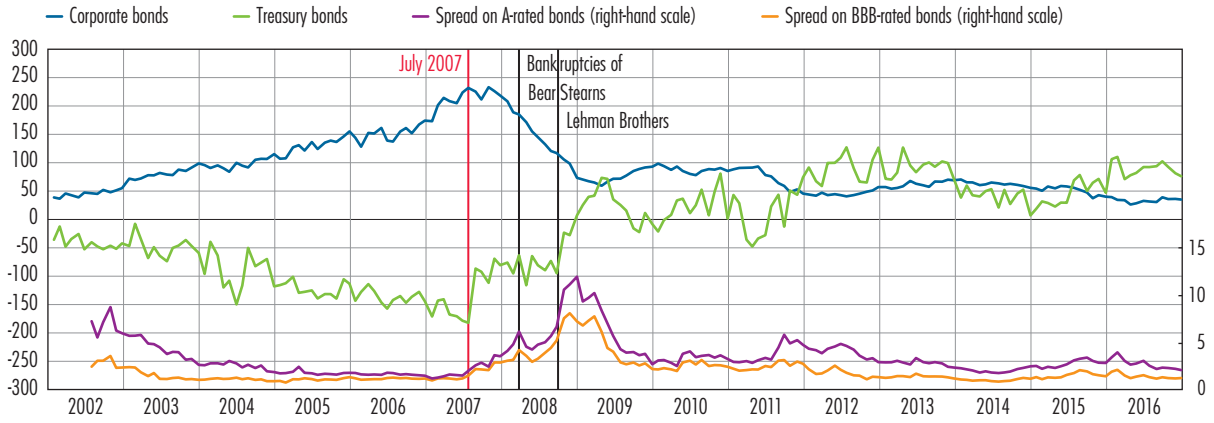
2 In reality, the price at which an investor can purchase an asset (offer or ask price) is higher than the price at which it can sell it (bid price) to an intermediary. This difference (the bid-ask spread) must be taken into account when assessing the profitability of a convergence trade. Here, the price (singular) of an asset is taken to be the average of the bid and ask prices.

3 Banks and other financial institutions agree to subscribe regularly to issues of US Treasury bonds, and trade them in the secondary market.

4 Bonds top-rated by credit ratings agencies.

C1 US primary dealers' positions and corporate bond spreads

(outstanding amounts in USD billions, spread in %)



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The benefits of convergence trading and especially arbitrage: intermediation between fragmented markets

Two identical bonds, A and B, generate identical revenues in all circumstances. Consequently, any price divergence between the two bonds reflects a fragmentation between markets: participants in the market for bond B, which is more expensive, cannot opt instead to buy bond A, which is more attractive price-wise.

There is therefore a benefit to be gained from bringing participants in both markets together: participants in market A can sell their securities at a higher price to participants in market B. While a straightforward merger between markets might be impossible, or indeed undesirable from the point of view of market managers, arbitrageurs can bring the two together by buying from sellers in market A and selling to buyers in market B.

However, the benefits for markets go hand in hand with substantial risks.

2 The 1998 and 2008 crises laid bare the risks of convergence trading

In theory, arbitrage is risk-free if (i) bonds A and B are absolutely identical, and (ii) the arbitrageur can maintain their positions[5] indefinitely. If these conditions are met, the arbitrageur can wait until either the bonds mature or the issuer defaults: they will then receive a reimbursement for bond A and, instead of returning bond B to its owner, can give back an amount corresponding to the security's full or partial reimbursement.

Risk 1: the bond prices do not converge because the observed divergences are justified by the underlying fundamentals

Betting that the prices of two very different assets will converge is just as risky as gambling that an asset price will rise or fall.

5 A position in a security can be short or long. A long position is where the investor holds the security. A short position is where the investor has borrowed the security and sold it in the market.

