

- Adam:** 00:00:00 Okay, I'm here with Marat Molyboga from Efficient Capital, Marat, welcome to the show. Thanks for coming.
- Marat:** 00:00:08 Thanks so much. Thanks for having me.
- Adam:** 00:00:10 So Marat, I think you're probably a fairly well-known name in the academic establishment certainly in certain sub domains of empirical finance, but maybe just tell our audience a little bit about yourself and about Efficient and what you do there.

### Backgrounder

- Marat:** 00:00:30 Sounds good, so you might have noticed that I have an accent, and it's because I grew up in the Soviet Union. So I'm 'Soviet-trained' mathematician, which is always a plus, I guess. And I've been with Efficient for quite a while. Efficient, since our very inception, we've been specializing in building multi-manager customer solutions for institutional investors. We allocate about \$2 billion to commodity trading advisors around the world. And we serve large institutions, insurance companies, pension plans, family offices, and so on. So that's kind of a quick summary of what we do.
- Adam:** 00:01:06 Okay, so yeah, so your background then is in mathematics, but then you went on and did your PhD in mathematics, or is it in finance?
- Marat:** 00:01:15 It's in finance. So I got my masters in financial mathematics first in Moscow. Then I got an MBA in finance, economics and strategic management from the University of Chicago. Then I got a CFA after that. And after that a couple years ago, I got a PhD in finance from EDHEC Business School. But my PhD is more empirical, so like, I'd say, closely related to applied statistics.
- Adam:** 00:01:41 I actually, I'm curious, why did you decide to go back and do a PhD in finance after you'd already done a PhD in, was it mathematical finance or quantitative finance or -
- Marat:** 00:01:50 No. No, I didn't like, before, I have a couple of masters before.
- Adam:** 00:01:54 Oh, I see. Okay.
- Marat:** 00:01:55 Yeah, that's a good question though. There are a couple reasons for that, one, I'm a nerd. I'm a nerd at heart. And I love learning. Like, I love talking to you about research papers. And I love when you give me feedback on my research. I love following what other people are working on in different areas of finance or mathematics and so on. So I just love learning in general. But to, about six years ago, I started teaching at IIT, Illinois Institute of Technology, Stuart School of Business. And I really enjoyed it. And I was thinking that I would like to teach a little

bit more. And I think a PhD is helpful for that. And also, frankly, like in my role of Director of Research, I feel like it's really a requirement to have a PhD because we need to do pretty rigorous research and it does help to go through training to prepare for that. So that was another reason why I did this PhD.

**Adam:** 00:02:56 Nice. Yeah. Our Head of Research, Andrew Butler, is also going through his own PhD and in mathematical finance at U of T. And, yeah –

**Marat:** 00:03:06 Great school

**Adam:** 00:03:07 He also had like very similar motivations, so definitely worthwhile. Alright, so like you said, you love doing research, discussing research, publishing research, you've published, any idea how many papers, it's got to be 6,7,8,9 -

**Marat:** 00:03:27 Maybe 20 so far, like this year I think four papers came out this year.

**Adam:** 00:03:33 Right.

**Marat:** 00:03:34 I've been fortunate. But I mean, just to be fully transparent, it's not my only, like it's not the only, I don't do this work on my own. I love learning from other people. I love collaboration. I think that I become a better thinker when I work with others. I learn about different techniques when I work with other people as well. So I really don't, I hardly write any papers on my own. It's highly unusual.

**Adam:** 00:04:02 Right, got it, and so you've got, we were going to talk about three papers out of the four that you wrote this year, one of those on carry and pairing carry signals with time-series momentum, which you wrote with Junkai, who I've collaborated with you and Junkai on a couple of projects, which have been great. And then someone else Chaohua E, or He,

**Marat:** 00:04:26 Chaohua He, he's a professor in a university in China.

**Adam:** 00:04:32 Gotcha, so how did you guys connect on this topic?

**Marat:** 00:04:38 So Junkai was my intern at that time and I think very highly of him. He's really fantastic at doing any type of empirical work. I have full confidence in the quality of his work. And Chaohua He, he was actually one of my, he was my TA when I was teaching a class at IIT and then when he got his PhD he moved to China, and we stayed in touch. We wrote a couple of papers together. So, for example, we wrote a paper about Chinese commodities, which is actually quite interesting.

**Adam:** 00:05:09 Mm hmm.

### Chinese Commodities

**Marat:** 00:05:11 So it was the first paper we wrote. It came out in The Journal of Commodity Markets. And in that paper, we tried to contrast Western and Chinese commodities

and there were quite a few differences. For example, in China, what we find is that there a lot of retail investors who participate in the markets unlike the US. In the US there are lots of hedgers that participate. And that really affects the risk premia that we find. Like for example, there are some very significant term premia that could be captured with calendar spreads in Western markets, and that's not the case in China. Momentum is extremely strong in Chinese markets as well. So it's kind of interesting to compare some of those risk premia and it was interesting to see how market participation itself affects what type of risk premia you can actually observe in the market. Anyway, so there is a white paper that he and I wrote, and then we wrote this paper about carry and time series momentum, and then we're working on another project as well.

**Adam:** **00:06:15** Nice, I was actually just reading a paper this morning on differences in momentum and mean reversion character for A-shares versus B-shares in China. So I guess, the majority of A-shares are traded by Chinese retail investors. And the majority of B-shares are traded by international institutional investors. And the A-shares are dominated by mean reversion tendencies and the B-shares by trending tendencies. And so it sounds like some common threads with your research in commodity markets, which is kind of neat. And then, so the most recent one that you were working on with him and with Junkai was on pairing carry with momentum, so maybe describe the thesis there.

### Carry and Time-Series Momentum

**Marat:** **00:07:02** So let me pull up my slide real quick. Okay, so I will talk about a couple of papers today and the first one is, "Carry and time-series momentum: a match made in heaven." This paper actually just came out in The Journal of Alternative Investments in the fall of this year. And once again, I wrote this paper with Junkai and Chaohua He. So, let's talk a little bit about this whole topic and why I think it's interesting. So, one, I'd like to clarify what time series momentum is. A lot of the times people say momentum. And there is a lot of confusion between time-series momentum and cross-sectional momentum. Most academic literature is about cross-sectional momentum which is all about persistence in relative performance. In other words, winners are going to win and the losers are going to continue losing. And it's typically captured by long/short strategists that go long on winners and short losers. And time-series momentum is all about persistence in absolute performance. So if the markets are going up today, they'll continue going up tomorrow. If they go down today, they'll continue going down tomorrow. So time-series momentum and cross-sectional momentum are similar, but they're also distinctly different from each other.

