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Roll strategy efficiency in commodity futures markets

Nick Taylor

School of Economics, Finance and Management, University of Bristol, Bristol BS8 1TN, UK

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ABSTRACT

Issues pertaining to the investor decision to sell a security and buy another (of the same type and with the same terms) with a longer period until the expiration date (the roll forward decision) are examined. In particular, a framework is developed in which it is possible to test the trade execution quality efficiency of a roll strategy against a mean–variance optimal roll strategy characterized by multiple-day roll. Applying this framework to five leading US grain futures markets (corn, wheat, soybean, soybean meal and soybean oil) demonstrates that commonly used single-day and multiple-day roll strategies (including the Goldman roll strategy) exhibit considerable inefficiencies. These are consistent over the markets and over the time of the day in which trading occurs, and vary with execution quality risk-aversion in a predictable way. A practical multiple-day roll strategy is proposed that reduces these inefficiencies.

1. Introduction

A large number of investment strategies involve the decision of when to sell a security and buy another (of the same type and with the same terms) with a longer period until the expiration date (the roll forward decision). For instance, a portfolio manager with responsibility for a diversified portfolio of assets that includes a commodity market component will undoubtedly have positions in commodity derivative contracts. Consequently, the manager must decide when to roll forward the derivative contracts which are close to maturity. Likewise, a stack hedger with a risk exposure to a particular commodity market that extends beyond the maturity of available derivative contracts faces a similar decision. A key factor in such decisions is expected trade execution quality. The approach taken in the current paper considers this decision such that this component is optimized.

There are a number of conventional approaches to the roll forward decision, all of which exploit the *periodic* nature of expected execution quality in the period leading up to contract maturity (cf. the vast majority of trade scheduling environments). These can be categorized as either single-day or multiple-day strategies. The former assumes that the securities roll forward on a single day that is a fixed number of days prior to the maturity date. By contrast, multiple-day strategies involve spreading the roll forward over a finite number of days prior to the maturity date. For instance, the commonly used *Goldman roll strategy* involves a commodity futures roll (with uniform weights) between the fifth and ninth business days of the month preceding the expiration month. The likely virtue of such a strategy in comparison to the single-day strategy is that the user has a lower risk of being exposed to poor execution quality. It is this conjecture that is examined in the current paper.

E-mail address: nick.taylor@bristol.ac.uk

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The advent of electronic trading platforms has led to an increasing number of financial institutions employing algorithmic trading systems. A key component of these systems is trade scheduling, defined according to a trade target, that is, the number of asset units (shares or contracts) to be bought or sold during a pre-specified finite time horizon. Specifically, trade scheduling involves specifying the rate at which these asset units are traded over this period (referred to as the trade list) in order to optimize execution quality. Within the context of derivative markets, a simple-to-implement trade scheduling procedure is proposed that solves the problem of when traders in such markets should switch from contracts that are close to maturity to deferred contracts (henceforth referred to as the roll strategy). This strategy applies irrespective of whether the user has speculative, hedging, or arbitrage motives.

Trade scheduling is important as it is a significant determinant of the overall success of a trading strategy. The academic literature has recognized this importance. The vast majority of studies propose strategies that optimize the tradeoff between pricing impact and timing risk; see Almgren and Chriss [1], He and Mamaysky [16], Engle and Ferstenberg [9], Schied and Schoeneborn [25], Forsyth et al. [12], and Tse et al. [29] for a representative sample.[1] This literature is complemented by proposing a framework that is designed specifically to examine the quality of the roll decision faced by participants in markets in which there is periodic variation in execution quality. Our framework has some overlap with this literature, but fundamentally differs in terms of the tradeoff undertaken.