Even in the case of arbitrage, in practice two assets are rarely completely identical, so the revenues they generate may differ. The strategy therefore carries a risk – albeit a limited one if the bonds are relatively similar. Under certain circumstances, price discrepancies may be justified by the differences in revenues.

Institutions that lend to banks and hedge funds take a number of precautions, described below, to protect themselves against the risk of non-convergence. However, these precautions in turn generate other risks for the market.

Risk 2: risk of a forced liquidation before prices converge

The strategies used by hedge funds or investment banks are not always visible to their creditors.[6] Even when they are, the price convergence may take longer than expected, raising fears that it might never happen. In response, creditors can protect themselves in two ways.

First, lenders of security B might ask for cash collateral to protect against the arbitrageur's potential default. The arbitrageur pays for this collateral from the sale of the security in the market. They then have to find another source of funding to purchase bond A. The solution is to borrow the cash from another counterparty, who in turn asks that bond A be pledged as collateral.

In general, the creditor will demand that the collateral value be higher than the value of the loan, to ensure that it will cover the amount of the debt in the event of a default. This excess is financed from the arbitrageur's capital: creditors thus impose a capital requirement on arbitrageurs which is distinct from regulatory requirements. In principle, the higher the risk of a change in the underlying asset price until loan maturity, the higher the capital requirement imposed by the creditor.

The loan to fund position A takes the form of a repurchase agreement (repo): the lender purchases the security from the arbitrageur and agrees to sell it back at a set price that includes interest. The transaction to borrow security B is a reverse repo (and a repo from the perspective of the lender of the security).

The other way creditors can protect themselves is to lend over a short-term horizon, often overnight, even if this means having to renew the transaction regularly. This extra precaution avoids the risks and complexities of having to recover a debt in a period of market stress, and makes it possible, prior to a default, to adjust the amount of credit provided on each security loaned or financed (which equates to adjusting the capital requirement).

The risk for the convergence trader is substantial: the transaction requires them to take on a short-term debt, denominated in cash or securities, which can be called in at any time. If the loan of bond B is terminated, the arbitrageur has to buy it back immediately in order to return it to its owner; if the financing for bond A is terminated, the arbitrageur has to sell the security immediately.

The potential systemic effects of a forced liquidation

Creditors tend to terminate their financing when the underlying asset is at its most volatile, in other words during periods of market stress: they cannot see whether the losses on the financed position are offset by gains on an opposite position.[7]

A forced liquidation of a long position in A, for example, will amplify the fall in A, causing lenders to other banks and hedge funds holding A to become nervous about potential losses. These lenders may in turn cut off their financing for security A, leading the other banks and hedge funds to liquidate their positions, and so on in a chain reaction.

6 Publishing details of the strategy would allow the competition to copy it and would lower the funds' returns. However, not publishing it also increases the potential for hidden risk-taking. If a hedge fund only has one creditor (a bank acting as prime broker), then that creditor has details of the entire strategy. But some large, well-established funds are able to deal with more than one bank and are not obliged to reveal their strategies.

7 The quarterly accounts published by banks show large aggregate items that make it impossible to identify individual strategies. Hedge funds are often even more opaque.

The liquidation of a position also results in the liquidation of the opposite position, triggering a contagion effect. As A and B are relatively similar, supply and demand for these assets are influenced by common factors: under normal circumstances, a loss linked to a fall in A will be more or less offset by the gain on the buyback of B. If an arbitrageur sells bond A because it is no longer financed, they will be exposed to the risk of a rise in B, which was not part of the original strategy. The arbitrageur therefore has to buy back B as well in order to balance the trading book. This leads to a vicious circle of forced buybacks of B.

The losses caused by forced liquidations can also trigger losses for creditors, obliging them in turn to liquidate positions in other assets to make up for the shortfalls.

A forced liquidation by an arbitrageur can hence become systemic and spread to the entire market.[8] There is a chance that this may not happen, especially if the creditor(s) is(are) aware of the arbitrageur's strategy. However, the risk did effectively materialise in the last three major financial crises.

