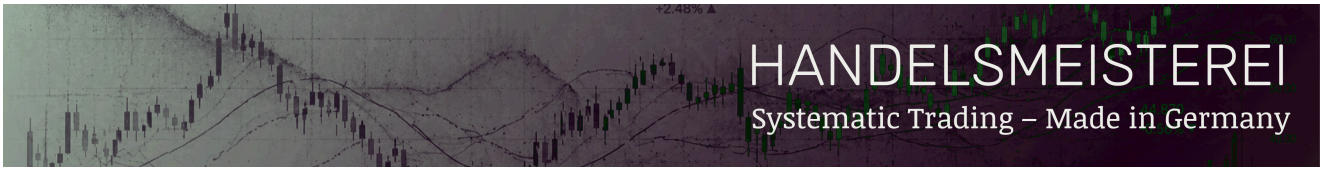

SYSTEMATIC CASH MANAGEMENT FOR FUTURES TRADERS — PART I

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This is the first article in a series about cash management for futures traders. This article lays the theoretical foundations needed to understand the topic in more detail and will introduce two systematic strategies for interest optimization and automatic margin management.

You trade futures across multiple markets. A few months in, your account holds ten currencies—and you're paying interest on some of them. You buy crude oil in US dollars here and sell KOSPI in Korean won there. All of a sudden, you ask yourself how you ended up in this situation. At the same time, you earn less interest than expected and the broker charges you for negative cash balances. How do you manage this efficiently?

Ironically, the safest looking part of your account—cash—can be one of the most inefficient if left unmanaged. Analyzing the cash balances against your portfolio and doing manual foreign exchange (FX) trades is tedious and complicated. This process warrants a systematic approach. This series will guide you through the topic. We begin with theory and derive systematic strategies both for interest optimization and cash conversion. The series will also show you how to monitor your account effectively and give implementation hints for Interactive Brokers.

Margin Mechanics

Let's start with the basics: the margining system. If you're reading this article, you probably already have a working understanding of margin mechanics, but let's do a quick recap. First of all, there is an important difference between buying stocks and trading futures on margin. When buying stocks, you typically pay only half of the price yourself and the other half is financed by a loan from your broker if you run out of cash. When buying futures, there is no loan involved: The broker simply sets aside a predefined initial margin from your account.

Suppose your broker account is denominated in US dollars (your base currency) and you are bullish on the German economy, so you decide to buy a DAX mini future. Behind the scenes, in a windowless room downstairs at your broker, the following happens: The last time you checked, your account value was $100,000 and the DAX traded at 23,000 index points. The contract is denominated in euros and has a multiplier of 5. One contract therefore has a current notional value of €115,000. Even if your dollars are not worth as much as they used to be, you can afford one DAX mini. You can even afford a lot more because futures are leveraged instruments that trade on margin.

The broker requires about €10,000 of your account equity as collateral to open the position. This is the initial margin required to buy one DAX mini and is usually determined by the exchange. The broker can also increase this margin if deemed necessary. Once the

position is open, you only need about €9,000 as collateral to sustain the position. This is called maintenance margin. The difference between the initial and the maintenance margin can be seen as a buffer for the price of the DAX mini to move around a little bit before the broker has to call you up and require additional funds to maintain the position.

But wait a second: You do not have a single euro in your account. And yet the trade goes through. No problem! Posting the initial margin does not involve any cash movement or currency conversion in your account. The friendly people downstairs simply set aside a dollar equivalent from your account as collateral to cover the initial margin. This procedure only affects how many additional positions you can open. Foreign currency cash flows occur only later on, when the future contract changes in price and daily settlement occurs. Just remember: Margin is not money that moves—it's money that gets locked.

Day 1: Opening the position

Let's walk through an example: You bought one DAX mini at a price of 23,000 and €1 is worth $1.15. Let's further assume the DAX did not move at all until the end of trading on day 1.

