Short- and long-run effects between oil consumption and economic growth in China

Gaolu Zou[a],*, K.W. Chau[b]

[a]*Faculty of Resources and Environment, Sichuan Normal University, Chengdu, Sichuan 610068, China*
[b]*The University of Hong Kong, Hong Kong*

Available online 13 September 2005

Abstract

This paper examines both the equilibrium relationship and the predictability between oil consumption and economic growth in China. Time series variables are employed in empirical tests. Cointegration tests suggest that these two variables tend to move together in the long run. In addition, Granger causality tests indicate that oil consumption could be a useful factor that forecasts changes in the economy in the short run as well as in the long run. The oil consumption is found to have great effects on the economy. This is because the enormous use of oil in sectors like the industry may have directly pushed the economy. However, this finding would probably stimulate faster growth in oil consumption and so should be concerned with care. Conversely, economic growth could be used as a predictive factor forecasting oil consumption only in the long run. Economic growth appears to have small effects on oil use; this could be attributed largely to China's energy consumption structure. Coal constitutes most of the energy consumption and thus the considerable demand for energy resulting from rapid economic growth could be mostly explained by the mass use of coal.

0. Introduction

China initiated its reform and open-door policy to the outside world in 1979. The economy has since then experienced fast growth, with growth rates averaging around 8 percent over the past two decades (Table 1); and China's economic size has expanded substantially as well. Meanwhile, oil consumption has grown rapidly; it has for instance increased at an annual average rate of 5.77 percent in recent years (He, 2003). China has presently acted as the world's second largest oil consumer after the United States. On average China's oil consumption accounts for 17–24 percent of its total primary energy use (National Bureau of Statistics of China, 2004). In addition, oil use has far outpaced oil

supply and thereby leading to rapidly increasing net oil imports. In 1993, China became a net oil importer and up to now its oil imports have ranked third after the United States and Japan in the world. In 2003, China imported 128.3 million tons of oil (making up nearly 46 percent of domestic oil consumption), of which 91.1 million is crude oil. In 2004, China imported 120 million tons of crude oil (General Administration of Customs of China, 2005).

1. Literature and objectives

Growth in the oil consumption in China seems to have kept pace with the rapidly expanding economy. The interaction between the oil consumption and the aggregate economy is deserved to be examined. In the literature regarding the interactions between energy and/ or oil consumption and economic growth in China,

*Corresponding author. Tel.: +86 288 476 1028.
E-mail addresses: zougaolu@vip.163.com (G. Zou), hrrbckw@hkucc.hku.hk (K.W. Chau).

Table 1
Growth rate of China's GDP over preceding year

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	9999	2000	2001	2002	2003
Growth rates (%)	3.8	9.2	14.2	13.5	12.6	10.5	9.6	8.8	7.8	7.1	8	7.5	8.3	9.3

Source: National Bureau of Statistics of China (2004).

many studies have focused on forecasts for demand for energy, in which the forecasts for oil demand can be sporadically found. Some forecasts for oil consumption in the literature have depended on the argument that it is the economic growth or related economic factors like price and tax that cause changes in oil consumption. Along with these oil demand forecast studies, the strategy of oil consumption has frequently been discussed.

Regarding the effects of economic factors on energy or oil consumption, as early as in 1996, Chan and Lee use a cointegration and vector error-correction model (ECM) to make forecasts for China's total energy use, suggesting that energy price and income, and the share of heavy industry output in the national income as well, are significant factors that predict China's energy consumption. A research report released by Ministry of Communications of China (2003) claims that over the past 10 years, China's rapid economic growth, together with quick economic restructuring, have led to fast growth in crude oil consumption, with an annual average growth rate of more than 6 percent. While the Chinese economy goes into a crucial phase of completion of the industrial restructuring in the coming 5–10 years, its crude oil consumption would be forecasted to grow at an annual average rate of some 4 percent. The most recent important contribution to this literature is made by Crompton and Wu (2005). By using GDP in the Bayesian VAR system designed to capture the derived nature of energy consumption in domestic production, Crompton and Wu study China's energy consumption over the period 1956–2003. They forecast that China's oil consumption would grow at an annual average rate of 4.5 percent over the forecast period 2004–2010.

On the other hand, a few other studies examine the effects of oil and/or total energy consumption on economic growth. Zhu (2003) claims that until natural gas, nuclear energy and hydroelectricity are "fully" developed and used in China, reduction in the share of oil consumption in total energy and the containment to oil use may have a negative effect on China's economic development. Han et al. (2004) finds that bidirectional Granger causalities exist between total energy consumption and GDP over the period 1953–2002. They argue that China's continuous and stable economic growth tends to depend on increasing energy supply.

In addition, Wei (2002) detects a long-run relationship between total energy consumption and changes in some main economic factors like price, income and heavy industry's output in China. Shiu and Lam (2004) suggest that China's real GDP and electricity consumption are cointegrated and electricity consumption Granger causes real GDP but not vice versa.

However, the past studies shown above have little examined whether economic growth is a predictive factor of oil consumption and/or vice versa. A currently available good but not best solution to this problem is to study the predictability between time series variables by performing Granger causality tests before the forecasts (Granger, 1969, 1988; Luetkepohl, 1993), and study their cointegrated or long-run equilibrium relationships if necessary (Engle and Granger, 1987). In addition, the forecasts in some past studies in the literature have in general not distinguished between short-run dynamics and long-run equilibrium, possibly existing between oil consumption and economic growth. So these studies may have drawn inexact conclusions particularly where GDP series are used to perform forecasting. This is because there may be short- and/or long-run Granger causal or predictive relations between two time series variables. On the one hand, the forecast conclusion is doubtful, if a short-run (say several years) forecast is conducted where there is no short-run Granger causalities between these two variables. On the other, the forecast conclusion may still be arguable, if a long-run (say tens of years later) forecast is conducted where there are neither long-run equilibrium nor long-run Granger causal relationships.

Therefore, this paper attempts to examine the predictability, and the long-run equilibrium relationship between oil consumption and economic growth. In order to do so, both cointegration and Granger causality tests will be performed, in which short- and/or long-run Granger causalities and elasticities will be recovered in vector autoregressive (VAR) or in error-correction (EC) frameworks where required. In addition, the discussion in this study will focus on the period after the mid-1980s. This is because China has since then gone into an era of market-oriented economy and thereby leading to fast economic progress and the increasing use of oil. The study based on the market economy (irrespective of its imperfectness) will improve our understanding of the mutual effects between oil consumption and the economy, thereby having practical