

Let's Talk Pendulums

This is based on a paper I wrote with Vitaly Fiks, the F in TF Market Advisors, back in the day. I think it is worth updating this report (or regurgitating it, depending on your view), for two reasons:

- 1. The economy is complex and predicting the next steps for the economy, both domestically and globally, is going to require some creative thinking to get it right. Translating any economic outlook into market calls will be particularly difficult given that we really are at an inflection point in terms of dealing with a pandemic the likes of which we have not faced in recent times. Not only is the pandemic without precedent, the monetary and fiscal response has been extraordinary. As discussed in this weekend's T-Report, "Look Ma, No Hands" we cannot rely on data (so much of which is backward looking) and expect to make correct decisions. While the focus on pendulums may seem absurd, I think it is crucial to have in the back of your mind as you attempt to navigate the coming months.
- 2. As we've discussed in multiple pieces, there is a lot of reason to think of market structure in terms of pendulums. We will repeat that view of market structure, which involves triple pendulums and machine learning, after we've covered the more 'basic' (but incredibly relevant) concept of double pendulums.

Complexity and Shocks

Modern financial markets are complex nonlinear systems. Academics are still trying to figure out whether markets are stochastic (random) or deterministic chaotic (it may look random, but if you could repeat a process identically, it would produce the same result).¹

That complexity is often masked by the relative simplicity of individual transactions that are generally a zero-sum game – the gains of one party to the transaction are equal to the losses of the other party, and this gain/loss is symmetrical. But the individual trade simplicity often tends to affect how we analyze market moves. We look for "tells" or what the market has done recently for epiphanies on the markets in the future. We also tend to look for coherent logical frameworks for information that we receive.

As an example from the original paper in 2014, when oil was a topic of conversation, we can ask the following questions: Lower oil? Is that good or bad? And what are the likely reasons it is lower? Implicitly we form a "view" / logical tree of possible outcomes in conjunction with the logical framework – e.g., if you think that supply/demand is driving oil prices lower, then if OPEC does not cut production, you expect prices to move lower.

This logical view of the markets often proves inadequate when there are big and fast moves.

Complexity

One of the principal qualities of complex systems is that they are extremely sensitive to initial conditions – the so-called "butterfly effect" (originating in a metaphorical example that the flapping of

¹ Financial Markets Stochastic: Test for Noisy Chaos http://www.aijcrnet.com/journals/Vol 2 No 8 August 2012/6.pdf May 5, 2021 1



the wings by a distant butterfly may influence the path of a hurricane weeks later). Very slight differences in such initial conditions may then result in significantly different outcomes.



For illustration, we can take a look at a simple chaotic system – a double pendulum. Vitaly wrote his senior thesis about a slightly different chaotic resonant double pendulum. We are all familiar with a single pendulum, whether it is a child swinging, a metronome, or some old grandfather clock. We see pendulums all the time and we are also very familiar with the movement and can easily predict the result. A double pendulum is simply one pendulum with another pendulum attached to its end. Such **a seemingly simple change, however the difference is profound when trying to predict the movement of a double pendulum versus a traditional single pendulum.** (Graphic Source: Wikipedia)

This system, even though it seems simple and **ordinary differential**

equations describe its behavior, is strongly sensitive to the initial conditions of where each pendulum is located when it is launched. Both single and double pendulum movement can be predicted, but while the result of swinging a single pendulum can be judged with a high degree of accuracy by the human eye, that is far from the case with double pendulums.

Here are a couple of static pictures of side-by-side simulations with slightly different starting positions for the outer pendulum (the inner pendulum leaves a red track and the outer a blue one). The first picture is close to launch, where the blue pendulum was launched at slightly over horizontal on the right and at horizontal on the left.



These starting positions look almost identical but they are not and we will see how quickly the two paths diverge.

And here are the same simulations only a few swings of the pendulum later.

Despite starting nearly in the same position, the paths of the two simulations have already diverged and look completely different. Chaos and the Double Pendulum shows the paths.

