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How does coal price drive up inflation? Reexamining the relationship between coal price and general price level in China

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ABSTRACT

Due to the coal-dominated energy structure, China is currently facing significant economic uncertainties brought forward by instability of coal price. By separating the asymmetric effects that how upward and downward coal price changes pass through to the economy, this paper reexamines the relationship between coal price and general price level in China. The asymmetric effects are investigated via vector autoregression models, Granger Causality tests, and impulse response function analyses using the monthly time series data from Jun-98 to Sep-14. Results show negative coal price change presents more significant impact on inflation than positive one. The inflation responses very abruptly to coal price shock in the short run, but the impact regresses rapidly along time. Accumulatively, a 1% increase of coal price will push CPI and PPI up by 0.04% and 0.12%, while a 1% decrease of coal price will pull them down by 0.08% and 0.17%, respectively. The linkage among coal price change, PPI, and CPI is demonstrated as the main transmission channel of price shock. The inflationary effect is strong in the initial stage, but will be weakened in the later stage since the pass through effect from PPI to CPI is tiny, which confirms PPI is more responsive than CPI to coal price change. For policy implications, how to avoid extreme volatility in general price level is a major concern of recent agendas such as reforming energy market and building green fiscal system.

1. Introduction

Considered as one of the major causes of macroeconomics uncertainty in at least industrial countries, the dramatic fluctuation of energy price has obtained more and more attention from both policy makers and researchers. Particularly, based on the fact that crude oil plays a pivotal role in the energy mix of many countries, a series of studies were conducted to examine the economic impact of crude oil price change. By employing the Phillips curve model, Hooker (2002) and LeBlanc and Chinn (2004) found that increase in oil price results in modest inflation effect in the United States, Japan, and some European countries. Berument and Tasci (2002) suggested that the oil price increase might, in some cases, lead to hyperinflation, if wages, profits, interest, and rent earnings are flexible in Turkey by constructing an input–output model. Doroodian and Boyd (2003) showed while the external shock has fairly severe effect on energy commodities, the aggregate price level change can be significantly dissipated over time by running a computable general equilibrium (CGE) model. Jiménez-Rodríguez (2008) estimated the dynamic effects of oil price shock on the output of the main manufacturing industries in six OECD countries via bivariate vector autoregression (VAR) model. In spite of the different concerns of studies, a generally accepted conclusion is that crude oil price change would pass through into the macro-economy.

Recognizing the asymmetric pass-through mechanisms, the different impacts of oil price increase and decrease were emphasized in many studies (An et al., 2014; Burbidge and Harrison, 1984; Cuñado and Pérez de Gracia, 2003, 2005; Darby, 1982; Hamilton, 1983, 1988, 1996, 2003; Huntington, 1998; Jiménez-Rodríguez, 2008; Kilian and Vigfusson, 2011; Lee et al., 1995; Mehrara, 2008; Mork, 1989; Mork et al., 1994; Mory, 1993), most of which concentrated on the debate that economic performance is considerably worsened by negative oil price shock (i.e., price increase), but positive oil shock (i.e., price decrease) has very limited effect in stimulating economic growth. The increasing oil price was even identified as the major driving factor of the economic recessions in some industrialized countries after the World War II (Bruno and Sachs, 1985; Burbidge and Harrison, 1984; Darby, 1982; Hamilton, 1983).

As the largest energy consumer in the world, China is at risks from unexpected energy price shock along with its increasing energy demand. Yang and Li (2006) detected a long-term relationship among energy price, economic growth, and inflation. And they regarded increase in energy price as a key reason for inflation during the period of 1996–2005 in China. By employing input–output model and structural vector autoregression (SVAR) model, Lin and Wang (2009) studied the effects of energy price fluctuation on general price level. According to their

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results, an impulse of standard deviation scale in energy price drives PPI up by 0.24% in the first month, and the impact would further rise to its maximum of 0.57% in the sixth month. Zhang and Wang (2014) suggested that energy price shock would lead to macro-economic volatility more easily in the short run.

China relies heavily on coal in its energy mix compared to the industrialized countries, e.g., coal contributed to around 75% of the total energy production and 68% of the total energy consumption in 2012.[1] As a result of the coal-dominated energy structure, China is facing significant economic uncertainty brought forward by coal price fluctuation. Particularly, due to the uncoordinated regulations on the coal and the power sectors, increase in coal price raises the risk of electricity shortage and enterprises' loss (Peng, 2011). Therefore, understanding the relationship between coal price change and the macro-economy is of great importance to the government as well as enterprises.

In China, the pricing mechanism of coal has experienced multiple stages from the central government planned to entirely market-oriented. The market mechanism was first introduced after the 'reform and opening up program' initiated in 1978. With a looming demand–supply gap in the coal market, the system of dual track pricing was then introduced in 1992 as an incentive to increase coal output. Under the dual track pricing system, the coal output is divided into unified distribution coal and non-unified distribution coal. The price of non-unified distribution coal is determined by the market based on the supply–demand relationship. For unified distribution coal, a guidance price is set by the National Development and Reform Commission (NDRC), which is usually lower than the prevailing market price of non-unified distribution coal. While the state-owned coal mines have the capacity to produce more than the unified distribution quota they are designated, they can either: (1) provide the extra output to the government in a price 50% (later set to 70%) higher than the guidance price, or (2) sell them as non-unified distribution coal in the market. The guidance price policy was abolished in 2002, when the NDRC set price bands for negotiations between coal producers and coal-fired power plants (who are the major coal consumers in China) (Peng, 2011; Zhang, 2014). On the other hand, when the coal price was mainly determined by the market, the electricity tariff in China was then strictly regulated by the government. Having identified that the fact the increasing coal price in the early 2000s would increase cost and reduce profitability of coal-fired power plants, the NDRC proposed a 'coal-electricity price co-movement' mechanism to help ease the risk of electricity shortage in 2005.