**Adam:** **00:08:19** And time-series momentum, it's often used in the same breath as trend-following.

**Marat:** **00:08:26** Exactly. So time-series momentum and trend are the same thing. It's just time-series momentum is an academic term for trend. And then if you look at carry

trade, carry trade is a very popular strategy. It's really all valuation based. So if you look at some kind of ratio that makes sense, it could be like maybe P/E ratio in stocks. In case of futures markets, it can be basis between spot and futures contract. And what's also interesting about futures markets is that with futures markets, it doesn't really matter what the underline is. You can actually define carry trade very simply by looking at the futures basis. It's kind of like a universal predictor across all asset classes. And actually, I wrote my dissertation on that. But anyway, so the question we asked was, when you look at carry, we know that carry or basis are predictive of future performance across multiple asset classes, we have lots of research on that. And the question is if carry is positive then the asset is more likely to continue going up. And then the question becomes, is it more likely that you're going to see more positive trends in that market? And if that's the case, it's quite likely that if you condition the trend signal on the sign of basis, you're more likely to build a system that's going to be consistent and profitable. So that's kind of the thesis that we have.

- Adam:** 00:10:07 So maybe it's, maybe worthwhile for you to spend a little bit of time describing the theoretical basis for carry, right? So you've got a market where the term structure of futures is in backwardation and, or the term structure is contango, what dynamics are happening there that cause us to expect positive or negative returns on the front month given the term structure there?
- Marat:** 00:10:39 So there's actually a lot of research on that that's been published in commodity markets. For example, like there's a Fama and French 1988 paper that talks about metals. And in their case, they're really trying to tie this relationship to the convenience yield. So in case of metals, for example, you got copper, for example, if everything is going well, the business, you know, the, you are in an expansion, then you anticipate that copper is going to be in high demand, right? And if the copper is in high demand, there's actually a very significant value of having physical copper because it's used for production. And therefore, because of this very high convenience yield, you're going to see basis going up. And that's why there's this, you know, there's a business cycle effect, when basis, when convenience yield is high, when basis is high, you expect that future returns are going to be positive. So that's kind of the discussion that -
- Adam:** 00:11:47 So when basis is high relative to the front month future.
- Marat:** 00:11:53 Sure, yep.
- Adam:** 00:11:54 Right. Okay. Yeah.
- Marat:** 00:11:54 Well, typically, what happens is that, whether you look at basis of, you know, front month versus underlying or further out versus front month, and so on, those tend to be predictive of future returns, maybe for slightly different horizons, but in general, high basis means high return.

- Adam:** 00:12:12 So we typically say that carry is the return you expect on holding an asset if the price doesn't change, right?
- Marat:** 00:12:22 Exactly.
- Adam:** 00:12:23 So in bonds, it's the coupon of the bond in stocks, it's the dividend on the stocks. In commodities, it's the roll yield on the commodity as the front month moves, you know, or as whatever that commodity, whatever contract you own, becomes more mature, right? And so it rolls up or rolls down the curve, and depending on what the slope of the curve then the expected yield on that is positive or negative, right? And that -
- Marat:** 00:12:53 That's exactly right.
- Adam:** 00:12:54 Right, okay, yeah.
- Marat:** 00:12:56 So when you look at basis, so what I like about basis in the futures markets is that I don't need to worry as much about what it's related to. Like, for example, as you mentioned earlier, in stocks it would be dividend yields, right? But you can actually, you can, you know that basis in the futures markets for equities is going to be roughly expected dividend yield minus the risk-free rate, okay? Or in case of fixed income, you talked about coupons, you know that there's a very similar relationship, or in the case of foreign exchange markets would be interest rate differential.
- Adam:** 00:13:38 Right.
- Marat:** 00:13:39 So what's nice about using futures market for carry research, you can actually, instead of looking at multiple different ratios that are meaningful in different asset classes, you can actually come up with a unified return predictor you can use across all asset classes. And actually my first dissertation paper was exactly on that. I was showing that futures basis is a universal predictor across all asset classes.
- Adam:** 00:14:07 Nice. And it's great because it reflects the expectation and not the historical value of those variables.
- Marat:** 00:14:17 Exactly. Exactly.
- Adam:** 00:14:19 It's forward looking. Good, so you've got this carry signal, you've got, you are measuring, I think you measure basis as the difference between spot and the front month contract. Is that right? Or you measure it between front and back month for this paper?
- Marat:** 00:14:33 Between front and back.
- Adam:** 00:14:36 Front and back, okay, gotcha.
- Marat:** 00:14:36 Yeah.

- Adam:** **00:14:36** Yeah, and you're, you create a, or you construct a thesis for why positive carry assets are more likely to result in persistence of positive trends and vice versa in general, right?
- Marat:** **00:14:58** Exactly. That's exactly right. Yeah, so a couple of things to add to that, so you asked the question, how do you define basis, whether it's the difference between front month and spot or further out contract and spot, or further out and front month. And when you look at the literature on commodities, it's really hard to talk about an underline or spot. That's why in commodity literature, typically, the front month is considered to be the spot. And that's what's used for analysis a lot of the time. So we used a similar methodology for other asset classes as well, because it's unifying across all assets, making it easier for us to apply the same methodology for all asset classes.
- Adam:** **00:15:47** Right, nice. And so just how powerful is this relationship where, you know, if you condition time-series momentum on carry, what was your personal, what was your thesis for why this pairing should be effective and then what did you find in practice?
- Marat:** **00:16:06** Well, so let's just say that, if in commodity markets, for example, basis tends to be negative. If basis is negative, you actually expect the returns are going to be pretty poor in commodity markets. And that's exactly what we've seen. I remember there were some articles, or opinions in Wall Street Journal and Financial Times last year about how investors were thinking about walking away from, only commodity investing, because they did not believe in long term positive returns in commodities. And the reason for that is really because of negative carry. So what happens is that if you see high negative carry, you expect to see that a very significant downward trend that comes from this negative carry. And because of that, it's much more likely to see profitable signals that are short rather than long in commodities, for example. Whereas, if you look at some other asset classes such as equities, there's an opposite behavior, so the carry tends to be positive and you expect markets to go up. And that's why long bias in equity markets does make sense when you develop a time-series momentum strategy. And that's exactly what we observed. So actually, if you look at our results, we found that when you condition signals of trend on the sign of basis which is a very simple signal, we can see very significant improvement in the Sharpe ratios of those strategies. So let me just clarify a little bit about what you're looking at. So TSMOM is a trend strategy that gives equal notional occasion across all the strategies, across all the instruments. And TSMOMV is a strategy that was recommended by Toby Moskowitz in his 2012 paper that takes exposure in each market that's normalized to 40%. So in other words, its equal risk weighted allocation across all instruments. And what you can find here is that, one, risk weighting signals tends to help, you can see that Sharpe ratio is high, that 0.56 is higher than 0.25, 0.73 is higher than

0.43. But what we can also find is that conditional signals on the sign of basis improves performance.

**Adam:** 00:16:06

Right

**Marat:** 00:16:06

And then the question becomes, if you're an investor, is that a good strategy? Because if you have a strategy that has a high Sharpe ratio but it tends to hurt you when the stock market struggles, for example, if you look at volatility-selling, you know it does great during good periods, but then it really crushes you during your bad periods. And, for example, if you look at Q1 of this year, there were actually a lot of volatility-selling strategists that went out of business because they blew out because of that market environment. So we want to make sure that in this case, when we recommend a strategy that conditions the signal of trend on the sign of basis that would not have a similar behavior of good performance during good periods, but really bad performance during bad periods. So that's why we did additional analysis to evaluate performance by different macro environments.