Assumptions

- Base currency: USD
- Starting cash: $100,000
- Position: long 1 DAX Mini future
- Contract multiplier: €5 per index point
- Opening DAX level: 23,000
- EUR/USD: 1.15
- Ignore commissions and taxes

Your account balances look like this after nightly settlement:

USD Account balances	Amount
Cash	100,000
Net liquidation value	100,000
Available funds	89,650
Exchange rate EUR/USD	1.15

Table 1: Dollar balances after day 1

EUR Account balances	Amount
Cash	0
Maintenance margin	9,000
-	-
Price DAX mini	23,000

Table 2: Euro balances after day 1

Table 1 introduces two new terms: "Net liquidation value" (NLV) and "Available funds". NLV is simply the value of your account if you closed all positions now (including non-base cash positions). As the price of the DAX mini did not change and the exchange rate between EUR and USD is still the same as when the position was opened, the NLV of the account is still $100,000. "Available funds" is the amount of money you can employ to open further positions and cover their margin requirements. It is calculated as the NLV minus all maintenance margin requirements. If the margin requirement is in a non-base currency, then it is valued at the current FX rate (to your base currency). The USD-equivalent margin requirement is then subtracted from NLV. Your margin requirements on day 1 are easily satisfied.

Day 2: DAX move creates EUR cash

Moving on to day 2: The DAX makes a big move up from 23,000 to 24,000. You gained 1,000 index points on the futures position! That translates to €5,000, because the DAX mini contract has a multiplier of 5. Let's further suppose that the exchange rate did not change at all. The profit of €5,000 will be attributed to your euro cash position at settlement. This is called variation margin and

means that all daily profit and loss fluctuations are directly credited or debited to your cash position in the currency of the respective contract: Futures don't accumulate P&L—they settle it. Your account now looks like the following:

USD Account balances	Amount
Cash	100,000
Net liquidation value	105,750
Available funds	95,400
Exchange rate EUR/USD	1.15

Table 3: Dollar balances after day 2

EUR Account balances	Amount
Cash	5,000
Maintenance margin	9,000
-	-
Price DAX mini	24,000

Table 4: Euro balances after day 2

Both your NLV and the available funds now reflect today's profit from your DAX mini, because someone downstairs updated your EUR cash balance and quietly moved €5,000 onto your pile. The NLV now is the sum of your USD cash position and your EUR cash position (valued in USD with the exchange rate valid at the end of the trading day). The margin requirements are subtracted from NLV to arrive at available funds. In the example, the EUR margin of €9,000 equals $10,350, which results in available funds of $95,400.

So far, the mechanics are straightforward. However, an important practical aspect remains: interest. In reality, you pay daily interest on your negative cash positions and receive interest on your positive positions, but I am getting ahead of myself. Optimizing these payments will be part of the interest strategy later on.

Day 3: FX moves

To finish the example, let's have a look at day 3. On day 3, the DAX does not move at all, but the exchange rate between EUR and USD falls to 1.1. Essentially your euros are now worth less than the day before. You decide to close the position at the end of the trading day. What happens to your account balances?

USD Account balances	Amount
Cash	100,000
Net liquidation value	105,500
Available funds	105,500
Exchange rate EUR/USD	1.1

Table 5: Dollar balances after day 3

EUR Account balances	Amount
Cash	5,000
Maintenance margin	0
-	-
Price DAX mini	24,000

Table 6: Euro balances after day 3

Well, your cash position in USD is still the same, because you closed out a contract denominated in EUR. Nothing changes here, except that the margin is no longer required and therefore drops to zero. The DAX did not move, so it did not have any price impact. The FX market, however, had other plans: Yesterday, your EUR cash position was worth $5,750, but today, at an exchange rate of 1.1, it is only worth $5,500. Downstairs, nobody cares about the DAX anymore—but the FX desk shaved $250 off your account.

It is worth noting that for futures, FX risk materializes through cash positions created by daily settlement, not through the contract notional. If you are thinking "Wait, shouldn't the FX loss be much larger?" you are not alone. You bought the DAX at 23,000 $\times$ 5 EUR at an exchange rate of 1.15 USD, which equals $132,250. Today, it is worth only 24,000 $\times$ 5 EUR at an exchange rate of 1.1, which equals $132,000. This intuition is misleading. The

notional comparison suggests a $250 loss, but that is not how futures accounting works. You already realized the DAX gain through daily settlement. What remains exposed to FX is the accumulated €5,000 cash balance, now worth $5,500. Because futures are marked to market daily, only the accumulated cash balance is exposed to FX movements. In futures, FX risk lives in your cash—not in your position. In the real world, however, a big move in the exchange rate would of course be at least partially reflected in the price of the DAX, because international investors would probably adjust their positions.