The 1998 crisis: the case of LTCM

In August 1998, Russia defaulted on its debt: international investors shifted instead into US Treasury bonds which were more liquid and more secure. The reallocation was mainly into on-the-run bonds (which are more liquid and hence more easily available), which drove up their prices and increased the risk that LTCM would incur losses on its short position. As the prices were taking longer than expected to converge, the banks involved started to think about terminating their loans.

To prevent a forced liquidation of LTCM's positions from propagating to the rest of the financial system, the US Federal Reserve obliged the banks to organise a bail-out of the fund. The solution they chose was to buy it out via a consortium, and to then liquidate its positions very gradually. The consortium made a small profit on the transaction (Lowenstein, 2020): the strategy adopted would have been profitable if it had been followed through completely.

The 2008 crisis: the forced buyback of Treasury bonds

In July 2007, well before the collapses of Bear Stearns (March 2008) and Lehman Brothers (September 2008), primary dealers halved their net positions in Treasury bonds (see Chart 1 above).

In all likelihood they were forced to do so: the reduction was brutal and left them with a large stock of corporate bonds that were unhedged against interest rate risk, which probably led to a gradual sell-off of these securities over 2008. The reduction in primary dealers' positions came just a few weeks after a rise in volatility in the US Treasury market, but not in the corporate bond market. The increased volatility probably made creditors jittery, causing them to readjust their loan supply. Immediately, spreads began to widen between corporate and Treasury bonds (see "spread" curves in Chart 1), which was the first symptom of the crisis. If the Fed had loaned Treasury securities as of July 2007, the widening of corporate credit spreads could probably have been contained.

3 Arbitrage during the Covid-19 crisis in the United States

At the time of writing of this article, the impact of the Covid-19 crisis on the financial sector appears to have been surprisingly benign compared with the 2008 crisis – especially given the effects of the lockdown on economic activity and the rise in risk in US and European financial markets just before the pandemic. Indeed, at the end of August 2020, asset prices had nearly come back to their pre-crisis levels (December 2019).

The rise in risk in US and European financial markets immediately prior to the pandemic

Before the emergence of the coronavirus, asset valuations in Europe and the United States already appeared stretched relative to expected returns. In US equity markets in particular, price-to-earnings ratios had reached historical highs at end-2019. Doubts were raised over the valuations of firms that were promising to revolutionise their industry but had yet to turn a profit (e.g. WeWork

8 The theory behind this mechanism is described by Gromb and Vayanos (2002), and Brunnermeier and Pedersen (2009).

or Uber). Concerns also emerged over lax lending conditions in the US and European SME credit markets: the share of leveraged loans offering weak protection for the lender (covenant-lite loans) had reached 90% in the United States and Europe.[9] Yields on 10-year Treasury bonds had been below 3-month yields since 2018, which can be interpreted as a leading indicator of a crisis (Harvey, 1986 and 2008). There was thus a strong possibility that prices would fall, triggering massive liquidations.

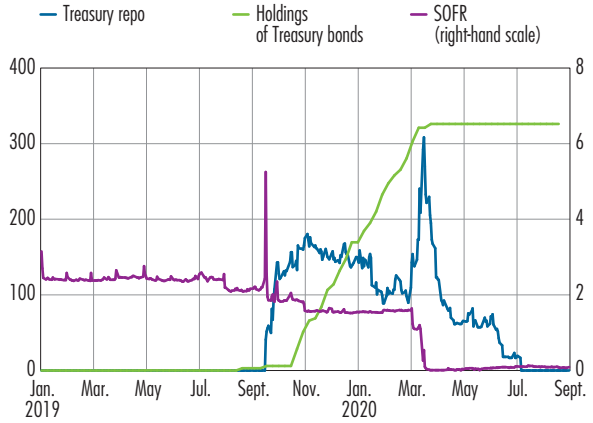
The first signs of tension appeared in September 2019 in the Treasury repo market: the associated rates, as measured by the SOFR,[10] climbed to more than 3 percentage points over the Fed's IOER.[11] Banks that held excess reserves should thus have been able to lend at extremely profitable rates, especially as the strength of the underlying collateral meant that the credit risk was very limited. However, Avalos et al. (2019) show that the banking sector was already under considerable strain. The Fed therefore stepped in rapidly to inject liquidity into the financial system, by lending massively on the repo market and then buying up short-term Treasury securities (see Chart 2). The episode appears to have set a precedent for the Fed, which subsequently chose to intervene massively and in a timely manner in March 2020.