**Adam:** 00:19:35

Gotcha, so were you, did you also review the paper, obviously, from Koijen on carry, on global carry? So, what, I think many investors would be or listeners will be surprised about is, cause typically carry is perceived as a procyclical strategy, right? Because it's typically implemented on currencies, and in currencies it does manifest as relatively procyclical. In other words, it hurts when it hurts to hurt. Like, for people who typically own an equity heavy portfolio, a carry portfolio will typically do poorly when, or like a traditional currency carry portfolio will typically do poorly when equities are also doing poorly. And, of course, when you diversify across all the major sectors, so into bonds and equities and commodities, and currencies, and volatility notably, that you find that actually isn't the case, right? That the carry strategy doesn't really have any major procyclical tendencies so, I guess, based on that you went into this expecting that pairing carry with trend across a diversified CTA universe would not introduce any meaningful procyclicality, is that what you observed?

**Marat:** 00:21:01

Actually I had a different suspicion. My suspicion was that there would be some procyclicality. So if you look at, and I'm well familiar with Koijen's paper, it came out in The Journal of Financial Economics. And actually, I was very fortunate because Ralph Koijen was one of my advisors, my PG advisors. And he gave me some really valuable feedback on my dissertation. But so what really happens is that, in general, when you look at carry trades, carry trade tends to be procyclical, and there are reasons for that. Like, there's a lot of work done on FX carry, there was a, for example, a paper by Nick Roussanov from Wharton. It's called Commodities and Carry: A Tale of Two Cities. And actually, what he does in that paper, he shows that, he actually links FX and commodities, which is very interesting. He talks about countries that tend to export commodities and those that tend to import and shows how there's a link with the carry trade through transportation. But anyway, that's very fascinating to me. But anyway, so all that

to say is that when I was looking at the results, my, actually, expectation was that if I condition the sign of trend, if I condition signal of trend on the sign of basis, I was actually worried that we're going to see more procyclicality, and I did not find that. And I was looking at what was driving that, you can actually find that, for example, commodities tend to be very helpful for the behavior of the strategy. For example, when the market crashes, commodities tend to struggle as well and this strategy tends to short commodities. And also another example is fixed income. So fixed income tends to have positive carry and so it does tend to help to have long bond exposure during crisis. So when you start looking at asset by asset, it actually does make sense. That's why this strategy performs better during times of crisis. But I was actually quite worried because when you take a simple carry implementation, it tends to behave poorly during times of crisis.

- Adam:** 00:23:38 Right, but typically, carry strategies focus on FX, and especially if you include -
- Marat:** 00:23:38 Exactly.
- Adam:** 00:23:38 Emerging market FX, then that certainly enhances the procyclicality, right? Okay.
- Marat:** 00:23:50 But I just want to show the result because I think they're pretty striking. So if you look at expansion and recession, you can see that, the unconditional time-series momentum strategy performs slightly better during recessions. The Sharpe ratio goes up from 0.56 to 0.61, but performance of the conditional strategy is much stronger during recessions. You can see that the Sharpe ratio goes up from 0.68 to 1.05. And when you start looking at different stages of recessions and expansions, you can actually find that the strategy tends to perform extremely well during early recession. And that's when the stock market struggles the most. So the strategy tends to add value during those periods when clients care the most about performance.
- Adam:** 00:24:36 That's a really interesting observation. I mean, just thinking through the character of the carry strategy that we run, it's, it performed extremely well, I think, counter intuitively, in the very early part of the March downturn. And then as markets began to recover, it began to roll over and, you know, do, you know relatively poorly. So it's sort of early recession versus late recession, given that the most recent recession played out over a matter of weeks, you know, it's hardly a prototypical example. But it is interesting to see that sort of, it does map anecdotally to the average profile.
- Marat:** 00:25:24 I think you have a really good implementation of the current carry trade strategy based on what you described. So that's very impressive.
- Adam:** 00:25:32 Alright, so you've got this, that's, those are the primary findings for the carry and time-series momentum. Do you in practice, I know you, I mean, your role is actually as, you know, Head of Research or you play a very large role in selecting managers for the Efficient portfolio. So to what extent do you use the type of research that

you do? Like, are you looking through the returns of your underlying managers to see the degree to which they are loading on or exposed to the time-series momentum or carry or whatever? Or, you know, in your experience, are more managers now gaining exposure to carry either unconditionally or conditioned on trend? What is the adoption curve look like for these signals?

## Evaluating Managers

- Marat:** **00:26:26** No, that's a great question. So let me talk a little bit about Efficient and how we approach manager selection. We have a fantastic CIO, Chad Martinson. He's, I think, he's very thoughtful. And I work very closely with Chad in determining which tools we're going to use to evaluate managers. And so historically we've done a lot of work on operational due diligence, investment due diligence. We've done a lot of qualitative analysis. We actually have a whole section of qualitative factors that we use to evaluate managers. But probably in the last six years, we decided that we're going to invest more effort to understand what drives managers' performance not based on what they tell us, but based on what their performance demonstrates. So we developed a lot of in-house factors like whether it's trends, or carry, or value, or cross-sectional momentum of volatility-selling. And we use those factors to evaluate managers.
- Adam:** **00:27:32** So almost like a return-based style analysis but for -
- Marat:** **00:27:35** Exactly, it's return-based. And it's interesting because sometimes it's a great validation. For example, remember a few years ago, we had a manager who had no stock exposure. And we run the analysis and it shows that the loading on stocks, can't remember but the stocks was zero. We said, "Great." That validates what they told us. But sometimes, this analysis is used to ask deeper questions. For example, we talk to a manager and the manager says that they don't have, they explain their methodology in a certain way, but then we see a certain loading, for example, maybe a loading on carry. And we say, "Well, help us understand why you seem to be exposed to carry." And then we start talking about the details of their methodology. And, what happens is that sometimes managers don't even realize themselves that they have that exposure, particularly the discretionary managers. But it's extremely helpful to do this analysis, one, for us to understand what drives managers' performance, but also to have those better informed conversations with managers about their strategies.
- Adam:** **00:28:49** And then are you trying to put together an ensemble of strategies that broadly diversifies across or you're trying to minimize the concentration in any particular tenor of the trend, term structure or any, you know, carry versus value versus volatility-selling, etc, do you think through some of that in the assembly of the portfolio?
- Marat:** **00:29:19** Well, that's, that's a good question. So when you look at the, when you look at managers, it's really difficult to target allocation across underlying strategies, trend

