Department of Finance

Essays on Time Series Momentum

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Aalto University

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Abstract

The three essays in this dissertation are all related to the topic of time series momentum. In the first essay, my co-authors and I introduce a cross-asset extension of time series momentum that we call cross-asset time series momentum. We show that cross-asset time series momentum outperforms time series momentum, and we link the profitability of both strategies to slow-moving capital in global bond and equity markets. In the second essay, I derive a decomposition of the expected return difference between the two strategies, in order to identify precisely why cross-asset time series momentum outperforms time series momentum. Finally, in the third essay, I present a theory of time series momentum and cross-asset time series momentum that is based on the assumption that some investors have limited attention. I show that investors' limited attention can explain the profitability of both strategies, and I argue that it can also provide a theoretical microfoundation for the slow-moving capital evidence presented in the first essay.

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To Anne, Jukka, and everyone else who helped me along the way, thank you.

La sottise, l'erreur, le péché, la lésine,
Occupent nos esprits et travaillent nos corps,
Et nous alimentons nos aimables remords,
Comme les mendiants nourrissent leur vermine.

Nos péchés sont têtus, nos repentirs sont lâches ;
Nous nous faisons payer grassement nos aveux,
Et nous rentrons gaiement dans le chemin bourbeux,
Croyant par de vils pleurs laver toutes nos taches.

...

Mais parmi les chacals, les panthères, les lices,
Les singes, les scorpions, les vautours, les serpents,
Les monstres glapissants, hurlants, grognants, rampants,
Dans la ménagerie infâme de nos vices,

Il en est un plus laid, plus méchant, plus immonde !
Quoiqu'il ne pousse ni grands gestes ni grands cris,
Il ferait volontiers de la terre un débris
Et dans un bâillement avalerait le monde ;

C'est l'Ennui ! — l'œil chargé d'un pleur involontaire,
Il rêve d'échafauds en fumant son houka.
Tu le connais, lecteur, ce monstre délicat,
— Hypocrite lecteur, — mon semblable, — mon frère !

Charles Baudelaire, "Au lecteur"

Table of Contents

Introduction

The three essays in this dissertation are all related to the topic of time series momentum. In the first essay, my co-authors and I introduce a cross-asset extension of time series momentum that we call cross-asset time series momentum. We show that cross-asset time series momentum outperforms time series momentum, and we link the profitability of both strategies to slow-moving capital in global bond and equity markets. In the second essay, I derive a decomposition of the expected return difference between the two strategies, in order to identify precisely why cross-asset time series momentum outperforms time series momentum. Finally, in the third essay, I present a theory of time series momentum and cross-asset time series momentum that is based on the assumption that some investors have limited attention. I show that investors' limited attention can explain the profitability of both strategies, and I argue that it can also provide a theoretical microfoundation for the slow-moving capital evidence presented in the first essay.

I now introduce the essays in more detail.

Essay 1: Cross-Asset Signals and Time Series Momentum

In the first essay, Matti Suominen, Lauri Vaittinen, and I introduce a novel asset pricing phenomenon that we refer to as cross-asset time series momentum, and which is a cross-asset extension of the time series momentum phenomenon first documented by Moskowitz, Ooi, and Pedersen (2012). Using bond and equity data from twenty countries, we show that not only do past bond returns predict future bond returns, and past equity returns predict future equity returns—thus confirming the findings of Moskowitz, Ooi, and Pedersen (2012)—but past bond returns also predict future equity returns, while past equity returns also predict future bond returns. Moreover, we show that by using this cross-asset time series predictability, we can construct cross-asset time series momentum portfolios that outperform the standard time series momentum portfolios in our data set.

To understand the economics underlying the cross-asset time series predictability that we uncover, we link both time series momentum and cross-asset time series momentum profitability to slow-moving capital in global bond and equity markets (Duffie, 2010). By using mutual fund flows, margin debt, and stock repurchases as proxies for bond and equity demand, we show that past bond and equity returns predict future changes in bond and equity demand, and that these changes in demand take place slowly over the course of several months, thus generating the return predictability that the time series momentum and cross-asset time series momentum strategies exploit.

We also study the links between time series momentum, cross-asset time series momentum, and the broader economy. Using industrial production, investment, inflation, and unemployment as our variables of interest, we show that past bond and equity returns also predict future changes in real economic activity. For example, we show that simultaneously positive bond and equity returns over the past twelve months are associated with better outcomes for the economy, with high industrial production growth, high investment growth, and decreasing unemployment over the next twelve months. By contrast, simultaneously negative bond and equity returns over the past twelve months are associated with worse outcomes for the economy, with negative industrial production growth, low investment growth, and increasing unemployment. We thus show that time series momentum and cross-asset time series momentum are not just financial market phenomena. Instead, they also contain information about fundamental changes in real economic activity.