Interest Strategy

Now that the margin mechanics are understood, let's dive into interest calculation at Interactive Brokers. Interest is easy to ignore—until you realize it has been draining your account for months. It accrues daily. Quietly. And then shows up at the end of the month when you nearly forgot about it. Every cash balance per currency is tied to the respective overnight benchmark rate—but Interactive Brokers does not pass that rate through fully. There are some caveats:

First, they internally have two segments: A security and a commodity segment. Futures margin sits in the commodities segment—and does not earn interest. But you also don't have to pay interest if, say, your USD account opens a DAX position without holding any EUR cash. Interactive Brokers uses your dollars as collateral for the margin. They effectively pool all customer positions for margin calculations at the clearing house.

Earning interest on non-base currency balances therefore is quite difficult: You would have to have more cash in that currency than the maintenance margin and also hit the cash balance tier (above 10,000 USD value in the respective currency). That is something you usually should not do, because it creates too much FX risk.

Second, they do not give you the benchmark rate on cash positions. They pay you wholesale minus a haircut and charge you retail plus a markup while the parking meter is ticking all night. For positive balances, the haircut is between 0.5% for US dollars and 4% for Mexican pesos for the lowest tier[1] to the respective benchmark rate. And because the people downstairs want to paint the walls from time to time, they also charge you an add-on for negative cash balances (between 1.5% for US dollars and 3% for Mexican pesos for the lowest tier[2]). In other words: Earning interest with Interactive Brokers on currencies other than your base currency is therefore often suboptimal, while negative cash balances are expensive to maintain. That's an important point to keep in mind when designing the strategy later on.

From a futures trader's perspective, interest at the broker is a game with two simple rules:

Interest Rules

- Try not to borrow
- Don't hoard the wrong currency

Let's say you are pretty prudent about avoiding negative cash balances and do not excessively hoard non-base currencies in your account. As a futures trader you typically will sit on about 70% of your cash, because responsible trading at a risk target of e.g. 25% will usually only use between 20% and 30% of your capital as margin. Therefore, you could invest the 70% "free" cash otherwise.

If you do not have a special strategy for that and want to stick to liquid instruments, you could park your money in a money market ETF tracking the benchmark of your base currency (like SOFR for USD). This way you do have a risk exposure similar to before (no FX risk and daily interest rate risk). Of course,

1. over 10,000 USD equivalent
2. under 100,000 USD equivalent

ETFs are not risk free: They add costs in the form of the Total Expense Ratio (TER)—about 0.1% per year. They also work well. Until the moment you actually need the money. And that moment tends to coincide with market stress, when liquidity is suddenly not as reliable as advertised. And times of market stress could be exactly the times when you need more margin because your trading strategy tanks. In such times, brokers also tend to increase margin requirements on top of that. So, keeping a cash buffer in addition to your ETF seems prudent.

The liquidity devil last struck the money market in March 2020, when COVID hit. At the time, neither SOFR nor €STR existed in their current form, but money market ETFs tracking T-bills or EONIA, the predecessor of €STR, encountered dislocations. Going down the ETF route and finding a good product for your use case requires some research. Avoid opaque swap structures, high counterparty risk and stick with the most liquid ETFs—and read the fine print. Also remember that letting your cash sit at your broker is also not risk-free—even if they hold your money at several banks.

What can you gain by going down this path? Let's say you have a decent account size for diversified futures trading of $500,000 and your margin uses 30% of that. You want to also employ a capital buffer of 20% so you can invest half of your account size in an overnight index ETF. You pick one at a TER of 0.1%.

Compare this with leaving the same cash balance at Interactive Brokers: You can calculate your average interest rate at their site. Leaving 50% of the account as cash at Interactive Brokers results in a haircut of 0.63% compared to SOFR. The ETF only has a TER of 0.1% and some transaction costs and a spread. Your improvement against Interactive Brokers will be about 0.50% per year.

Let's put that into perspective to your trading strategy. If you run a decent strategy with a Sharpe ratio of 1.0 at a risk target of 25%, your yearly expected return turns out to be also 25%. The ETF strategy corresponds to a Sharpe ratio increase of 0.02. The improvement is small, but not negligible as it also scales with your account size. I have put far more work into parts of my trading system for gains of similar size. In absolute terms: 0.5% of $250,000 equals $1,250 per year. That's a non-negligible part of the yearly transaction costs and seems worthwhile.

So far, we assumed everything works smoothly. But what happens in stress? To close this chapter, there is another very important aspect about cash management in combination with ETFs: Margin calls. A margin call occurs if your NLV is smaller than the sum of maintenance margin in your account. At Interactive Brokers this will trigger automatic fire sales of some of your positions to bring the margin requirements back in line with your NLV. Even if this hopefully never occurs, your systematic trading strategy has to be able to deal with this.