For me, seeing these paths, makes me extremely wary



of using historical reference to estimate where we are headed. I think the **"starting conditions"** are unique and we have to solve for those unique starting points. Remember, that while the two paths vary, they are both predictable if you spend the time to understand the exact starting conditions.

The Economy and the Market – Over Time

I think we are in a loop where answering these questions will lead to the right decisions.

- 1. What are our starting conditions?
- 2. What forces are acting on those starting conditions?
- 3. How will those forces change over time and react to each other? We are already seeing less urgency to spend on fiscal stimulus from some politicians as the earlier rounds of stimulus affect the economy and markets.
- 4. What are our "new" starting conditions (i.e., go back to step 1 and repeat, endlessly).

I would normally not advocate so strongly for this, but at the moment I cannot help but cringe when I see simple straight-line extrapolations. However, at the same time, I see some incredibly elegant reasoning about what it means that GDP is back to where it was in 2020 with far fewer workers (and so many unfilled job openings). For me (and I think this is **the biggest "new influence"** outside of government spending), **it is how the ongoing adoption of the principles of ESG will affect the economy and markets**.

Markets on a Short Term Basis

I believe that there is ample evidence that we have created a market structure that "encourages" reasonably long periods where trends (generally to the upside) are the "norm". In credit, it is typified by extended periods where credit slowly grinds tighter and tighter. In equities it seems to manifest itself in momentum strategies, often backed by volatility selling (selling volatility has some similarities to trading credit). In any case, that seems to happen a lot in these markets.

We have discussed market structure for some time and think that this 'faux' liquidity has created a false sense of security about liquidity and stability. Markets rely heavily on systematic trading and algorithms to produce at least the perception of liquidity, if not actual/deep liquidity. The algos and trading systems tend to rely very heavily on correlations and the ability to find liquidity in a "near" market whenever liquidity is challenged in a given market.

It is that reliance which creates these sharp moves (typically declines and typically against the trend) when cross-asset correlation spikes and there is seemingly no good place to hide.

Ultimately, I believe that this pattern of long periods of relative stability followed by brief bursts of intense volatility **can be explained by pendulums**, otherwise I wouldn't include it in this report.

Machine Learning Triple Pendulum. I find this <u>video</u> (via YouTube) fascinating and a bit frightening every time I watch. If you cannot access the link directly, try googling **"Triple Pendulum on a Cart"** or more ominously by googling **"triple pendulum machine learning**".

The video is only 56 seconds, but I think the impact is powerful. It has a machine ('cart') that can move May 5, 2021 3



back and forth on a bar. The cart is attached to a triple pendulum (a stick riveted to another stick riveted to another stick). We've already demonstrated how complex a double pendulum is compared to a single pendulum, so we can already guess how much more complex this triple pendulum is.

The cart whips back and forth rapidly to get the 3 sticks to 'stand up' perpendicular. Once it achieves that, it makes minute adjustments to keep the sticks in a very unstable position. What is fascinating is how the machine makes these micro adjustments, but when stability is lost – it comes crashing down. It doesn't just lose a little control, it loses the entire system. It can re-establish it reasonably quickly (though with some truly bizarre gyrations). The only 'stable' condition of a triple pendulum is actually everything hanging straight down as gravity does its thing. So, all the energy is spent trying to keep the triple pendulum in a position that is the exact opposite of its resting point.

Does the computer controlled triple pendulum have anything to do with market structure? I think it does. Effectively, all of these trading systems and market making functions act like the cart in the video. They are doing everything possible to balance an incredibly delicate system (that relies heavily on cross-asset correlation to balance everything.) Sometimes, something gets just enough out of whack that it cannot be contained, and we "reset".

I think most recently, **that is what happened with the ARKK type of stocks** and may be in the process of occurring again, as we deal with inflation and an economy that is morphing once again.

Enough of Pendulums

I won't yammer about pendulums any more, but as you play devil's advocate with your own ideas, keep that vision of pendulums (and the machine learning cart) in the back of your mind. It will hopefully encourage you to challenge your ideas (and mine) especially **when we might be in danger of relying too heavily on historical patterns or data (that isn't forward looking) to make our forward-looking investment decisions** (and I mean a broad definition of investments, including corporate planning).



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