The trade scheduling literature typically adopts the following framework. A trader wishes to sell a fixed number of asset units over a finite horizon. Execution quality is typically measured by comparing the total revenue generated by selling at the arrival price (the price observed when the trade instruction is received) and the total revenue generated by selling these units over the horizon, with the difference referred to as the implementation shortfall [22]. Within this context, price impact is generated by assuming that the asset is subject to trading costs that increase disproportionately with the trading rate (for instance, most studies adopt a quadratic cost model). This provides the incentive to avoid fast liquidation. By contrast, timing risk represents the risk of trading at prices away from the arrival price (induced by assuming that prices evolve in a stochastic fashion). These two effects are commonly balanced such that execution quality is optimized within a mean–variance framework in which the expected implementation shortfall is minimized subject to a pre-specified implementation shortfall variance. Moreover, these moments are determined from the perspective of a single trader prior to the trading taking place.[2]

Within our setup a trader holds a position in the first month maturity derivative contract set and wishes to schedule trades over the period prior to the first notice day (FND) such that the position is replaced by a corresponding position in the first back month derivative contract set.[3] Applying the conventional trade scheduling approach would not be appropriate. To see this, first note that the current application involves simultaneous trading in two (near) perfectly correlated price series (that is, prices of the first month and first back month derivative contract sets). Consequently, positive future shocks to prices will lead to falls in the implementation shortfall associated with the former contract set; however, the implementation shortfall associated with the latter contract set will rise and offset the former contract set implementation shortfall. The net effect means that there is essentially no timing risk in the strategy. For this reason, a different perspective on the problem is taken.

The proposed framework is one in which execution quality is optimized from the perspective of a trading desk manager who is concerned about the ex post unconditional mean and variance of execution quality over a series of trade lists (cf. the perspective of a single trader who is concerned about the ex ante moments of a single trade list).[4] Within our framework, the mean–variance optimal trading desk manager will typically face a tradeoff between achieving a maximum level of mean execution quality with high variance (achieved by focusing trading on a particular day prior to the FND), against a lower level of mean execution quality with lower variance (achieved by spreading trading over several days).

The trader within the proposed framework could be a (stack) hedger, speculator, or arbitrageur – all that is relevant is that the trader requires a roll strategy to maintain a broader trading strategy. This includes market timing traders who seek to exploit systematic variation in roll yields (the price difference between the front month and first back month contract).[5] This could be achieved by optimizing the roll strategy with respect to roll yields as opposed to execution quality. However, the analysis presented in this paper demonstrates that such a strategy is unlikely to be highly efficient as these data do not

[1] The former of these reflects the increased costs of immediate trading based on liquidity considerations, while the latter risk measures the costs associated with delayed trading at prices away from those anticipated.

[2] The literature based on this framework can be categorized in many ways. Perhaps the most obvious way is to label papers in terms of whether conditional or unconditional strategies are proposed. The former consists of a trade schedule that is mean–variance efficient with respect to implementation shortfall, but does not change over time to reflect changing market conditions (see, e.g., [1]). By contrast, conditional strategies are also mean–variance efficient but adapt to dynamic variation in market conditions (see, e.g., [2]).

[3] Within the context of commodity derivatives, the FND represents the day after which a roll can occur to avoid taking physical deliver of the underlying commodity.

[4] There have been previous studies of the roll decision in futures markets. Motivated by the abnormal volatility in futures prices close to their maturity [24], this literature focuses on the effect of single day roll selection on the return series (and not execution quality). Using a variety of futures data, Carchano and Pardo [6] find that there are no significant differences in the return series over a variety of different roll date selection criteria (cf. Ma et al. [20]).

[5] There is some empirical evidence that is consistent with higher roll yields prior to and during the Goldman roll period; see Mou [21]. However, many studies document contrary evidence. For instance, using different data and sample periods, Stoll and Whaley [27] and Hamilton and Wu [15] find little evidence of price patterns, while Bessembinder et al. [3] document that such effects disappear within minutes. Thus it seems that as information regarding use of commercial roll strategies is in the public domain, any remaining patterns are likely to be due to limited arbitrage effects that cannot be exploited.