An LTCM-type episode?

The temporary nature of the fall in asset prices can perhaps be explained by the Fed's decision to step in massively to limit forced sales and buybacks of Treasury bonds by arbitrageurs. Two types of strategy may have been involved: on-the-run/off-the-run arbitrage, as in 1998, and arbitrage between Treasury bonds and the associated futures contracts.

C2 Repo rates and intervention by the Federal Reserve

(rate in %; amount in USD billions)



Sources: Federal Reserve Board, Federal Reserve Bank of New York; author's calculations.
Note: SOFR is the Secured Overnight Financing Rate.

Bond and futures arbitrage[12] consists in buying a Treasury bond and selling it forward via the associated futures contract if the price of the underlying bond is lower than that of the future, and vice versa. This strategy probably explains the huge position built up by hedge funds immediately prior to the Covid-19 crisis (see Chart 3 below and Schrimpf et al., 2020).

With regard to on-the-run/off-the-run arbitrage, the fall in US long-term interest rates (10-year yields fell from 1.5% on 19 February 2020 to 0.7% at end-February[13] – see Chart 4) reflects both the

9 In theory, the losses on these loans are not borne by the lending bank, as the debts are sold to a special purpose vehicle (SPV) controlled by the lending bank. The bank may guarantee the repayment of the loans to safeguard its reputation; however, in practice, and as observed during the 2008 crisis, it may not have sufficient resources to do so during a period of stress (Duffie, 2020).

10 Secured Overnight Financing Rate.

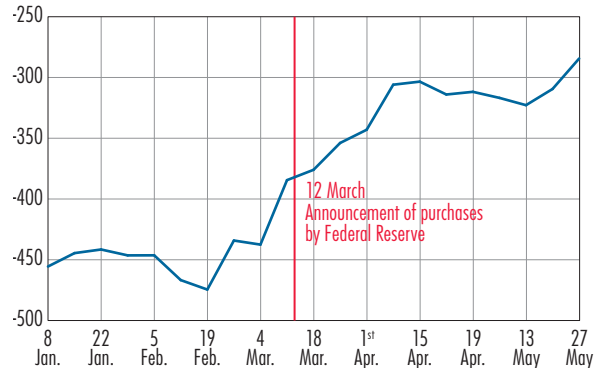
11 Interest Rate On Excess Reserves.

12 In a futures contract, a buyer and seller agree to exchange a set quantity of an asset at a predetermined price (the futures price) on a specified date in the future. The buyer (seller) makes a profit if the futures price is lower (higher) than the market price when the contract matures.

13 In other words, a 10% rise in the price of a 10-year bond.

C3 Hedge funds' positions in Treasury bond futures, all maturities combined, from January to May 2020

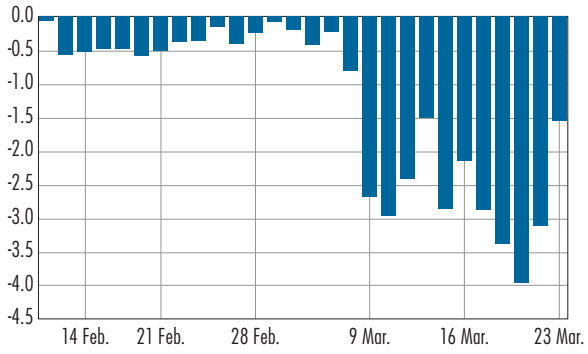
(USD billions)



Sources: Commodity Futures Trading Commission (*Commitments of Traders Report*); author's calculations.
Key: A negative position denotes the sale of futures by hedge funds.