or carry or exposure by sectors because they do change over time. And it's really hard to find a manager without any type of style drift, so it does change over time. For example, if you look at trend managers as a whole, I think what we've seen since the global financial crisis is that, in general, it's been a tough period for trend. And because of that, the holding periods, they have gotten longer. So the ... periods as well have gotten longer. And also managers don't like getting chopped by the actions of the central banks, for example. And also, we've also seen that quite a few managers have been expanding to some other complementary strategies such as carry. And it doesn't necessarily mean that it's bad to have carry in the portfolio, I think it does improve risk adjusted performance, if you're careful about how you implement it, if you care about sizing in the right way, it doesn't hurt crisis alpha of the portfolio. But with that said, I think it's extremely difficult just to target exposure of the overall portfolio to, to those basic strategies. So what we do, we actually try to put managers in some groups. At Halo, we think about managers as trend managers. We have long term traditional trends, long term differentiated trends, those would be trend plus carry and so on. Then we have short term trends, and actually my second paper is exactly going to be about short term traders. Then we have global macro managers who tend to be discretionary and they tend to take longer term positions based on some, you know, macroeconomic analysis that they do, certain themes. And finally, we have unique diversifiers who tend to be maybe some market specialists in case of commodities, like for example, could be grains and softs and soy beans, or we can have some FX specialists as well. So what we try to do, we actually try to put managers in the appropriate category, and then we try to control the allocation between those groups. And we try to be very careful about style drift of each manager within the group as well. So that's kind of how we try to allocate to the portfolio level. So we don't necessarily try to be very precise about allocation across underlying simple strategies but we try to be more thoughtful about how do we actually allocate risk across different groups of managers and within those groups of managers as well.

- Adam:**                    **00:32:17**            Gotcha, gotcha, so obviously, a combination of qualitative and quantitative analysis to determine which group a manager belongs to and probably you revisit that every now and then to ensure -
- Marat:**                   **00:32:30**            Exactly.
- Adam:**                   **00:32:31**            No meaning, no meaningful style drift or you don't need to reclassify a strategy. And then you achieve your diversification by ensuring that your, the groups are diversifying the portfolio in the way that you're targeting, and not relying on any sort of look through quantitative structure within the portfolio.
- Marat:**                   **00:32:56**            That's right. I mean, we still do the look through to be aware of what's happening at the same time we don't target it explicitly. It's kind of like when you look at the question of correlations, for example, right? There could be some instant correlations over one day periods, right? And you can look at correlation between

any two managers based on the underlying exposure. So one is, for example, long stocks and another one is short stocks. You know they're gonna be negatively correlated that day, right?

**Adam:** 00:33:27

Right.

**Marat:** 00:33:29

And I think it's really valuable information to have if your horizons are short. At the same time, when we build portfolios we tend to think about longer horizons. And when you look at longer horizons, instant correlations are not as valuable as long term correlations. So that's why in our case, we need to be a little more careful about not overreacting too much about instant or shorter term observations, think about, more about it as balancing the portfolio in the long run.

**Adam:** 00:33:59

So that's actually a really good point and it dovetails into some questions around how investors are using trend following and trend following funds of funds or you're not a fund to fund but you've got like a, I guess, you sort of bundle a large number of strategies into a managed account, right?

**Marat:** 00:34:24

Correct. So our business has evolved over time. But since our inception, we have been focused on building customized solutions for investors. So even though we have a flagship fund, at the same time we have quite a few customized solutions as well. Because what I, what we're seeing is that there's, that we've seen that investors have become more sophisticated, and they have some very specific needs in their portfolios that they hope to meet with a CTA bucket. So in certain cases, it can be crisis alpha. It's a very popular investment objective for trend portfolios. In some other cases, it can be ... return. And what we try to do, we try to work with clients to understand what their needs are. And we try to figure out which managers would be the right fit, given their objective, and also what type of techniques we can apply on top of that through portfolio management techniques, through different fee structures to meet that particular objective. We put a lot of effort into fees, like for example, we have a patent on a certain fee structure, that's quite innovative. And we also do a lot of fee netting, for example, as you know, there's always this risk that if you have portfolio of two managers, one makes money and other loses money, then the client ends up getting the negative return and pays a performance fee to one of the managers.

So we try to go away from that by incorporating netted fee structure where managers only get paid when the client makes money. It also is a great alignment of incentives. We also have quite a few portfolio management techniques. I think you've seen my paper on volatility targeting at the portfolio level. We also have some, you know, portfolio management techniques for allocating within a bucket as well. So what we hope to do, hope to understand what clients need then find the managers that they're going to meet their objective and also apply some portfolio management techniques, some fee structures, they can actually help us get closer to meeting that need.

**Adam:** **00:36:42** So I'm curious about how management or investor needs or objectives have evolved over the last few years because we've had such a strange environment of really rapid moves. So the, the crises for which investors have often sought crisis alpha, have historically evolved over a period of months or quarters. And in the last few years, what we've observed, of course, is that these crises play out over days and weeks. And historically, many CTAs are not really designed to provide crisis alpha over crises that have that play out over days and weeks, but are very nicely designed to protect against or offset or diversify against crises that play out over months and quarters. So how have you (a) seen investor expectations evolve over the last few years? And how have you seen managers evolve and evolved your own process in response to these evolving or adaptive market conditions?

**Marat:** **00:37:58** That's a great question. It's, it's interesting, because I think in general, sophisticated investors understand CTAs pretty well. And we actually really enjoy talking to sophisticated investors, because we can actually show them, okay, here's what's happening in the markets, here is the positions of the managers, here are the, here's how they are reacting to, to the moves in the markets and this is the outcome, right? Sometimes it can be good outcomes, sometimes it can be a bad outcome. But it's really important that when we evaluate managers, and when we evaluate ourselves is that we actually get what we expect to get in that particular environment, right? So we don't have control over the environments. But we have control over how we position our portfolio to benefit from certain environments. So now, when you, when we're looking at how managers adjust, we've seen lots of adjustments.

I think that overall, we've seen some really interesting policy by the central banks since the global financial crisis. If you look at the stock market, it's really become between March of 2009 and maybe beginning of 2018, I think it was a risk free asset. It would not go down in any type of retracement was very short. And, and I think what managers have learned is that if you trade in the same way that you used to 10 years ago you would get chopped. And I think that's why we've seen a lot of adaptation by the managers. So I think some of them have lengthened their rollback periods to not be as sensitive to market moves. We've also seen that managers start adding some additional strategies such as, you know, I've talked about carry, maybe some other complementary strategies. And I think that, on the one hand, it's a positive thing, I think managers should evolve through the market at the same time. There also some risk associated with that, for example, when we look at Q1 of this year, trend performed pretty well on average, whereas, on average carry trade got hurt. So, some of the pure managers who did not have carry trades actually on average have performed better than those who did have carry trade. So and another, another point is that, I think, we, at a portfolio level, we try to be well diversified. If you look at what happened in Q1 of this year, it was really hard to find a trend manager that performed well trading in equities. Because the markets made all time highs as in February and then you saw the largest five day

drop since October '87, the largest 20 day drop since the Great Depression. It was a really violent move in the equity markets. And, and most trend managers lost on that reversal. But at the same time, some shorter term managers were able to recover faster, they would reverse their positions. And that's why I think my paper about short term trend is so timely because I think it does help a lot in providing crisis alpha. And also what we found is that if managers had exposure to some other less popular assets such as commodities, and I'd like to kind of, if you put into perspective, it was really tough period in commodities for the last probably six years since 2014. There were very few trends in commodities, but we kept our exposure to that asset class. And, and I think that really helped because there were some significant trends in commodities in Q1 of this year, and being well diversified across timeframes and assets actually helped our portfolio perform better.

