Dynamics of China’s carbon prices in the pilot trading phase

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HIGHLIGHTS

- Study on the carbon prices of four Chinese cap-and-trade pilot schemes.
- Links carbon prices to macro-level financial risks, commodity markets and sentiment.
- Strikingly vast differences in prices and trading volume across the markets.
- The carbon price fundamentals are weak and the markets are immature.

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ABSTRACT

This paper is the first to investigate empirically the link between carbon prices and macro risks in China’s cap-and-trade pilot scheme. Using data from four pilot markets in Beijing, Guangdong, Hubei, and Shenzhen from 2014 to 2016, we demonstrate that the carbon price in Hubei is weakly linked to international prices of natural gas. Our results also indicate that energy, utilities, industrial and materials sector indices are positively related to the allowance prices in Shenzhen and Guangdong, suggesting that higher emitters in the region may have factored the carbon price into their production mix. We find no statistically significant relationship in the Beijing pilot. Overall, the findings suggest that China’s carbon market is currently in an early stage of development, as the carbon price fundamentals are weak and the markets are comparatively less efficient than the European trading scheme in an informational sense. The findings of the paper have policy implications for the upcoming integration of regional markets into the national carbon market.

1. Introduction

For a considerable time following the introduction of the European Union’s Emissions Trading Scheme (EU-ETS), China, the largest emitter of carbon dioxide (CO2) by volume in the world, has been under international pressure to reduce its CO2 emissions. Subsequent to the United Nations Climate Change Conference (COP15) in Copenhagen in 2009, China’s government announced its intention to cut carbon intensity or greenhouse gas (GHG) emissions per unit of gross domestic product (GDP) by 40–45 percent below 2005 levels by 2020. Despite challenges like its emerging economy, its developing financial market, and inadequate technology to facilitate practical carbon trading, China surprised the world by announcing a national emissions trading scheme (ETS) that would commence in the second half of 2017. If successful, China’s ETS will become the world’s largest, doubling the size of the EU-ETS [1,2].

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allowances plays a critical role in the design of an ETS system, as a stable carbon price that gradually increases ensures the transition from a pollution-intensive economy to a cleaner, more sustainable economy in the long run. Consequently, the findings presented in this paper shed new light on the final design of China’s ETS (i.e., its allocation of allowances, cap pricing, industry coverage, and compliance issues).

Hintermann et al. [6] provide a summary of the empirical literature on carbon allowance prices since phase II of the EU-ETS and highlight the roles of economic activity, growth announcements, and energy prices in the dynamics of the carbon prices in Europe. Aatola et al. [7] document a negative influence of coal prices on the price of carbon, whereas Lutz et al. [8] find a negative relationship only in certain periods. Earlier studies, such as Mansanet-Bataller et al. [9] and Alberola et al. [10], provide evidence that carbon prices in the EU-ETS are linked to oil, gas, and coal prices. In terms of economic activities, Chevallier [11,12] show that there is a weak link between macro factors (equity dividend yield and junk bond premium) and carbon prices.

The literature on China’s ETS is currently in its infancy. A limited number of studies focus on the policy debate rather than quantitative analysis of the allowance price. Zhang [13] discusses the motivation behind implementing the ETS instead of a carbon tax policy. Liu et al. [14] explore the policy process and barriers to the development of ETS, while Zhao et al. [15] comment on the market efficiency of ETS pilots based on a naive assessment of price, trading volume, and information transparency. These studies offer some first-hand lessons from early observations of China’s carbon pilots, including the need to improve market liquidity, information transparency, and operational efficiency. A number of studies simulate the impact of various allowance-allocation strategies on the performance of a national trading system [16–19], finding that an ETS system improves economic efficiency and increases the price of electricity.

