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From hero to zero: Evidence of performance reversal and speculative bubbles in German renewable energy stocks

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ABSTRACT

Stocks of German renewable energy companies have commonly been regarded as lucrative investment opportunities. Their innovative line of business initially seemed to promise considerable future earnings. As shown by two powerful bubble tests, the positive sentiment for renewable energy stocks even led to explosive price behavior in the mid-2000s. However, intense sector competition and the economic downturn following the global financial crisis erased profit margins to a large extent. As a result, the former fad stocks have recently turned into losers, loading negatively on price momentum and delivering significantly negative Carhart four-factor alphas. The radical shift in Germany's energy policy following the 2011 Fukushima nuclear disaster in Japan could thus only temporarily halt the continuing decline in alternative energy stock prices.

1. Introduction

The rapid expansion of renewable energies in recent years has made the sector one of the most promising industries and has attracted the attention of a growing number of investors. According to Bloomberg New Energy Finance (2011), the global new investment volume in renewable energy reached a record high of US$211 billion in 2010, an increase of 32% compared to 2009. The growth path was only temporarily interrupted by the global financial and economic crisis. After experiencing double-digit growth rates in the early and mid-2000s, new investments remained practically unchanged in 2009. Despite strong growth in the last years and the adoption of energy policies favoring the use of renewable energy sources in nearly 120 countries, renewable power generation accounted for merely 5.4% of the total global electricity generation in 2010 (Bloomberg New Energy Finance, 2011). Nonetheless, renewable energy sources constituted almost 30% of the increase in global power generation in 2010, reflecting their prominent status in satisfying the world's increasing energy needs.

The further development and promotion of renewable energy technologies are also crucial to dampening the economic effect of finite fossil fuel resources and to reducing carbon dioxide emissions that substantially contribute to global warming (Leggett and Ball, 2012). Similarly, renewable energy sources already play a decisive role in achieving the European Union's 2020 climate targets. Among other things, the EU-27 member states have committed themselves to raising the share of renewable energy in overall energy use to 20% by 2020 (Eskeland et al., 2012; Klessmann et al., 2011).

In view of the sector's growing importance, the primary goal of this paper is to assess the performance of German renewable energy stocks during the time period from 2004 to 2011. Germany provides an interesting and unique setting to analyze the return behavior of companies in the alternative energy sector. The German Federal Government undertook a variety of energy policy changes that have paved the way for a transition to a sustainable energy supply. Such measures include the adoption of the Renewable Energy Sources Act in 2000, which aims to encourage the deployment of renewable energy technologies through the use of feed-in tariffs, as well as the accelerated nuclear power phase-out.

Following the Fukushima nuclear accident in March 2011, Germany decided to permanently shut down eight of its oldest

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nuclear power plants, while the remaining nine reactors will go offline by 2022 at the latest. This unprecedented decision to accelerate the nuclear power phase-out in Germany was entirely unexpected because not long before in October 2010, the German Federal Government successfully passed an amendment to the Atomic Energy Act that even delayed the original phase-out strategy of June 2000. The amendment extended the lifetimes of the country's nuclear power plants for another 8 to 14 years (Betzer et al., 2011; BMU, 2011; Nestle, 2012), but was repealed again in light of the Fukushima nuclear disaster.

Given the increased public awareness of the potential risks of nuclear energy and climate change, Germany set ambitious goals to foster the development of a sustainable energy system. In 2010, the share of renewable energy sources in total energy consumption amounted to 11.3%, whereas the contribution to electricity generation was slightly higher at around 17.1% (BMU, 2011). By 2050, the German Federal Government even intends to cover at least 60% of total energy consumption and at least 80% of electricity consumption through the use of renewable energy sources (BMU, 2011). As a result, the growth prospects for German alternative energy companies may appear bright at first glance. However, fierce competition from Chinese manufacturers has increased the pressure on the industry, in particular on solar companies. The excess supply of solar panels from China, overcapacity and declining module prices have taken their toll on the solar industry's profitability. The strong decline in solar module prices began in the third quarter of 2008, amidst the global financial and economic crisis. According to Bloomberg New Energy Finance, a research provider that regularly collects market data from a variety of sources, prices for crystalline silicon modules ranged from US$3 to US$4.13 per watt of generating capacity between 2000 and mid-2008.[1] Since then, prices have fallen below US $1 per watt, which is even less than the production costs for many Western manufacturers. In 2011, the price drop of nearly 52% from US$2.01 to US$0.97 per watt was particularly severe and exacerbated the German solar industry's struggle to survive. As a result, a number of once pioneering German solar companies had to file for insolvency in late 2011 and early 2012.