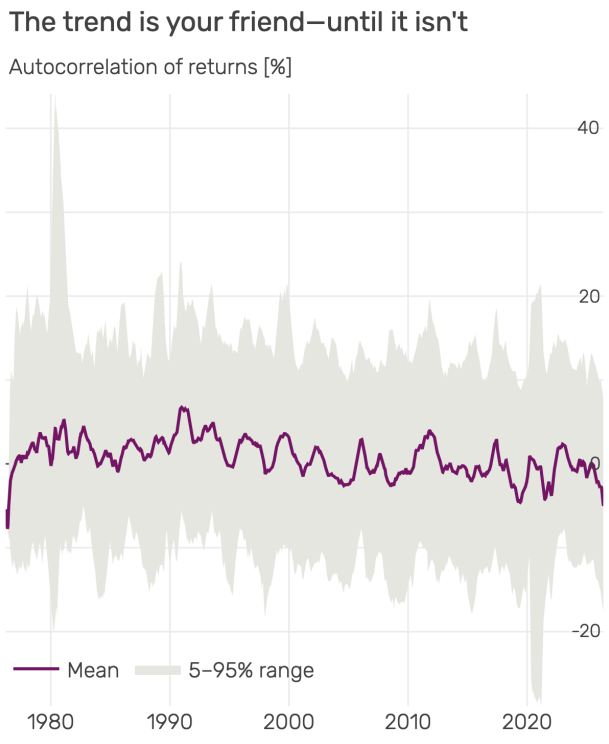

Figure 1: Average rolling one-year autocorrelation of one-day returns across all traded instruments, with 5–95% band. Smoothed for readability.

In normal times the safety buffer is enough to absorb any P&L shocks but it also can go to zero. The trading system needs an alert

mechanism that liquidates positions automatically when the threshold is hit. I suggest that you size down your ETF position the moment your margin requirements hit 95% of your NLV. Sell as much as you need to bring your margin back to 80% of your NLV. If the ETF position has been fully liquidated, you start liquidating your futures positions.

There is a small edge in closing the biggest daily winners first. That's because a lot of instruments exhibit slight mean reversion (negative autocorrelation) in the short term. This behavior seems to persist since the year 2000[3]. It means that today's winners tend to be tomorrow's losers (see figure 1). This effect comes in handy when you are forced to close a position—if it made money today, odds are a little bit higher that it will lose money tomorrow.

We now have all ingredients for a systematic rule set: margin utilization, ETF exposure, cash buffers, and a liquidation priority. The next step is to turn these concepts into two simple algorithms.

Margin Alert Strategy

To avoid any margin calls, we can now formulate the margin alert strategy.

Objective

Reduce margin utilization from 95% to 80% before the broker liquidates positions.

Definitions

$$\text{margin}_{\%} = \frac{\text{margin}_F + P_{ETF} \times n}{NLV}$$

P_{ETF}: Price of the overnight index ETF in base currency

n: Number of shares of the ETF currently held

margin_F: Sum of maintenance margin of all futures positions in the portfolio, converted to base currency

NLV : Net liquidation value of the account

$\text{margin}_{\%}$: Margin utilization of the account. The ETF position is added in full notional value to make sure not to borrow against it

Algorithm

```
while (margin > 0.95) {
  if (n > 0)
    SELL k <= n ETF shares
  if (n == 0)
    CLOSE future with highest PnL
} until margin < 0.8
```

This algorithm sells part of the portfolio until the margin utilization is back below 80%. The overnight index ETF position is sold first (in the tranches in which it was bought). If that is not enough, start liquidating some futures positions. The tradable position with the highest daily P&L will be liquidated first to make use of mean reversion properties.

Notes

This is a continuous strategy that runs all day and needs updates of margin utilization and the P&L of each portfolio position.

Interest Rate Strategy

Next up is the strategy to optimize our interest income. This strategy can be formulated as follows:

Objective

Invest free cash in money market ETFs while keeping margin utilization below

3. Before the year 2000 the mean 1 day autocorrelation of my universe of traded futures was +2.0%, afterwards it dropped to -0.4%

80% and ETF exposure below 50% of NLV.