C5 Spread between on-the-run and off-the-run US 10-year Treasury bonds, between February and March 2020

(%)

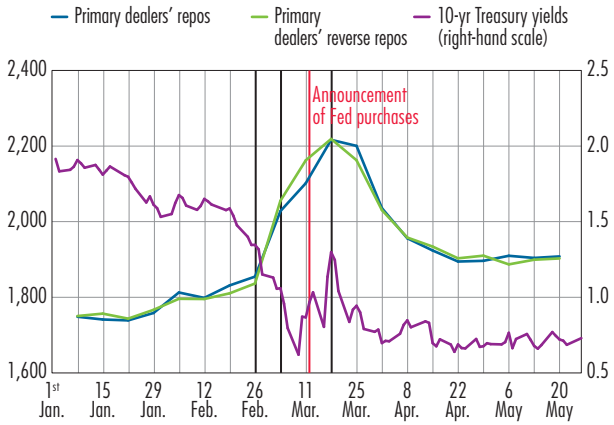


Sources: Bloomberg, Spratt (2020).

Fed's decision to lower short-term rates and a flight to quality, essentially towards on-the-run bonds. Primary dealers symmetrically increased their stock of Treasury repos (which financed holdings) and reverse repos (which financed Treasury bond borrowing) by USD 400 billion, in all likelihood to profit from the widening of the spread between on-the-run and off-the-run bonds, as in 1998 (see Chart 4).

C4 Primary dealers' Treasury repos and reverse repos, and 10-year Treasury yields, from January to May 2020

(outstanding amounts in usd billions; rates in %)



Sources: Federal Reserve Bank of New York, author's calculations.
Note: Primary dealers are specialists in Treasury securities.

10-year yields hit a low on 9 March 2020, on the same day that the on-the-run/off-the-run spread widened abruptly (see Chart 5), which was both a cause and a symptom of tensions among arbitrageurs.

On 12 March, the Fed announced a massive purchase of Treasuries of all maturities, probably mainly off-the-run bonds, to limit spreads and take the pressure off arbitrageurs. In the space of just a month, it purchased over USD 1,200 billion of Treasury bonds.

4 Is it right to help convergence traders faced with the threat of forced liquidation?

The experience of the past 25 years suggests that it may be desirable for central banks to intervene in order to limit forced liquidations.[14] However, authorities also need to limit the associated moral hazard: the expectation that central banks will intervene could encourage banks and hedge funds to take excessive risk. A first avenue would be to use the "LTCM solution" immediately after helping the convergence trader: liquidate its positions gradually via a consortium, and without the involvement of the fund managers if they are found to have taken excessive risk.

14 This is also the objective of liquidity swaps between central banks (see Panetta and Schnabel, 2020).

There also needs to be a discussion over the upstream regulation of convergence trading, as its outlines are not clearly defined. As indicated earlier, to the extent that the capital requirements imposed by creditors or regulations are short term and depend on the riskiness of the arbitraged assets, a change in the risk on either one of those assets is liable to lead to forced liquidations (Gromb and Vayanos, 2002).

A final avenue would be to address the causes behind arbitrageurs' leverage. Duffie (2020) notes that the leverage of arbitrageurs (especially banks) increases for purely technical reasons due to the time lag between the finalisation of transactions and their settlement-delivery:[15] central clearing would limit the number of bilateral exposures and thereby reduce agents' leverage.

15 During this time lag, the seller of the security has a debt denominated in securities and a claim on the buyer (and vice versa for the buyer).

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