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Time series momentum ☆

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ABSTRACT

We document significant "time series momentum" in equity index, currency, commodity, and bond futures for *each* of the 58 liquid instruments we consider. We find persistence in returns for one to 12 months that partially reverses over longer horizons, consistent with sentiment theories of initial under-reaction and delayed over-reaction. A diversified portfolio of time series momentum strategies across all asset classes delivers substantial abnormal returns with little exposure to standard asset pricing factors and performs best during extreme markets. Examining the trading activities of speculators and hedgers, we find that speculators profit from time series momentum at the expense of hedgers.

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1. Introduction: a trending walk down Wall Street

We document an asset pricing anomaly we term "time series momentum," which is remarkably consistent across very different asset classes and markets. Specifically, we find strong positive predictability from a security's own past returns for almost five dozen diverse futures and forward contracts that include country equity indexes, currencies, commodities, and sovereign bonds over more than 25 years of data. We find that the past 12-month excess return of each instrument is a positive predictor of its future return. This time series momentum or "trend" effect persists for about a year and then partially reverses over longer horizons. These findings are robust across a number of subsamples, look-back periods, and holding periods. We find that 12-month time series momentum profits are positive, not just on average across these assets, but for *every* asset contract we examine (58 in total).

Time series momentum is related to, but different from, the phenomenon known as "momentum" in the finance literature, which is primarily cross-sectional in nature. The momentum literature focuses on the *relative* performance of securities in the *cross-section*, finding that securities that recently outperformed their peers over the past three to 12 months continue to outperform their

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peers on average over the next month.[1] Rather than focus on the relative returns of securities in the cross-section, time series momentum focuses purely on a security's *own* past return.

We argue that time series momentum directly matches the predictions of many prominent behavioral and rational asset pricing theories. Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmanyam (1998), and Hong and Stein (1999) all focus on a single risky asset, therefore having direct implications for time series, rather than cross-sectional, predictability. Likewise, rational theories of momentum (Berk, Green, and Naik, 1999; Johnson, 2002; Ahn, Conrad, and Dittmar, 2003; Liu and Zhang, 2008; Sagi and Seasholes, 2007) also pertain to a single risky asset.

Our finding of positive time series momentum that partially reverse over the long-term may be consistent with initial under-reaction and delayed over-reaction, which theories of sentiment suggest can produce these return patterns.[2] However, our results also pose several challenges to these theories. First, we find that the correlations of time series momentum strategies across asset classes are larger than the correlations of the asset classes themselves. This suggests a stronger common component to time series momentum across different assets than is present among the assets themselves. Such a correlation structure is not addressed by existing behavioral models. Second, very different types of investors in different asset markets are producing the same patterns at the same time. Third, we fail to find a link between time series momentum and measures of investor sentiment used in the literature (Baker and Wurgler, 2006; Qiu and Welch, 2006).

To understand the relationship between time series and cross-sectional momentum, their underlying drivers, and relation to theory, we decompose the returns to a time series and cross-sectional momentum strategy following the framework of Lo and Mackinlay (1990) and Lewellen (2002). This decomposition allows us to identify the properties of returns that contribute to these patterns, and what features are common and unique to the two strategies. We find that positive auto-covariance in futures contracts' returns drives most of the time series and cross-sectional momentum effects we find in the data. The contribution of the other two return components—serial cross-correlations and variation in mean returns—is small. In fact, negative serial cross-correlations (i.e., lead-lag effects across securities), which affect cross-sectional momentum, are negligible and of the "wrong" sign among our instruments to explain time series momentum. Our finding that time series and cross-sectional momentum profits arise due to auto-covariances is consistent with the theories mentioned above.[3] In addition, we find that time series momentum captures the returns associated with individual stock (cross-sectional) momentum, most notably Fama and French's UMD factor, despite time series momentum being constructed from a completely different set of securities. This finding indicates strong correlation structure between time series momentum and cross-sectional momentum even when applied to different assets and suggests that our time series momentum portfolio captures individual stock momentum.

To better understand what might be driving time series momentum, we examine the trading activity of speculators and hedgers around these return patterns using weekly position data from the Commodity Futures Trading Commission (CFTC). We find that speculators trade with time series momentum, being positioned, on average, to take advantage of the positive trend in returns for the first 12 months and reducing their positions when the trend begins to reverse. Consequently, speculators appear to be profiting from time series momentum at the expense of hedgers. Using a vector auto-regression (VAR), we confirm that speculators trade in the same direction as a return shock and reduce their positions as the shock dissipates, whereas hedgers take the opposite side of these trades.

Finally, we decompose time series momentum into the component coming from spot price predictability versus the "roll yield" stemming from the shape of the futures curve. While spot price changes are mostly driven by information shocks, the roll yield can be driven by liquidity and price pressure effects in futures markets that affect the return to holding futures without necessarily changing the spot price. Hence, this decomposition may be a way to distinguish the effects of information dissemination from hedging pressure. We find that both of these effects contribute to time series momentum, but

[1] Cross-sectional momentum has been documented in US equities (Jegadeesh and Titman, 1993; Asness, 1994), other equity markets (Rouwenhorst, 1998), industries (Moskowitz and Grinblatt, 1999), equity indexes (Asness, Liew, and Stevens, 1997; Bhojraj and Swaminathan, 2006), currencies (Shleifer and Summers, 1990), commodities (Erb and Harvey, 2006; Gorton, Hayashi, and Rouwenhorst, 2008), and global bond futures (Asness, Moskowitz, and Pedersen, 2010). Garleanu and Pedersen (2009) show how to trade optimally on momentum and reversal in light of transaction costs, and DeMiguel, Nogales, and Uppal (2010) show how to construct an optimal portfolio based on stocks' serial dependence and find outperformance out-of-sample. Our study is related to but different from Asness, Moskowitz, and Pedersen (2010) who study cross-sectional momentum and value strategies across several asset classes including individual stocks. We complement their study by examining time series momentum and its relation to cross-sectional momentum and hedging pressure in some of the same asset classes.

[2] Under-reaction can result from the slow diffusion of news (Hong and Stein, 1999), conservativeness and anchoring biases (Barberis, Shleifer, and Vishny, 1998; Edwards, 1968), or the disposition effect to sell winners too early and hold on to losers too long (Shefrin and Statman, 1985; Frazzini, 2006). Over-reaction can be caused by positive feedback trading (De Long, Shleifer, Summers, and Waldmann, 1990; Hong and Stein, 1999), over-confidence and self-attribution confirmation biases (Daniel, Hirshleifer, and Subrahmanyam, 1998), the representativeness heuristic (Barberis, Shleifer, and Vishny, 1998; Tversky and Kahneman, 1974), herding (Bikhchandani, Hirshleifer, and Welch, 1992), or general sentiment (Baker and Wurgler, 2006, 2007).

[3] However, this result differs from Lewellen's (2002) finding for equity portfolio returns that temporal lead-lag effects, rather than auto-covariances, appear to be the most significant contributor to cross-sectional momentum. Chen and Hong (2002) provide a different interpretation and decomposition of the Lewellen (2002) portfolios that is consistent with auto-covariance being the primary driver of stock momentum.

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