More recently, Ren and Lo [20] find that the rate of return in the Shenzhen carbon market is negatively associated with expected risk, and Liu et al. [21] study the impact of the policy mix on the operating national carbon emission trading market in China. Wu et al. [22] assess emissions trading policy among sectors in the Shanghai pilot and find that trading behaviour depends on burden-sharing and the use of renewable energy. Xiong et al. [23] conduct a comparative analysis of the designs of China’s ETS with the EU-ETS and the California ETS in which they highlight distinctive features in allowance mechanisms that affect the efficiency of China’s pilot markets. Motivated by these distinctions, we contribute to this emerging literature by investigating the deterministic drivers of carbon-allocation prices across trading pilots in China. By employing pricing fundamentals that have been proven effective in the more mature and developed EU-ETS markets, we draw conclusions about the overall informational efficiency of China’s carbon markets and provide policy implications for the upcoming integration of regional markets into the National Emissions Trading Scheme.

The scarcity of empirical research on China’s pilots may be due to the length of available data. Although data on price and trading volume are available from the respective exchanges, historical archives are not easily accessible. By employing a comprehensive dataset from all seven trading pilots, we provide the first deterministic analysis of carbon-allocation pricing in China’s ETS. The main challenge in using the dataset is the large number of missing values that indicate little or no trading activity. In order to draw meaningful conclusions from the data and our analysis, we focus on four markets: Beijing, Guangdong, Hubei, and Shenzhen. We conduct regression analysis based on weekly returns series that are constructed using volume-weighted prices. Our findings suggest that the allowance price in the pilots’ trading phase is only weakly linked to stock market and energy prices, although this finding is not universal across the four markets.

This paper makes three primary contributions to the carbon literature. First, after providing fresh insights into the institutional settings of each trading pilot, we investigate the explanatory power of macro-level financial risks. Oberndorfer [28] and Veith et al. [29] demonstrate that stock returns of the most affected companies (i.e., electricity) under the EU-ETS are positively correlated with carbon prices and conclude that firms can not only pass the regulatory burden on to customers but can also profit by overcompensating for the costs. We find that carbon prices in Hubei loads weakly on the utilities index and that the Shenzhen pilot prices exhibit a positive relationship with energy and materials sector indices, suggesting that high emitters in the region may have factored the carbon prices into their operations. However, we found no significant relationships in the Beijing or Guangdong pilots.

Second, studies such as Mansannot-Bataller et al. (2007) and Alberola et al. (2008) provide evidence that carbon prices in the EU-ETS are linked to oil, gas, and coal prices, while Aatola et al. [7] and Lutz et al. [8] document a negative influence of coal prices on the price of carbon. Motivated by these findings, we investigate the relationship between the prices of carbon allowance with variations in the coal, steel, gas, and crude oil prices and the iron ore inventory. These variables are selected because China is the world’s largest producer of steel, and its iron- and steel-production industries, which are largely state-owned, are more energy-intensive than those industries are in other developing countries, such as Brazil and Poland [30]. As a result, data on China’s iron ore inventory and steel prices contain dynamics that are relevant to a variety of economic functions. In addition, we choose these variables because China’s energy imports, fuelled by rapid economic expansion, have grown significantly over the past decade. To separate domestic shocks from regional and global shocks, we employ price series that reflect China’s (coal, steel, and iron ore), Asia’s (JCC, Asia LNG, and Australia coal) and global (Brent and NYMEX gas) demand and supply dynamics.

We find that Brent crude oil in both the Hubei and the Shenzhen pilots exhibits statistically significant relationship with the allowance prices. While the positive significance of crude oil in Hubei conforms to findings in the extant literature [11,12,7,8], the negative sign in Shenzhen is at odds with previous results and suggests that high (low) fuel prices contribute to the decrease (increase) in carbon prices and the possibility of omitted variables. Once again, no statistically significant relationship was found in Beijing and Guangdong pilots. The lack of association with established energy variables suggests that the pricing fundamentals of China’s carbon market remain relatively weak, as variables that have been informative in the EU-ETS are not currently priced in China’s trading pilots. The differences in Brent crude price loadings may also suggest that carbon price dynamics in Hubei and Shenzhen pilots differ.

Third, since our sample period overlaps with the recent meltdown in China’s equity markets, we include sentiment variables as a way to determine how carbon prices in each pilot respond to expectations on the state of the economy, as reflected by the market trend. Following Prete and Norman [31], we employ China’s VIX (CHVIX) index from AlphaShares in which measures the implied volatility of options on
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