- Adam:** **00:42:05** Nice. Yep, okay, that makes sense. So, a lot of managers have moved to longer term, to longer term trends. But you've got a recent paper, actually you wrote this with Larry Swedroe, who's a friend of ours, and I guess this is introducing or just reinforcing the value of also considering short term trends, right?
- Marat:** **00:42:30** That's right. So if you look at academic literature on trends, so the, the first paper came out in 2012, was a paper by Toby Moskowitz, and a few other co-authors. And he introduced a 12 month momentum strategy that's based on monthly returns. He wrote it to adjusted exposure so that 40% was targeted in each market, those, in other words, with equal risk allocation across different, different markets. And then there was another paper by, and the Hearst paper in 2017, ... that actually introduced one month and three month momentum strategies. However, overall time series momentum is really a, I guess, it's, it gets ignored in, in the literature. And the question we asked was, well, what happens if you go beyond monthly returns? Is there a benefit? And one obvious benefit, potential benefit, well, if you're able to come up with a short term strategy, there's additional diversification that comes with that. And if you're able to capture the diversification without sacrifice and the crisis off of benefits of trend that could be extremely, extremely valuable for institutional investors.
- Adam:** **00:43:44** So just for clarity –
- Marat:** **00:43:46** That's pretty much exactly what we found.
- Adam:** **00:43:47** The Moskowitz and the Hearst paper, they both only use monthly level data, right? They published on monthly level data?
- Marat:** **00:43:59** Yes, to be able to, to be careful. So the look back period was monthly. That's right. So Moskowitz used a GARCH model to estimate volatility and GARCH was applied to daily data. So even though the signals were generated using monthly returns, there was some daily data used for position sizing.
- Adam:** **00:44:23** Right, but the statistics they reported were at monthly granularity, right?

- Marat:** 00:44:28 Exactly.
- Adam:** 00:44:28 So you weren't able to see the intra month effects of higher frequency observation, which obviously makes a large difference and especially in the current environment.
- Marat:** 00:44:38 That's right. I also want to be careful because there was another paper by, you know, Professor Hearst and Au , 2014 paper that actually talks about the impact of rebalancing. So they actually do look at certain ... pairs, but they say, "Well, if you balance more often what's going to happen?" And they found that before you consider fees, more frequent rebalancing tends to help. And actually in our paper, when we found the benefits of short term trend, we asked the question, "Well, is it all driven by the rebalancing frequency benefits? Or there's some other reasons?" And we'd find actually there was some other reasons which were more important.
- Adam:** 00:45:17 What were the results and what were some of the other reasons?

### Rebalancing Benefits

- Marat:** 00:45:21 Sound's good. Okay. Let me just, I'm going to summarize some results, because we've done a lot of analysis. But once again, this paper is available in The Journal of Portfolio Management, it's coming out in November of this year. So we've done a lot of additional work, but this is a quick summary. So if you look at, we replicated 12 months, three months and one month momentum using daily returns. So 252 day look back period is roughly 12 months, 63 look back period is roughly three months and 21, 21 day look back period is roughly one month, then we hold it either one month, which is 21 days, or five days, which is roughly one week. And we'll get two strategies. Panel A shows the strategy that allocates equally across all the instruments. And panel B uses equal risk allocation just like in the paper by Moskowitz across all the, all the assets. And what you will find, once again for the most part, trend as well across different asset classes, across different timeframes. In general, volatility targeting does improve performance except there is one incident where you will get monthly return. And in equities, you can see it's like the worst result. But for the most part, volatility targeting does add value. What you can notice here is that when you compare our short term strategy, which is 21/5, it tends to perform better than, than a typical one month strategy, 21/21, whether it's panel A or panel B. So the hope is that if short term strategy is actually superior to one month, and if correlations are high enough, it could be actually a good substitute for the traditional one month strategy.
- Adam:** 00:47:13 I see.
- Marat:** 00:47:14 And when you look at correlations, you can actually, I mean, of course correlations are pretty, you know, they're pretty intuitive. For example, you can see that correlation of short term momentum in one month is pretty high at point six and then declines. It goes down to point 21, when you look at the correlation of short

term momentum and total months momentum. Those are very typical patterns. But based on two facts, one is short term trend tends to perform better than one month momentum, and correlations are relatively high, our hypothesis was, well, it's possible that short term trend would be a good substitute for the one month momentum strategy. So we actually looked at, we looked at benchmark portfolio, there was, introduced by Hearst and Au in 2017, that gives equal weight to 12 months, three months and one month. And then we tried to introduce short term momentum by either taking complete weight of one month, which is balance one strategy or splitting equally, the allocation to the one month strategy between one month and short term momentum. And, and the reason why we look at both of those is because we want to be extremely careful with data mining. So when I want to see validation in a couple of different implementations. And we ask a few questions. One is, is performance getting better and we want to be careful that we consider transaction costs. The second thing is are we losing the crisis alpha benefits of trend if we introduce certain trends. And the third question is really inspired by this data mining concern. If we see an improvement, what drives it. We want to understand why short term trend improves performance of trend strategies. So those are three key questions we try to answer. And what we found, we found is that before we consider fees balanced portfolios tend to be superior to the benchmark center portfolio of Hearst. And you can also see that, that happens without sacrificing correlation to S&P. They pretty much stay roughly the same, maybe slightly more negative. So we're able to improve performance without sacrificing crisis alpha. And then the question becomes, if that's the case, what's the impact of fees and looked at a couple of different versions of fees. We start with some more conservative costs, and we took them from the Hearst paper and what we found is that if costs are conservative, there's actually no benefit of short term trends. And, but we also argued that even though conservative costs are appropriate for typical strategies, when you look at short term strategies typically those managers tend to take execution very seriously. They often use co-located servers. They often use specialized algos to reduce costs. And that's why we also looked at another set of assumptions with more optimistic costs. And what we find that in that case, short term trend still substantially improves performance of traditional trend strategies. So our conclusion here is short term trend has the potential to improve performance of trend strategies without sacrificing crisis alpha benefits but this conclusion highly depends on the quality of execution.

**Adam:**

**00:50:44**

So I wonder, so I look at these, I look at these results. And I say, even at the higher cost expectation level, adding diversity to your trend signals doesn't hurt, right? The Sharpe ratio is essentially the same, right? You go, you've got point 1, 71, 73, 74. So it doesn't hurt. And then you sort of lean on some of the literature on ensembles about the fact that the benefit of an ensemble doesn't really show up in the Sharpe ratio, but it does show up in the standard error of terminal wealth. And I think all things equal if I get the same Sharpe ratio, and I get a narrower distribution in terminal wealth, because of the ensemble benefits, then even with

the higher cost expectations, I think I'd still skew to using the, the ensemble over then the single specification is, do you have somewhat intuition there?

