How quickly is temporary market inefficiency removed?

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ABSTRACT

I provide evidence on the length of time it takes for arbitrageurs to exploit attractive investment opportunities. A unique data set from the Internet sports betting market allows me to focus on the speed of investor response in an environment that is not affected by the joint hypothesis problem. The market does not instantly converge to an efficient level after mispricing occurs, but the adjustment process is rapid. Arbitrageurs remove many of these opportunities within minutes of them being created and the majority are gone within an hour. Arbitrage opportunities that are more difficult to find last for longer.

1. Introduction

Available information is fully reflected in prices in an efficient market (e.g., Fama, 1970), but in reality prices do not always react instantly to new information. Merton (1987, p. 485) states “the expected duration between the creation of this investment opportunity and its elimination by rational investor actions in the market place can be considerable.” Much research energy has been devoted to how quickly individuals respond to information which is unsurprising given the importance of the efficient market hypothesis to finance.

This literature involved too approaches, both of which have a weakness. The first strand considers the convergence of prices to efficient levels, but in order to do so the authors first need to identify what the efficient price level is. This requires the use of a benchmark model, which as Fama (1998) points out, effectively means that two tests are jointly being undertaken. The first is speed of price convergence and the second is ability of the benchmark model to correctly identify efficient price levels. The second
strand of literature, which considers convergence to efficient price levels by considering the speed at
which arbitrage opportunities are removed, overcomes this joint hypothesis problem, however another
issue is encountered. Most arbitrage in financial markets is not free of impediments to arbitrage such as
short-selling constraints (e.g., Shleifer & Vishny, 1997) so it is possible that mispricing persists for
long periods due to these rather than a lack of effort by investors to remove them.

I consider how quickly prices converge to efficient levels (i.e. arbitrage opportunities are removed)
in an environment which does not suffer from either of the weaknesses outlined above, the Internet
sports betting market. Durham, Hertzel, and Martin (2005) point out that sports betting markets are
similar to financial markets in that they attract large volumes and information is widely available, but
they also have several strengths as an empirical laboratory. The particular advantages this paper is
interested in are: numerous price (or odd) quotations on the same event by different decentralised
market makers (bookmakers), diverse price quotations generating arbitrage opportunities, arbitrage
opportunities being easily identified and valued based on odds that are perfect substitutes (i.e. no
fundamental risk), the odds having a short life and a well defined termination point (i.e. no noise trader
risk), the arbitrage transaction being executed with minimal cost via the Internet (i.e. low transactions
costs), and the absence of short-selling constraints.

It is difficult to quantify exactly how many individuals are actively involved in sports betting arbi-
trage. However a quick search on the Internet generates over 1.8 million links to websites discussing
the concept, providing advice on how best to capture the profits on offer, and giving feedback on
how much money individuals are making exploiting these arbitrage opportunities. Sports betting
arbitrage forums such as www.arbforum.co.uk and http://www.sportsarbitrageworld.com have over
10,000 posts from individuals who appear to be actively engaged in this activity.

I show divergent price quotations on the same sporting event allow median arbitrage profits of just
over 1.5% per trade to be made. Once created, these opportunities are quickly removed. Their median
duration is 15 min and 75% of all opportunities are removed within 50 min. Arbitrage opportunities that
are more difficult to find last for longer. These include opportunities involving three- rather than two-
outcome sporting events and arbitrage opportunities created by bookmakers who do not typically
post odds that create such an opportunity. The opportunity costs of checking these odds are larger
than those of checking the odds of bookmakers who frequently create opportunities so it is rational
for arbitrageurs to check these bookmaker websites less frequently.

My results provide further support for the Merton (1987) suggestion that attractive investment
opportunities are not removed instantaneously. Investors take time to locate and exploit attractive
investment opportunities even in a market setting where fundamental risk, noise trader risk, transac-
tions costs, and short-selling constraints do not impede the capturing of arbitrage opportunities. My
finding that arbitrage opportunities that are more difficult to find last for longer is also consistent with
the propositions of Merton (1987). My results are not affected by the joint hypothesis problem that is
inherent in most tests of the speed of convergence to market efficiency, as no model of efficient price
levels is required. Sports betting markets are less liquid than financial markets and it is possible that
credit concerns are more prevalent in sports betting markets. However, I propose that neither of these
factors, which are discussed in detail later in the paper, affect my conclusions in a major way.

The remainder of the paper is organized as follows: Section 2 provides a discussion of relevant
literature. The market setting, data set and methodology used to determine if an arbitrage opportunity
exists is described in Section 3. The results are presented in Section 4. Section 5 concludes the paper.

2. Related literature

In an efficient market, prices quickly react to information and rapidly converge to efficient levels as
rational individuals seek to exploit attractive investment opportunities. However, many researchers
show that in reality mispricing persists for long periods of time. Lamont and Thaler (2003) find evidence

1 Others have indicated there are similarities between bets and certain financial assets. For instance, Vecer, Ichiba, and
Laudanovic (2006) shows bets and credit derivatives have many similar properties.
2 The Google search for the term “sports arbitrage” was conducted on 27 September, 2007.
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