

# What drives metropolitan electricity consumption in Guangzhou, China?

A number of studies have examined the relationship between electricity consumption and economic growth, but few have explored the links between electricity consumption, urbanisation, industrialisation, and economic growth. Dr Yiming He from South China Agriculture University has studied the relationship between these variables in Guangzhou, China. Using a large sample of data collected over an extended time period, Dr Yiming He's research makes an important contribution to the economic literature.

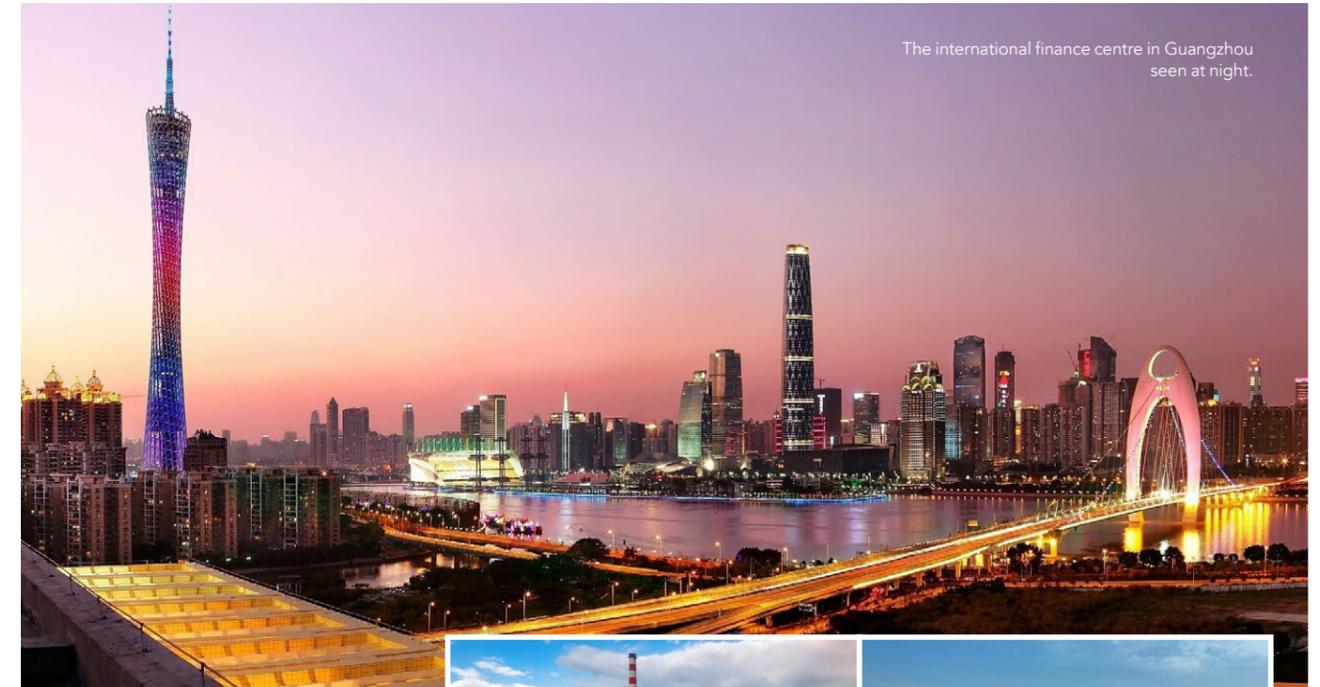
The research literature has identified four possible hypotheses on the relationship between electricity consumption and economic performance. The first hypothesis is known as the conservation hypothesis, which proposes that economic growth directly causes higher electricity consumption. In contrast, the second hypothesis, referred to as the growth hypothesis, suggests that electricity consumption causes economic growth over time, which is known as unidirectional Granger causality. This means that electricity consumption should be able to predict future economic growth. The third hypothesis is the feedback hypothesis, which proposes that electricity consumption and economic growth cause each other, known as bidirectional causality.

The fourth hypothesis, known as the neutrality hypothesis, suggests that there are no causal links between electricity consumption and economic performance. Despite a number of hypotheses, the relationship

between electricity consumption and economic growth remains unclear. This provided a key stimulus for Dr Yiming He's research based on Guangzhou in China.

## THE CONSERVATION HYPOTHESIS

Support for the conservation hypothesis has been reported in data from a number of countries. Previous research in India covering the time period from 1950 to 1997 found that economic growth directly causes higher electricity consumption, providing support for the conservation hypothesis. Similarly, in Malawi, increased GDP was found to cause higher electricity consumption between 1970 and 1999. Strong causality has been reported between economic growth and energy use in oil-exporting countries during the time period 1971–2002. Economic activity has also been found to cause higher electricity consumption during the time period between 1960 and 2008 in Pakistan. In addition, economic growth has been found to cause higher electricity



The international finance centre in Guangzhou seen at night.

consumption during the time period 1971 to 2009 in Portugal.