**Marat:** **00:51:48** No, I think that's exactly right. And I think that, I think in general, I think we believe in diversification. So as I mentioned earlier, in Q1, we saw a great example that it was better to be diversified across timeframes and assets. And I'm a huge believer in ensembles. I'm a huge believer in diversification across parameter sets. So, from that perspective, for sure, I do prefer having a more balanced portfolio. And I think that's really, that's what sets us apart from most trends and even CTA programs, is that we tend to be much more diversified across different types of managers and across different timeframes, across different markets. So we, we're strong believers in ensembles. And I think you're right that in this case, that in short term trend does improve diversity across parameters.

**Adam:** **00:52:41** Beautiful. So the third question was why, right? Why -

**Marat:** **00:52:48** Yes. So you actually looked at, we had two hypothesis. It actually was really great, because Larry knows everybody. So he just emailed Cliff Asness and said, "Hey, Cliff, what do you think about this paper?" And Cliff said, "Oh, let me just talk to my academics." So he actually asked a couple of them, and they gave some really good feedback. And the feedback was, well, maybe it's all driven by rebalancing, the rebalancing effect, because they wrote a paper about, that came out in 2014. So we actually looked at that, and what we found that rebalancing did not really add value after transaction costs. So even though there was some significant potential benefits before you consider costs, after transaction costs, there's no benefit. And, and then we said, "Okay, so is it possible that performance gets better because of some diversification benefits, right?" And what we found, I'm going to show you the slide, when you look actually at the worst performance for the 12 months strategy, you can see that, you know, in the first column, you can see there's been the ten worst instances, on average, the stretch was down 7.85%. And, and on average, neither three months or one month momentum made money during those periods, right? By contrast, you can see that short term momentum tends to make money and makes money more consistently than the other strategies. So our conclusion here was that the reason why short term trends improves performance of trend strategies is because actually, it's a really great diversifier to the other strategies and then in particular to the very popular 12 month momentum strategy.

**Adam:** **00:54:31** Yeah, so I love it. So if I remember back to the chart where you showed the correlation between the different strategies, I want to say that the correlation between 252-21 and 21-5, was it .26 or .36?

**Marat:** **00:54:50** Yeah, yeah, it was roughly .2.

- Adam:** 00:54:52 And, so that obviously captures some of it. But what I think what I'm seeing here is that actually the correlation when you just observe returns in the tails, may be even lower between the -
- Marat:** 00:55:07 Exactly, that's exactly right. And, and we actually, the paper has more details on that because the free assets to do by asset class. So we actually downloaded by individual asset class. We looked at 12 worst months in equities to 12 worst months in fixed income, FX, commodities and we got very similar results.
- Adam:** 00:55:28 Awesome, so I just wanted to back up. So when the folks at AQR suggested that it might be due to rebalancing, do you mean the rebalancing premium like gamma scalping, vol harvesting that kind of stuff or some other effect?
- Marat:** 00:55:46 Well, so they wrote the paper about the impact of rebalancing. And in that paper, they said, "Well, let's look at monthly rebalancing, weekly rebalancing and daily rebalancing. And they were actually showing that more frequent rebalancing tends to produce better results. And I don't remember all the details, but my theory is that the reason why rebalancing tends to help is because of better diversification. And it could be, here's a very simple example. So let's say, let's say you have two investments. And, and they had, they're very similar, they have the same odds of making money. Let's say it's 50/50 okay? And let's just say that one of them just happens to be lucky. And the second one just happens to be unlucky, right? So if you don't rebalance between those two, then your variance, expected variance could be higher, given the same expected return, right? Because you give disproportionately high weight to the first investment that happened to be lucky.
- Adam:** 00:56:52 Which compounds.
- Marat:** 00:56:53 Whereas if you, yeah, if you don't, yeah, if you don't rebalance. But if you rebalance, you get the same expected return. But your variance goes down, because you are better diversified across those two investments. Does it make sense? Or -
- Adam:** 00:57:06 Yeah, I'm writing a paper on the rebalancing premium in futures specifically for risk parity strategies. And so I'm just wondering to what extent they were leaning on that effect. I don't know if you saw the new paper, I think it came out of Boston University, Corey Hoffstein, he shared it with me. And I think he just tweeted on it a couple days ago. But the authors, they introduced a new explanatory variable. So they looked at the, the Rob Arnott's or Research Affiliates, fundamental indexing methodology.
- Marat:** 00:57:44 Mm hmm.
- Adam:** 00:57:45 And they were wondering the degree to which the excess returns were due to the, the characteristics like the loadings on value and size and some of the other classic factors, or was it just due to this rebalancing effect. And what they found was that

the entire premium was explained by this rebalancing premium, and when you fact that out, there was no remaining, the intercept term flattened. And so I just, I was wondering because this, there's a lot of an increasing cacophony of discussion about the, the size of this rebalancing premium. And in a, a, an environment where risk free rates are at, you know, .5, .7% or 70 basis points, then a 1% or 2% rebalancing premium is a really substantial boost to expected returns, right? So maybe that's –

- Marat:** 00:58:47 Absolutely.
- Adam:** 00:58:48 This, some of this research. So I just wonder whether that's what -
- Marat:** 00:58:51 No, I mean, yeah -
- Adam:** 00:58:51 For rebalancing variable, but I'm not sure it's exactly the same.
- Marat:** 00:58:56 Yeah. So I mean, Adam:, I know that you think very deeply about lots of different topics. And I think, I know that you and Corey, you guys have done quite a bit of work on rebalancing. You guys know more about it, about it than I do. So in my case, I just compare performance of those strategies. But I think you're definitely thinking more deeply about this issue of rebalancing than I do.
- Adam:** 00:59:19 Okay. Well, it sounds like something that we can we can carry on offline with some, with some case examples.
- Marat:** 00:59:26 Yeah, sounds good.

### Allocating Across Managers

- Adam:** 00:59:27 But, okay so you've, this is the short term amendment and the third paper that you, and I think we went back and forth on quite a bit, actually was this one on how to think about allocating across managers. And there were a couple of different things I really liked about this. But one of them is the Monte Carlo type experiment that you did, which I want to make sure that we cover. And then just in general, the sort of the diagonalization and that sort of cluster based hierarchical covariance estimation and how do you use that in portfolio formation, which I thought was great. So why don't you walk us through what the thesis was here?
- Marat:** 1:00:05 Yeah, that sounds good. So I need to give a lot of credit to other people. And actually, so this whole research paper was inspired by Adam Duncan from Cambridge Associates. I was supposed to give a presentation at QuantsMinds Americas last September. And it was supposed to be a presentation about portfolio management with machine learning. So I called Adam, and I was like, "Hey, what should be the initial topic to explore?" And he said, "Well, why don't you look at this HRP approach by Marcus Lopez de Prado? And, and I knew of that approach before, but I didn't look at all the details, so all the credit really goes to Adam for