Definitions

$$\text{margin}_{\%} = \frac{\text{margin}_F + P_{ETF} \times n}{NLV}$$

P_{ETF}: Price of the overnight index ETF in base currency

n: Number of shares of the ETF currently held

margin_F: Sum of maintenance margin of all futures positions in the portfolio, converted to base currency

NLV: Net liquidation value of the account

$\text{margin}_{\%}$: Margin utilization of the account. The ETF position is added in full notional value to make sure not to borrow against it

Algorithm

```
addedMargin = (200 * P) / NLV
currentETFMargin = n * P / NLV
if (margin + addedMargin  < 0.8)
  if (currentETFMargin < 0.5)
    BUY 200 ETF shares
```

This algorithm will buy ETFs in tranches of 200 as long as the margin utilization is below 80% and the overall ETF position is less than 50% of the portfolio size. The size of 200 is selected to match the minimum transaction costs at Interactive Brokers. My trading system always closes the same position size it originally opened (no pyramiding), therefore I trade in as small sizes as I can. Adjust the position size if the exchange you trade the ETF on has a different commission structure.

Notes

This strategy should run near the close of each trading day because holders of overnight index ETFs are entitled to interest at settlement.

With the margin alert strategy, your account should be much less likely to run into a margin deficiency or forced liquidation. It does not eliminate the risk entirely, but it gives the system a disciplined way to respond before the broker does. The interest strategy is designed to improve the return on otherwise idle cash.

ETF Selection

One practical question is still unanswered: Which ETF should you use to invest your spare cash? The answer is driven by the ETFs available for trading at Interactive Brokers, the exchanges they trade on with their respective commission structure and the typical bid/ask spreads. The example below is EUR-focused because my base currency and regulatory setting are European; the same selection logic can be applied to USD, CHF, GBP, or any other base currency.

Let's dive into the comparison. Interactive Brokers offers the following ETFs (see Table 7). I filtered for accumulating and UCITS compliant ETFs (they reinvest the returns). UCITS is the European regulation for exchange-traded funds. All of these ETFs use swap-based replication through agreements between the fund and one or more banks. One advantage of UCITS is that counterparty exposure from over-the-counter (OTC) derivatives is capped: generally 10% of fund assets for qualifying credit institutions and 5% for other counterparties. This constrains, but does not eliminate, counterparty risk.

ETF	Spread	TER	Exchange	Collateral	Size
Amundi EUR Overnight Return UCITS Ticker: CSH1	0.1bp	10bp	Paris	EU-Bonds Gov & Banks	3€bn
Amundi Smart Overnight Return Ticker: CSH2, EGV2, SMARTU	6bp	10bp	Paris Frankfurt Milan	US-Tech Equities	6€bn
BNP Paribas Easy Overnight PEA Ticker: OVNI	21bp	3bp	Paris	Bonds	30€M
Invesco EUR Overnight Return Swap UCITS Ticker: EONS	10bp	10bp	Frankfurt	EU-Bonds Gov	5€M
Xtrackers II EUR Overnight Rate Swap + 8.5bp Ticker: XEON	0.3bp	10bp	Frankfurt	EU-Bonds Gov & Banks	22€bn

Table 7: UCITS compliant €STR ETFs tradable at Interactive Brokers

This list can be narrowed down further: Both the BNP Paribas ETF and the Invesco ETF are relatively small, so I exclude them from consideration: I do not intend to be the largest investor in any ETF!

The remaining ETFs use unfunded swap replication. They invest shareholder capital in a substitute or collateral basket and contract a swap agreement with a swap provider. The ETF exchanges the total return of the collateral portfolio for the €STR return (in case of the Xtrackers even €STR plus 8.5 basis points).

This exhibits two main risks: Counterparty risk—the risk that the swap counterparty defaults or otherwise fails to perform under the swap. And collateral risk: This is the risk that the collateral falls in value. Collateral risk becomes relevant primarily in the event of a counterparty default, although daily margining significantly reduces this risk. The quality of the collateral is especially relevant in systemic crises. Swap counterparties are usually banks which only default in financial crises and in such a case it is safer to have government bonds as collateral than US tech companies.

From a risk perspective (and we want to have as little risk as possible in our cash investment) it makes sense to invest in an ETF that uses bonds as collateral. The Xtrackers offers the most diversified and conservative collateral structure and the largest fund size, which can be advantageous from a risk and liquidity perspective. Its return is also slightly higher with €STR plus 8.5 basis points. The Xtrackers also trades on Xetra in Frankfurt which exhibits the lowest commissions of the relevant exchanges and is tradable at a low bid/ask spread. I guess we found a hot candidate!

Part II will introduce a strategy for converting non-base cash balances more efficiently. It will also teach you, how to aggregate trading signals and your cash positions for slightly better returns and less trading.