## THE GROWTH HYPOTHESIS

Mixed results have been reported relating to the growth hypothesis, with some studies reporting that electricity consumption causes economic growth but not vice versa. Others have found that electricity consumption and economic growth cause each other. Electricity consumption was found to cause higher GDP over time in Turkey between 1971 and 2000. Another study reported that electricity consumption caused higher income in Turkey during the time period 1950–2000. In addition, other research has found a causal relationship between electricity consumption and increased GDP over time but not vice versa between 1978 and 2004. Similarly, a study in Nigeria reported that electricity consumption caused higher GDP over time but not vice versa in the time period 1980–2006. Using data from 12 European countries, Granger causality from electricity consumption to GDP was found between 1970 and 2007. Electricity consumption was also found to cause higher GDP for former Soviet Republics during the time period 1990–2009. Similarly, electricity consumption was reported to have a long-term causal effect on GDP growth in 18 Latin American countries between 1980 and 2010.



Power plant in Guangzhou.



Urban development in Guangzhou.

## THE FEEDBACK HYPOTHESIS

A number of studies have found support for the feedback hypothesis. For example, data from Korea between 1970 and 2002 demonstrated a bi-directional causal relationship between electricity consumption and economic growth for the time period 1970–2002. Similar results were reported for the relationship

1971 to 2006, which means that each causes the other over time and each can be used as future predictors for the other. A bidirectional causal relationship has also been found between electricity use and GDP using Taiwan's quarterly data between 1982 and 2008. Similarly, research reported bidirectional Granger causality between electricity consumption

**The research literature has identified four possible hypotheses on the relationship between electricity consumption and economic performance.**

between electricity consumption and economic growth in Malaysia and Singapore between 1971 and 2002. In Malaysia, a bidirectional Granger relationship was found between electricity consumption and economic growth in South Africa during the time period

and economic growth for the time period of 1972–2009 in Pakistan. The same pattern was found between electricity use and GDP between 1968 and 2003 in Burkina Faso. Further support for the feedback hypothesis has been found between 1980 and 2010 in Bahrain.





Night lights around Pearl River in the 1950s.



Dr He's work examines electricity consumption in Guangzhou from 1950 to 2013.



Night lights on Pearl River in 2018. Image taken by Yiming He.

### THE NEUTRALITY HYPOTHESIS

The neutrality hypothesis has also received support from the research literature. In low income countries, it has been found that there is no causal relationship between electricity consumption and economic growth between 1972 and 2002. Similarly, in the Middle East and North African countries, no relationship was found between electricity consumption and the economic growth during the time period 1971 to 2006. Further evidence of the neutrality hypothesis was found in data from Turkey on non-renewable electricity consumption and economic growth between 1990 and 2012.

### UNANSWERED QUESTIONS

The relationship between electricity consumption and urbanisation has been extensively studied but evidence has so far been contradictory, making it difficult to draw firm conclusions about the potential causality and directionality between these factors. Researchers have tended to rely upon national level data, excluding many institutional factors,

which are significant in determining the relationship between electricity consumption and urbanisation. Literature focusing on electricity consumption and economic growth has also tended to exclude the potential effect of institutional reform, industrialisation and urbanisation. Furthermore, research has not investigated interactional relationships between electricity consumption, industrialisation and urbanisation and metropolitan economic performance. In response to these issues, Dr Yiming He sought to more conclusively establish the relationships between these four variables using data from Guangzhou in China.

### A FOCUS ON GUANGZHOU

Dr Yiming He used a number of statistical tests to explore the relationship between urbanisation, electricity consumption, and metropolitan economic performance in the city of Guangzhou in China between 1950 and 2013. Initial findings showed that there was a long run relationship between these factors. Specifically, he found cointegration,

which means that there is a link between urbanisation, electricity consumption, and metropolitan economic performance that remains consistent over a given period of time. Subsequently, Dr Yiming He investigated how these factors influence each other over both the short term as well as the long term.

It was found that there was unidirectional Granger causality from electricity consumption to GDP and over the long term, which means that electricity consumption can predict GDP over an extended period of time. In addition, unidirectional Granger causality was found from GDP to electricity consumption over the short term, meaning that increased GDP can predict electricity consumption in the short term. A bidirectional Granger causal relationship was found between urbanisation and electricity consumption, whereby each predicts the other. In addition, bidirectional Granger causality was found between industrialisation and electricity use in the short term, which means that each may be used to predict the other over a limited period of time. This research has helped to more definitively determine the relationship between electricity consumption, industrialisation and urbanisation and metropolitan economic performance, using realistic historic data spanning an extended period of time.

**Despite a number of hypotheses, the relationship between electricity consumption and economic growth remains unclear.**



# Behind the Research

## Dr Yiming He

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### Research Objectives

Dr He's work focuses on investigating the nexus between electricity consumption, urbanisation, industrialisation, and economic growth in Guangzhou, China.

### Detail

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### Bio

Dr He is a South China Agriculture University PhD, Professor and PhD Advisor, who won the Ten Thousand

Program of the national youth talent support project, national natural science twice, national social science three times, and China Scholarship Council visiting scholar program. He has published more than eighty papers on Man and the Economy and Energy Economics. Dr Yiming He is also the Ronald Coase Institute Young Fellow, Hong Kong Baptism University Adjunct

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### References

Yiming He and Shaohui Gao. 2017, "Economic Growth, Urbanization, Industrialization, and Metropolitan Electricity Consumption: Evidence from Guangzhou in China", *The Empirical Economics Letters*, 16(3):195-208.



### Personal Response

#### Were you surprised by the results you found in Guangzhou?

/// The empirical results are consistent with the expectation of economists. In terms of the long run, electricity consumption is an input to drive economic growth, according to New Classical economic growth theory. In the short run, electricity consumption is the function of output or income, based on macroeconomic consumption theory. //