The dual track pricing system was entirely abolished in 2013. To ensure that the coal price fluctuation transmits through the economy smoothly, the 'coal-electricity price co-movement' mechanism was revised, according to which power plants can pass up to 90% of the increased fuel costs on to grid companies if coal price rises by 5% or more in 12 months.[2] At the same period, the government also launched reform on the power sector to address the concerns of inflation, electricity shortage, price acceptability, business loss, and energy-related expenditure, which were the main issues of concern in the last decade with large coal price volatility. To the best of our knowledge, there are nevertheless very limited existing studies that center on this particular field. Lin and Mou (2008) argued that energy price shock would impede economic growth of China via inflationary pressure and industrial contraction effects. Especially, the effect of coal price shock is greater than that resulted from oil price change. Using an input–output model, Chen (2014) showed that 5%–25% of the general price level change in China between 2007 and 2011 were attributed to coal price shock which is measured by real coal price instead of hypotheses in the previous studies.

Nevertheless, the aforementioned two studies neglected the asymmetry pass-through effects of energy price change in China, which is especially important for coal: when over a half of the coal is used in thermal power plants, the electricity tariff adjustment is more responsive at the margin to rising than declining coal price (Liu et al., 2013). Hence, the impact mechanism of increasing coal price is different from that of decreasing price. This paper contributes to the existing literature by reexamining the relationship between coal price change and general price level in China in three major respects. First, this study applies the VAR model with monthly time series data from Jun-98 to Sep-14 in China, which contains more information to reflect detailed coal price volatility compared to the CGE and input–output models. Second, China's coal market experienced two important stages of reform in 2002 and 2013, and an exogenous shock from Global Financial Crisis in 2008. This study tests the structural breaks in the coal price series and the VAR models. It is helpful to understand the economic impacts of those important events. Third, this study identifies the asymmetric effects introduced by positive and negative coal price changes using the nonlinear transformation measure. The main finding of this study is that the coal price-inflation interaction in China is positive and asymmetric: negative coal price change has more significant impacts on general price level than positive one, and short term volatility is more likely to be introduced. Since the recent energy market reform synthesizing market liberalization, environmental tax, and carbon tax tend to push up coal price, the asymmetric mechanism helps moderate the inflationary concerns. But policy makers still need to design the reform prudently in order to avoid extreme volatility in the short term.

The rest of this paper is organized as follows. Section 2 offers the analytical framework and data description. Section 3 gives structural break tests and unit root tests of data series. Section 4 presents empirical results, discussions, and robust tests. The final section provides conclusions.

2. Methodology

Lately, many papers have examined the asymmetric effects by VAR model with nonlinear transformation of energy price. However, Kilian and Vigfusson (2011) claimed that the asymmetric models of the transformation of energy price shock would lead to the parameter estimates inconsistent and inference invalid in price and economic output relationship because of fundamentally miss specified whether the data-generating process is symmetric or asymmetric. In order to avoid criticism about miss specification, first, this paper includes PPI and CPI reflecting the general price level rather than focusing on the relationship between energy price and economic output, such as GDP or GDP growth rate. Second, before traditional unit root tests and VAR model analyses, structure break tests proposed by Perron and Yabu (2009) is used to identify the characteristics of data-generating process. It is helpful to specify attributes, such as structural breaks reflecting symmetric or asymmetric trend, and unit root, contained in the series. Third, the positive and negative changes in coal price are included in the same VAR system, instead of giving a zero weight to energy price decrease in many previous studies.

2.1. VAR model

The traditional VAR model is shown as below.

$$\begin{aligned} Inf_{CPI,t} &= CPI_t - 100, CPI_{t-1} = 100 \\ Inf_{PPI,t} &= PPI_t - 100, PPI_{t-1} = 100 \\ \Delta price_t &= \ln price_t - \ln price_{t-1} \end{aligned} \tag{1}$$

$$\begin{aligned} Inf_{CPI,t} = \alpha_1 &+ \beta_{11} Inf_{CPI,t-1} + \beta_{12} Inf_{CPI,t-2} + \ldots + \beta_{1p} Inf_{CPI,t-p} \\ &+ \gamma_{11} \Delta price_{t-1} + \gamma_{12} \Delta price_{t-2} + \ldots + \gamma_{1q} \Delta price_{t-q} + \varepsilon_t \end{aligned} \tag{2}$$

[1] Source: IEA, http://www.iea.org/statistics/statisticssearch/report/?country=China&product=balances.

[2] Source: State Council, http://www.gov.cn/zwgk/2012-12/25/content_2298187.htm.