Providing Low-Sulfur Fuels for Transportation Use: Policy Options and Financing Strategies in the Chinese Context[1]

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Introduction

Good fuel quality is an essential component of any strategy to reduce air pollution from transportation sources. Studies have found that the benefits of clean fuels, in combination with stringent standards for new vehicles, greatly outweigh the costs. Because improving fuel quality requires significant investments to upgrade refineries, a key question for government policymakers is to determine how refinery upgrades will be paid for to meet standards for low-sulfur fuel. The capital costs to improve the refineries are certainly large, but refiners have been able to recover these costs through slightly higher fuel prices or with the help of innovative financing arrangements and/or government assistance.

The sulfur levels in Chinese fuels are high by international standards. Sulfur levels in diesel fuels were 2000 ppm and 800 ppm in gasoline fuels through 2005. In 2005, a new standard took effect requiring sulfur levels to be no higher than 500 ppm for gasoline nationally, and 350 ppm in Beijing as of July 1. It is well known that Chinese domestic crude oil is typically low in sulfur, which is why most of China's refineries are not equipped to desulfurize crude oil. In 2004, China became the fourth-largest importer of oil in the world, at 2.4 million barrels per day, and most of these crude oil imports were high in sulfur, resulting in high-sulfur refined products available to consumers.

This short paper is intended to outline the primary policy options available to the Chinese government to ensure that low-sulfur fuels become widely available in China to provide cleaner air and the ability to deploy more advanced vehicle technology. The paper will review options for how China could support refineries, either through pricing mechanisms, tax incentives, direct subsidies, or innovative financing mechanisms, and the advantages and obstacles to each option will be discussed. Brief case studies of how other countries handled these issues are reviewed. The feasibility of the policy options in the Chinese context is assessed.

Background

Transportation is an important and growing source of air pollution in many of the world's major cities, and especially in China. During the past 20 years, motor vehicles have emerged as a

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leading source of air pollution in China's large cities. During the 1990s, sales of new automobiles grew on average 27 percent annually in China, resulting in a doubling of the number of passenger vehicles on the road every two and a half years (CATARC 2004). This rapid growth in the number of cars on the road is causing air pollution to rise, and increasing the costs associated with delay in improving vehicle technologies and providing cleaner fuels.

Improving fuel quality is a critical component in any effective, long-term strategy to reduce pollution from transportation sources because low-sulfur fuels ensure the effectiveness of emission-control technologies in vehicles and reduce harmful air pollution (EPA 1999). Lead and sulfur are the most critical components of fuel quality in terms of their effect on human health. Eliminating use of lead additives in gasoline not only eliminates lead emissions but also allows for use of catalytic converters to control conventional pollutant emissions: hydrocarbons (HC), carbon monoxide (CO), and nitrogen oxides (NO_x). Most countries have already eliminated the use of lead additives in their gasoline supply, which has generally required upgrading refineries to produce a higher octane product. At the present time, approximately 90 percent of all gasoline sold in the world is lead-free, and efforts are underway to completely eliminate the use of leaded gasoline.

Unlike lead, sulfur is a naturally occurring component of crude oil. Reducing sulfur from gasoline and diesel directly reduces emissions sulfur compounds, including sulfur dioxide (SO_2) and sulfate particulate matter, and allows for the introduction of advanced pollution-control technologies. Many foreign vehicle manufacturers have not transferred better pollution-control technologies to China partially because they know that they would be rendered ineffective by China's relatively dirty fuels (Gallagher 2006). The transfer of near-zero emitting, energy-efficient technologies such as those contained in hybrid-electric vehicles (HEVs) is also hindered by poor fuel quality in China.