The empirical findings of this paper are in line with the ambiguity concerning the current economic conditions for renewable energy stocks. We first analyze the multi-factor performance of two German stock indices — the ÖkoDAX and the DAXsubsector Renewable Energies. These alternative energy indices earned substantial positive returns from 2004 to 2007, even after controlling for exposures to the Carhart (1997) four-factor model. Most interestingly, the index constituents loaded positively on the price momentum factor, suggesting that they were perceived as winner stocks. However, the favorable risk-adjusted performance changed between 2008 and 2011, when the German renewable energy sector was severely hit by the global recession and the growing competition from East Asia. As a result, German renewable energy companies have recently turned into loser stocks and have delivered significantly negative Carhart alphas.

Given the positive market sentiment for renewable energy stocks in the first subperiod from 2004 to 2007, we conjecture that the strong outperformance might have been driven by a speculative bubble. To the best of our knowledge, no study has been conducted so far to test for explosive price behavior in renewable energy stocks in the mid-2000s. The stock market bubble literature has mostly focused on international large-cap stock indices and the dotcom era of the late 1990s. The reader may refer to Gürkaynak (2008) for a comprehensive survey of econometric techniques widely used to detect bubbles in asset prices. One reason for this gap in the literature might be the lack of usable data on fundamental factors, such as regular dividend payments or a sufficiently long history of positive corporate earnings. Researchers interested in testing for speculative bubbles in German renewable energy stocks are therefore confined to econometric methods that are not based on fundamental factors, but rather focus on the time series of stock prices themselves. The main advantage of the latter approach is that it avoids testing a joint hypothesis of the presence of speculative bubbles and of the validity of the model used to determine the stocks' fundamental values.

Modern techniques which meet this requirement comprise the supremum Augmented Dickey–Fuller (sup ADF) test (Phillips et al., 2011, 2012) and the Markov regime-switching ADF test (Funke et al., 1994; Hall et al., 1999). These two right-tailed unit root tests indeed find explosive behavior in the real price time series of the ÖkoDAX and the DAXsubsector Renewable Energies during the second half of the 2000s and thus corroborate our conjecture.

The paper proceeds as follows. Section 2 provides a short review of the existing literature on renewable energy stocks. In Section 3, we explain the research methodology employed for performance measurement and bubble detection, while Section 4 describes our data. In Section 5, we present our empirical results. Section 6 summarizes our main findings and finishes with concluding remarks.

2. Literature review

The existing literature on the performance and price behavior of renewable energy stocks is still relatively scant. Henriques and Sadorsky (2008) show that prices of technology stocks and of crude oil each individually Granger cause stock prices of alternative energy companies listed on major U.S. stock exchanges. The authors emphasize that the return behavior of alternative energy companies is closely related to that of high-tech stocks, whereas oil price shocks only have a limited impact. In a similar vein, Sadorsky (2012a) employs a number of multivariate GARCH models to study the volatility dynamics of alternative energy stocks. In particular, he finds that stock prices of alternative energy companies correlate more closely with technology stock prices than with oil prices. Kumar et al. (2012) confirm these findings by showing that clean energy stock prices are influenced by oil prices, interest rates and technology stock prices, but surprisingly not by the prices of carbon allowance futures from the European Union Emissions Trading System.

Moreover, Sadorsky (2012b) studies the determinants of systematic risk for U.S.-listed renewable energy stocks between 2001 and 2007. He finds that an increase in a company's sales growth reduces its stock's systematic risk, whereas a rise in oil prices tends to have an even greater, yet positive impact on the stock's beta. Interestingly, both Henriques and Sadorsky (2008) and Sadorsky (2012b) document that renewable energy stocks exhibit substantial market risk, as their betas range from 1.4 to even 2.

Bechtel and Füss (2010) examine the redistributive effects of the government's political orientation on economic sectors for the period from 1991 to 2005. The authors find a positive relationship between the electoral prospects of a left-leaning government in Germany and the stock returns of the alternative energy sector. However, the recent turnaround in energy policy adopted by the current conservative–liberal coalition government suggests that Germany's entire political spectrum now supports the development of renewable energy sources.

Two very recent studies investigate the impact of the Fukushima nuclear disaster in Japan on nuclear and alternative energy stocks. Ferstl et al. (2012) conduct an event study for the time of the nuclear accident and find that nuclear energy companies in France, Germany

[1] We thank Martin Simonek, solar analyst at Bloomberg New Energy Finance, for providing us with the relevant data.