Economic Cycles and the Responsiveness of Natural Gas Demand in China's Residential Sector – An Unobserved Components Model

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Overview

Currently, China's 13th Five-Year Plan promotes the use of natural gas and China's government provides consistent regulatory support to increase its consumption. The goal is to fulfil the dual objectives of its Energy Development Action Plan: (a) to increase the share of natural gas in energy demand to at least 10% by 2020, and (b) to reduce coal consumption, thereby decreasing pollution levels and achieving a cleaner energy mix. China is the sixth-largest producer and the third-largest consumer of natural gas in the world and is a vital player in global energy markets as both an importer and an investor. Accordingly, implications of China's Energy Development Strategy Action Plan for 2014–2020 are unlikely to be limited to the domestic economy and will potentially have global spillover effects.

If consumption actually grows at the rates required to achieve the announced targets in the13th Five-Year Plan,[1] natural gas imports and production, and investments in infrastructure (i.e., shipping terminals, pipelines, and power plants) must increase along with it. These changes will certainly affect both domestic investment and prospects for exporting hydrocarbons to China. Foreign investment in the country's energy sector and China's investments abroad also will be affected.

In the previous Energy Plan, the target was for natural gas consumption to reach 7.5% of energy consumption in 2015. However, this target was not achieved. To achieve the target in the current plan, China's government has been encouraging the use of natural gas over substitutes such as coal to decrease the risks of oversupply. Authorities also are seeking to avert the re-occurrence of the gas shortage that took place in 2015, which required the government to impose caps on residential users' consumption.

The objective of this research is to examine China's demand for natural gas and estimate price and income elasticities for the residential sector.[2] Understanding the trends, variations, and determinants of the demand for natural gas in China is vital to predict the success of the 2020 plan and comprehend its likely impact on China's economy and the international economy as well as the potential to export resources to the Chinese market.

Chinese macroeconomic data are characterized by the coexistence of trend drifts and cyclical swings (Chang et al., 2015). A Five-Year Plan could trigger a longer cyclical swing as with the 8th National People's Congress in 1996, which passed a long-term plan to bolster heavy industry (Chang et al., 2015). The 8th National People's Congress's long-term plan was associated with an increase in urbanization and infrastructure development, which have contributed to the increase in natural gas consumption. Chang et al. (2015) noted a lack of empirical research on trends and cycles in China's macroeconomy. Existing studies on China's energy consumption are primarily limited to primary energy consumption and electricity consumption. To my knowledge, only Wang and Lin (2014) have applied time series analysis and Yihua et al. (2014) have used unbalanced panel data to study national natural gas demand in the residential sector. Wang and Lin's (2014) error correction model (ECM) was non-stationary, Yihua Yu et al. (2014) panel analyses covered only 2006 to 2009, and none of them accounted for cycles. This paper contributes to the literatures on natural gas demand and trend-cycle decomposition in China.

In Wang and Lin's (2014) model, the adjustment term is positive and insignificant, indicating a non-stationary relationship. Similarly, the results from my initial analyses - which included applying an ECM and a fully modified ordinary least squares (FMOLS) model – show that the model is non-stationary. Therefore, I apply an unobserved components model (UCM).

The residential sector's natural gas demand has been rising rapidly since the mid-1980s (Higashi, 2009; Yang et al., 2014). Its share of natural gas consumption increased from approximately 1% in 1980 to approximately 18% in 2016 (Author's calculations using CEIC series 3740601 [CBVHIH] and 3731601 [CBVGH]). This highlights the importance of studying the sector's demand for natural gas. Residential energy consumption in China ranks second behind the industrial sector; urban households represent the lion's share of residential consumption due to the construction of urban pipeline networks (CEIC, n.d.;Wang and Lin, 2014; Zhao et al., 2011). Hence, I focus on urban China in my examination of residential natural gas consumption.

[1] China's consumption of natural gas in 2025 is expected to be more than double that estimated for 2015 (Ratner et al., 2016).
[2] Research on the industrial sector is dealt with in a separate paper and is in process.

Methods

The residential demand for natural gas has been driven mainly by income growth, urbanization, and low prices (Wang and Lin, 2014). My analysis focuses on estimating the responsiveness of urban residential demand for natural gas to changes in price and income. Using data from CEIC, I: (a) calculate the ratio of "Natural Gas Consumption: Residential" to the urban population as a measure of per-capita residential consumption of natural gas in urban China[3]; (b) use "Disposable Income per Capita: Urban" as a measure for income and deflate it by the urban retail price index; and (c) employ "Service Price: 36 City Average: Pipe Natural Gas: for Resident" as the price variable and deflate it by urban consumer price index. I apply a UCM to to address non-stationarity and data restriction issues. I allow for a stochastic trend to capture the effect of changes in government policies, economic institutions, socioeconomic factors, and technical progress; and incorporate short- and mid-term stochastic cycles to account for the impact of the Five-Year Plans and business cycles.

Results

Natural gas is a normal good for households in urban China. The estimated value of income elasticity is not statistically differenet from unity Such a high income elasticity suggests that natural gas for urban consumers tends to be a comfort good, which provides a good-quality standard of living, and is neither a necessity nor a luxury good. The value of price elasticity is approximately 0.52. These results suggest that natural gas does not represent an essential good for consumers in urban China during the time sample. The estimated mid-term cycle captures the 1999 trough in China's economic cycle (Yamasawa, 2008) and the peak in 2012 that aligns with the economic slowdown which began in 2013 (Chang et al., 2015). This is in line with concerns discussed in the 18th National People's Congress in 2012 with regard to low consumption, investment and income growth and low labor share of income (Chang et al., 2015). This shows that the model reasonably mimics China's economy and residential demand for natural gas in urban areas. Hence, this derived cycle can be considered a business cycle indicator. This finding shows that knowledge about Five-Year Plans and economic cycles is integral to comprehending China's economy and potential for natural gas export market.

Conclusions

I find that natural gas is a normal good that is price-sensitive and approximately unit income-elastic, which reveals its substitutability. The cyclical effect manifested in increased infrastructure development has been integral to the rise in demand. For demand to be more responsive to price and income changes and for the cleaner-energy-mix target to be achieved, government policies to incentivize the use of natural gas vis-à-vis substitutes such as coal and environmental regulation are vital. The message to natural gas exporters is the market for natural gas in China is still under development. Households' demand is increasing but so far is still maturing. Further environment regulatory reform and investment in infrastructure are key drivers to growing demand for natural gas. A business cycle indicator is a useful measure of the direction of change in demand and infrastructure development given data limitations in China.

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[3] Data that would enable urban and rural demand for natural gas to be separated are unavailable. However, as discussed, residential demand for natural gas is primarily in urban China.