



Assessing China's Provincial Electricity Spot Market Pilot Operations: Lessons from Guangdong Province

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Yang Liu^a Zhigao Jiang^c Bowei Guo^{a,b}

^aSchool of Applied Economics, Renmin University of China;

^bAssociate Researcher, EPRG, University of Cambridge

^cEnergysalent Consulting Co., Ltd.

Targeting on improving the efficiency of power generation, the Government announced its plan to reform China's electricity wholesale market. The reformed electricity wholesale market consists of three primary markets that operate in different timescales, namely the mid-to-long-term (M2L) energy market ranging from annually to multi-daily, the spot market containing day-ahead and real-time market, and the ancillary services market aiming to ensure the security of grids. As most generation volume is governed under M2L contracts, little revenue risk exists for market participants.

Among the three primary markets, spot markets are believed to be the most liquid in the future because they will be able to respond to later information such as outages and updated load and renewables forecasts. Therefore, a focal point of the wholesale market reform is to introduce a stable and reliable electricity spot market, which will substantially improve efficiency, reduce costs and lower greenhouse gas emissions.

Eight provinces (and regions) have been selected for spot markets pilot operations, including Southern China (starting from Guangdong), West Inner Mongolia, Zhejiang, Shanxi, Shandong, Fujian, Sichuan and Gansu. Among them, Guangdong is usually considered to be the province leading China's power market reform, as it is more open than other regions in terms of selecting market design choices and processes. Comparing with other regions, Guangdong has a high percentage of supply participating market exchanges and demand opening to retail. It is also the province with the longest functioning spot market pilot which started from September 2018.

Till June 2021, Guangdong has completed five rounds of pilot operations. the operation period is much longer towards recent rounds - the first round of pilots only lasted for two days while the 4th and 5th rounds both lasted for a month. During the time, with the gradual decentralisation of the wholesale and retail markets, the total number of spot market



participants is increasing. For each new round of pilots, lessons and experiences from the past are firmly learned, hence the settlement method has been improved, the information has become more transparent, and the decomposition of M2L contracts has become more liberalised.

In this article, we assess the efficacy of Guangdong's electricity spot market pilot operations. We aim at investigating the stability and reliability of Guangdong's spot market during pilot operations, where "stability" is reflected as the relationship between demand and prices, and "reliability" is reflected as the inefficiency of the market, measured as the market distortion due to a price floor, and local market power due to transfer capacity limits. We focus on the 4th and 5th pilots as sufficient lessons are learned from earlier pilots and both 4th and 5th pilots last for a month, hence (relatively) sufficient data can be collected for the econometric analysis. To the best of our knowledge, this is the first article that uses *ex-post* market data to investigate the operation of China's electricity spot market.

Our results suggest that during the 4th and 5th rounds of Guangdong's spot market pilot operations, the spot market prices (SMPs) are more volatile in the real-time than the day-ahead market, suggesting a higher risk trading in the real-time market. Due to historical high temperature, increasing coal prices, global Covid-19 outbreak while China being less affected, and a moderately concentrated wholesale market, we observe much higher SMPs in the 5th than the 4th round. The impact of electricity load on the day-ahead SMPs are also substantially different - during the 4th round, a 1 GW increase in the total load is associated with a ¥7/MWh increase in the day-ahead SMPs, while the number increased to ¥13/MWh in the 5th round. During the 4th round the SMPs were frequently censoring around the price floor of the SMPs at ¥70/MWh. This indicates a welfare transfer from electricity consumers to generators, and we estimated the monetary value of the transfer to be ¥84 millions, or about 1.3% of the total tradable value of the day-ahead market. Finally, we assessed the local market power in Guangdong, and argued that under heavy load, Guangzhou and Shenzhen, the political and economic centres of Guangdong, received electricity transfers from cities around, resulting in non-negligible local market power.

Guangdong's spot market pilot operations therefore bring us multiple lessons. First, market power needs to be firmly monitored and regulated, otherwise oligarchic conspiracy may take place and harm the benefit of small retailers. Second, the government's plan and policy need to be transparent and upfront, otherwise retailers' prior plans might be distorted and their long-term investment might be disincentivised. Third, a longer period of spot market pilot operation is desired and system operators should "let the market decide" - even though in May 2021 the retailers are losing, the hope was that if the spot market continues to operate for several months, their losses might be recovered. Finally, the price floor (and ceiling) needs to be gradually removed because a price floor harms consumers while benefits generators; on the other hand, a mechanism that can properly deal with extreme pricing is also needed to ensure the stabilisation of the market.

Contact
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Corresponding author: Bowei Guo, email: b.guo@ruc.edu.cn
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