Essay 2: Decomposing Cross-Asset Time Series Momentum

In the second essay, I build on the work in the first essay by deriving a decomposition of the expected return difference between time series momentum and cross-asset time series momentum. By applying the decomposition to the same data set as in the first essay, I show that 71–79% of the expected return difference between the two strategies is explained by two market timing components that are directly related to the cross-asset time series predictability results presented in the first essay.

I structure the essay around two recent critiques of time series momentum. In the first critique, Goyal and Jegadeesh (2018) show that the return difference between time series momentum and cross-sectional momentum can be explained by the fact that time series momentum is not a zero net investment strategy. Instead, the strategy typically has a net long exposure to risky assets, thus earning an additional risk premium which accounts for the return difference. In the second critique, Huang, Li, Wang, and Zhou (2020) revisit the time series predictability regressions of Moskowitz, Ooi, and Pedersen (2012), and argue that the evidence for time series predictability is much weaker than the evidence originally presented by Moskowitz, Ooi, and Pedersen (2012). Their analysis thus raises doubts about whether the profitability of time series momentum is actually driven by the strategy's ability to exploit time series predictability in the underlying assets, or by some other factors.

In my essay, I show that neither of these time series momentum critiques applies to cross-asset time series momentum. Using the decomposition I derive, I show that risk premia explain only a small minority of the return difference between cross-asset time series momentum and time series momentum, so the outperformance of cross-asset time series momentum is not simply driven by the strategy having a larger exposure to risky assets, and thus earning an additional risk premium. In addition, I show that the evidence for cross-asset time series predictability remains strong, even when taking into consideration the critique of Huang, Li, Wang, and Zhou (2020). I thus show that neither the risk premium critique of Goyal and Jegadeesh (2018) nor the time series predictability critique of Huang, Li, Wang, and Zhou (2020) applies to cross-asset time series momentum.

Essay 3: A Limited Attention Theory of Time Series Momentum

In the third essay, I expand on the empirical evidence of slow-moving capital presented in the first essay by proposing the first joint theory of time series momentum and cross-asset time series momentum. The key ingredient of the theory is the assumption that some investors have limited attention. Using a model of bond and equity markets based

on the limited attention framework of Hirshleifer and Teoh (2003), I show that investors' limited attention can explain the profitability of both time series momentum and cross-asset time series momentum, while also making several novel empirical predictions about the relation between limited attention and the performance of different time series momentum and cross-asset time series momentum strategies. I thus argue that limited investor attention provides a parsimonious explanation for time series momentum and cross-asset time series momentum profitability, while also functioning as a potential microfoundation for the slow-moving capital evidence presented in the first essay.

The intuition underlying the theory is straightforward. If some investors have limited attention—and thus do not consider all relevant information when making their trading decisions—while other investors are risk averse or otherwise face limits to arbitrage, then the information ignored by the inattentive investors will be incorporated into prices slowly, thus generating the return predictability that the time series momentum and cross-asset time series momentum strategies exploit. Moreover, under the reasonable assumption that attention-constrained investors are more likely to allocate their attention to information originating from their own market, rather than other markets, less of the information from other markets will be incorporated into prices, and therefore the return predictability across markets will be stronger than the return predictability within markets, precisely as shown in the first two essays. Limited investor attention thus provides an explanation for both time series momentum and cross-asset time series momentum profitability, as well as an intuition for why cross-asset time series momentum outperforms time series momentum.

References

Duffie, Darrell (2010). "Presidential Address: Asset Price Dynamics with Slow-Moving Capital." *Journal of Finance* 65.4, pp. 1237–1267.

Goyal, Amit and Narasimhan Jegadeesh (2018). "Cross-Sectional and Time-Series Tests of Return Predictability: What Is the Difference?" *Review of Financial Studies* 31.5, pp. 1784–1824.

Hirshleifer, David and Siew Hong Teoh (2003). "Limited Attention, Information Disclosure, and Financial Reporting." *Journal of Accounting and Economics* 36.1-3, pp. 337–386.

Huang, Dashan, Jiangyuan Li, Liyao Wang, and Guofu Zhou (2020). "Time Series Momentum: Is it There?" *Journal of Financial Economics* 135.3, pp. 774–794.

Moskowitz, Tobias, Yao Hua Ooi, and Lasse Heje Pedersen (2012). "Time Series Momentum." *Journal of Financial Economics* 104.2, pp. 228–250.

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