inspiring this idea. And this paper, by the way, it just came out in The Journal of Financial Data Science in June of this year. So if you want to look at the details go there. And it's, you know, it's all publicly available now. Anyway, so, and also, when we talk about the simulation framework, I need to give credit to other people as well, you know, we'll do it when we get there. Okay, anyway, so when you look at the HRP approach of Marcus Lopez de Prado, I think it's a really fantastic approach. I think that, I know that it was published in The Journal of Portfolio Management 2016 paper. And also, I believe, Marcus included that approach in his book, Advances in Financial Machine Learning. And so I actually did talk to him about my paper, and he emailed me good feedback, so I appreciate that. But what Marcus, if you look at his paper in JPM and you can, you know, look at all the details there. He was actually looking at mean variance optimization and the risk parity approaches. And he was actually criticizing both techniques because of high instability of returns. And, and he tied that to, they need to invert the covariance matrix, right? That's a well known problem. And one way to, to assess that issue is to look at the condition number of the covariance matrix, which is the ratio of the highest and the lowest, lowest eigenvalues. So when the condition number is high, this high sensitivity is condition number is low, there's low sensitivity. But the key problem really comes from the fact that all correlations are considered in building this portfolio, whether it's mean variance or risk variance. And, but, if we consider it, we say that each correlation is important, right? We implicitly assume that any two assets are potential substitutes for each other, right? And that's not necessarily how institutional investors allocate. It's more common to use a top down approach, you say, "Well, I'm going to have my equity portfolio, I'm going to use my fixed income portfolio. I'm going to use some hedge funds with CTAs, and so on." And by, so what investors really do, they say, "Well, we're going to ignore a lot of the correlations and we're going to, we're going to focus on some of the more important correlations right within different asset classes. So what I like about the HRP approach of Marcus Lopez de Prado is that he was able to impose this top down framework and focus on more important correlations by applying tree clustering technique. Okay, so that, so the high level, that's what I think, is the best concept that, I think, he came up with is to come up with a way to overcome the issue of inverting covariance matrices and apply a top down framework.

**Adam:** **1:04:00** Got it, yep, and just to be clear, you modified the HRP algorithm a little bit, right? From the one that de Prado presented. You didn't use an inverse variance allocation as the final step, right? You used an inverse volatility. And -

**Marat:** **1:04:22** Yeah, so let me talk to you about it. So it really, in this case, I think my contribution was actually pretty modest. And conceptual, I think I did not, it was not revolutionary. I think I just really tried to expand on his framework. But what was really striking is that the performance implications were very significant. So what I found, that the Sharpe ratio went up by about 50% on average, which is really

massive. So actually, so even though the changes I suggest, are very simple and intuitive, it was really great to see that the performance implications were striking.

- Adam:** 1:04:54 So what did you compare against? So you got HRP relate, you say an improvement of 50% relative to what?
- Marat:** 1:05:00 HRP.
- Adam:** 1:05:02 I know but HRP compared to what?
- Marat:** 1:05:05 I'm sorry, I'm going to, I'm going to get there. So let me just talk about the change and then I'll talk about the results. So really, I like, I looked at three potential improvements. So one, in his original approach, Marcus Lopez de Prado used the sample covariance matrix, and I'm not a huge fan of sample covariance matrix. And I was able to improve the estimate of the covariance matrix, but in two ways. One is, I used exponential weighting because I believe that more recent observations are more meaningful than old observations. And also I used the typical Ledolt-Wolf shrinkage as well. So basically, by using exponential weighting, and shrinkage, I come up with a better estimate of covariance matrix. If you have a better estimate of the covariance matrix, you can potentially build better portfolios. So the second thing is, I did not particularly like that Marcus used inverse variance approach. And conceptually, and I talked about that in my paper, is that when you look at inverse variance approach, what it does, it really tries to minimize volatility of the portfolio. And, that approach is actually quite effective if you assume that all returns are the same. So for example, if you believe that returns of all stocks are the same, actually inverse variance approach is a pretty good one. However, at least in our space, it's more reasonable to assume that the Sharpe ratios are more comparable across assets and managers. And in that case, when you assume that Sharpe ratios are roughly similar to each other then and equal to an adjusted or inverse volatility approach is much more reasonable. So I would compare EVA to risk parity and IVA as minimum risk approach. So, so the second change was, we're going to allocate within the cross classes using equal risk approach rather than minimum risk approach. And finally, there's another change I also implemented, I actually introduced volatility targeting at the portfolio level. So I think we spent a lot of time in asset allocation trying to figure out what's the right way to weigh different assets of managers. And we don't think as much about diversification across the dimension of time. And what happens it kind of happens unintentionally. For example, if our volatility today is 20%, and volatility tomorrow is 10%, we know that we took twice as much risk today than we are taking tomorrow. But it tends to float. And in the typical HRP approach is not intentional about keeping risk constant across time. So what I do actually try to target volatility of 15% each period to make sure that we're diversifying not only across managers, but also across the dimension of time.

- Adam:** **1:08:06** Nice. So what did you discover in terms of all those steps? So if I understand there's in an EWMA instead of using the sample covariance, you also apply the shrinkage, the Ledolt-Wolf shrinkage. You used inverse vol instead of inverse variance and you volatility targeted, so if I were to decompose those five steps, which ones had the most impact? And which ones ended up not having a huge impact on the outcome?
- Marat:** **1:08:41** That's a great question. You can actually look at my paper for all the details, what I've done, actually, I compared each of those steps individually. I said, "What's the marginal impact of just implementing a covariance matrix?" Then once we approximate covariance matrix estimation, what happens if we apply EVA approach? And then what happens if we're use volatility targeting on top of that? So we actually found that at each approach was actually quite meaningful. You couldn't really say that one was the dominant one. But, but I would say if I were to rank them, I would say that EVA approach added quite a bit of value and also volatility targeting added quite a bit of value as well. I'd like to, so let me just show you the results real quick. And then I'm going to mention the simulation framework we used.
- Adam:** **1:09:25** Yeah, great.
- Marat:** **1:09:26** So what I've done here, actually, I used portfolios of CTAs. We built portfolios of ten managers and applied this framework. And, and then we create a distribution of the Sharpe ratios for those portfolios. And you can see here is that on average, the Sharpe ratio goes up from .217 to .33. So it goes up by about 50%, which is quite meaningful. And if you look at different quartiles, you can actually see that all of them are getting better. So, what we're getting is that we're actually improving performance on average without sacrificing the tail, which is also quite, quite impressive.
- Adam:** **1:10:11** Actually the tail improves a little bit, if I look at the, in the bottom quartile, you get a larger boost than you get in the top quartile which is nice to see.
- Marat:** **1:10:21** That's right, so we get better results and lower tails, lower left tail. So let me just briefly talk about this framework. So this framework was developed by Christophe L'Ahelec, a friend of mine who's at Ontario Teachers' Pension Plan. He and I wrote a couple of papers together. So we introduced this framework in our 2016 paper, they got published in The Journal of Asset Management. And, and what we, what we did in this paper, we just said, "Well, if you look at typical hedge fund studies, they tend to perform analysis in a way that's not consistent with practices of institutional investors. For example, a lot of those studies would take hundreds of hedge funds, and build portfolios for them, which is not realistic. I think, typically, a hedge fund investor maybe would take 5, 10, 20 hedge funds, not 400. So now the example was that, there was a really big problem with look ahead bias. So typically, papers would build portfolios at the end of December using returns, up to the end of December. But as, you know, there were some reporting delays. And

if you look at what data is available at the time of the allocation decision, at the end of December, you'll find that you can only find returns through the end of November, because they come out about mid December. So we actually introduced this reporting delay lag in our framework. And we also did a lot of, we actually build this as a customized framework where you can customize your investment objective, you can customize your requirements of which management might qualify for a portfolio whether it's AUM size, length of track record and so on. So we built this really comprehensive and customized framework that's consistent with practices of institutional investors. So that's exactly the framework we applied to this case. And, you're welcome to read the original paper, can read about the whole framework in detail, but to apply this framework, and we got that, with, given this realistic framework that's relevant for institutional investors, performance, either improvements that I introduced, improve performance by 50%, and actually improved tail risk as well.

**Adam:** 1:12:45

So we chatted about how you structure portfolios and practice for efficiency, I'm just wondering, has any of this caused you to tweak some of the methods that you use either within the different groups of managers or across groups? Or to what extent are you leaning a little more quantitatively in terms of your portfolio formation as a function of this research? Or is it still just sort of experimental at this point?

**Marat:** 1:13:21

So I, I like Marcus' HRP approach. I like the improvements we've made. But I think the way we managed our portfolio is a little bit better. It's, because in general, when I think about approaches, I care a lot about robustness. And one of the things you find with HRP approach, it's not always stable across time either, in how cluster is different, .... So what I'm trying to work on is, how to actually apply some of the basic concepts that are valuable from applying this top down framework, but also implement them in a way that's going to be robust and not sensitive from period to period. So the approach we actually used, we've been using this approach since about 2012, is actually, is a top down framework that's pretty robust. And I think it has some of the similar components that I used in this paper such as, like using risk parity allocations. So, we applied risk parity techniques. We also like some of the volatility targeting techniques as well. So we actually control volatility of our portfolio very intentionally. So I think that, we pretty much are already using an approach that's better than MHRP. I still want to get better. I think there's a way for us to improve the estimate of the covariance matrix by using different types of shrinkage. Like I can talk about, like random matrix theory and ... and so on the ways to actually do ... matrix more effectively. So that's pretty much the direction in which I'm headed. But I'm already pretty happy with the techniques we're using to manage your portfolios, because I think they make a lot of sense. And they're pretty robust. And they're consistent conceptually with ideas of MHRP.

**Adam:** 1:15:21 So you're constantly doing research I know that. We chatted about doing something together. What is on your research docket at the moment? What are you most curious about?

### The Future

**Marat:** 1:15:32 Adam, I would love to work on research with you. I think that, I remember talking to Larry about you, about a month ago. And Larry said, Adam is the sharpest person he knows.

**Adam:** 1:15:42 He's such a sweet talker.

**Marat:** 1:15:43 He didn't know I would tell you that. But he just, you know, he just, he just talked about it. He just, he thinks highly, I think of you as highly as well. And I like the feedback you gave me on my research always. And I like the work you're doing on ensembles. And maybe there's a way for us to collaborate somehow. So I would love that. I am working on a couple of research papers in other areas. Actually, just next week, one of my co-authors is going to present a paper that he and I are working on. And in that paper we actually, it's a research about commodity markets. And what we show that the premia that exist in commodity markets, are actually driven by the financialization in commodities that started happening in about 2003, 2004. It's a really fascinating paper. We've done a lot of empirical work and we built a really nice theoretical model. So I think that paper is probably going to be the best paper I've written so far.

**Adam:** 1:16:49 Wow, okay so -

**Marat:** 1:16:51 And I would love to come and talk to you about this.

**Adam:** 1:16:52 Yes, that'd be great. So just to continue to tease it a little bit, so is, you observed the general structure, term structure of commodity futures as a function of the estimated amount of capital deployed to commodity indices? And you notice that as more financial capital is deployed to commodity indices, that it did create a change, a structural change in the term structure of the commodity futures markets?

**Marat:** 1:17:35 Yeah, well, let me share a couple of data points. So one data point, around 2002 or so, we saw a huge jump in so called financialization of commodities, which is that investors recognized that commodities are a distinct asset class. And they start investing in commodities using long-only indices, such as Dow Jones ... commodity indices.

**Adam:** 1:17:57 How do you measure that? Do you have data on the amount of money that was flowing into the indices at each year?

- Marat:** **1:18:03** I do, I do have the data. And what's also interesting, there was actually a paper that came out about, it's a JF paper, came out in 2014. And the paper actually reported term premia commodity markets. And it was the first paper ever that talked about the term premia. And I haven't seen a single great explanation of why it exists. So that's another data point. And when my co-authors and I we did research on commodities, what we found is that before 2002, 2003, the term premia was insignificant, and then they became significant. Another data point I wrote this paper about Chinese commodities. And in that paper we found there was no term premia in Chinese commodities. And that also makes sense, because there's no financialization. So what's the mechanism? So let's say, an institutional investor wants to get long on the exposure on commodities, they purchase indices. Indices, invest in index commodities, and they tend to invest in nearby spot contracts, okay? So the prices are driven up in spot, and because of that, since the prices of nearby contracts are higher than the further out contracts, you're able to collect this premium just because this price pressure from index investors. So we built a model, looked at empirical data, but also there was a way to validate this because if you look at the COT reports, Commitment of Traders reports by the CFTC, there's actually a supplemental report that starts reporting index holdings, holdings of index investors start in 2012. So what we've done, we actually looked at the data and we looked at, analyzed whether higher portion of index investors results in higher term premia and that's exactly what we found. We saw this relationship after we accounted for double cluster by time and commodity, we see there's a very strong positive relationship that's typically significant.
- Adam:** **1:20:18** So do you only really notice a change in the term structure for the front month, and the structure for all the other months remains much more consistent through time, but the front month relationship with the other parts of the curve, that changes most dramatically as a function of the amount of dollars or like the, the financialization of commodities?
- Marat:** **1:20:50** That's right. So really, it's really driven by the front months and only index commodities. So you can only see index commodities the difference is the same. But if you look at index commodities, you can see that term premia, they were insignificant and then jumped. And that that jump is related to the, is proportional of index investors in the commodity markets.
- Adam:** **1:21:15** Interesting, okay. And so where's that being published? We know yet?
- Marat:** **1:21:21** Well, I hope that it's going to be high caliber paper. So next week, my co-author is going to give a presentation at IIT. But, but it's probably that we'll need to partner with somebody who can help us take it to a higher altitude journal. There are a couple of people that we're considering. I'm excited. I think it's going to be the best paper that I'm going to write so far, like to date. But I don't think frankly, I'll be able to take it to a higher altitude journal just with me and my co-author. I think we need to partner with somebody.

- Adam:** **1:21:56** Yeah. Well, we'll debate the, all the challenges with, with academic publications on a different podcast. But –
- Marat:** **1:22:05** Sounds good.
- Adam:** **1:22:06** That's great. So listen, this has been a really cool conversation. Thank you so much for joining me and sharing all these insights, and I look forward to further collaboration in the coming months.
- Marat:** **1:22:23** Sounds good. Thanks so much for having me. And Adam, I love talking to you about research, and I look forward to working research projects with you.
- Adam:** **1:22:30** Likewise, alright, thanks. Have a great afternoon. See ya...