Near-zero sulfur fuels are a necessary precondition for making stringent vehicle emissions standards effective, and for introducing retrofit technologies for in-use vehicles so that they pollute less. For example, near-zero sulfur fuel is required by diesel particulate filters, which are rendered inactive by sulfur. The most advanced three-way catalysts also require near-zero sulfur fuel in order to achieve certification levels in Europe, Japan, and the United States. NO_x controls for diesel vehicles and other lean-burn engines may also require near-zero sulfur levels. At the same time, reducing sulfur can have a dramatic impact on emissions from unimproved existing vehicles.

Emphasizing that the critical role that clean fuels must play in a comprehensive emissions control system, the Asian Development Bank (ADB) has written, "The elimination of lead in gasoline as well as the dramatic reduction (if not virtual elimination) of sulfur from both gasoline and diesel are now well established elements of clean fuels programs. The major lesson of the past twenty-five years with regard to the components is to move quickly" (ADB 2003).

Government Policy Options

Government can help refineries make the transition to low and no-sulfur fuel by providing certainty about standards over the long term. Having clarity about future regulations provides refineries with the flexibility to incorporate future standards into their planning and scheduled maintenance and upgrades. This ability to plan around future standards reduces unnecessary costs to refiners. This paper assumes that the government sets a performance standard for low-sulfur fuel. Once this standard has been set, a number of economic and fiscal tools exist to help refiners and consumers shift to lower-sulfur fuels.

Supply-Side

On the supply side, the government has a fundamental choice about whether or not to provide financial support to refiners to help them upgrade to produce low to zero-sulfur products. Governments around the world have chosen a variety of approaches from providing no direct financial support (e.g. United States and Europe) to providing substantial support (e.g. Japan) to refineries.

If the government does not provide financial support, refineries must either pass on the costs of the upgrades to consumers or accept substantially lower (or negative) profit margins. This has implications for government revenues because tax revenues might also be reduced as a result of lower firm profits (but it depends on the tax structure of the country).

If the government decides to provide financial support, it can do so by providing direct subsidies or grants to refineries to help pay for the upgrades. Alternatively, it can offer low or no-interest loans to refineries, tax incentives (e.g. deductions) to refineries, or accelerated depreciation on purchased equipment.

Demand-Side

To stimulate demand for low-sulfur fuels by consumers, governments can provide tax incentives for low-sulfur fuels to encourage consumers to switch to low-sulfur fuels. Efforts can be made to make the tax incentives revenue neutral by charging more for high-sulfur fuels, but since tax incentives have proven to be very effective at changing consumer behavior, it may be hard to generate tax revenue from high-sulfur fuels if consumers do not buy them due to their higher cost. If a higher tax is charged on the higher sulfur product but the same tax is maintained on the lower sulfur product, the tax revenue should be unaffected or even slightly positive. In the short run, therefore, government revenues from the fuel taxes may be reduced. These losses can either be compensated for by imposing an equivalent tax elsewhere, or the tax can be re-imposed once high-sulfur fuels are no longer available on the market.

Another option for stimulating demand from consumers is to launch a government and/or company-sponsored public education campaign about the health and environmental benefits of cleaner fuels.

Review of International Experience in Financing Refinery Upgrades to Reduce Sulfur

United States of America (USA)

The United States has used a strictly regulatory approach to achieve very clean fuels. The U.S. Environmental Protection Agency (EPA) passed regulations requiring low sulfur gasoline by 2006 (average 30 ppm sulfur, with an 80 ppm cap), ultra-low sulfur highway diesel (phased in from 2006-2009), and non-road diesel (15 ppm sulfur maximum) by 2010. Prior to promulgation of these standards, sulfur was allowed to be up to an average of 300-350 ppm in gasoline and a maximum of 500 ppm in highway diesel (and 3,000 ppm in non-road diesel). Refiners are expected to comply with these regulations with no fiscal help from the government.

Market mechanisms are included in EPA's rule to help reduce the costs and to ensure that sufficient quantities of the near-zero sulfur fuels are available during the phase-in. Credits can

be traded or sold between refiners, offering flexibility in how targets are met and helping to reduce compliance costs.

Near-zero sulfur gasoline, which already comes in several grades, will be phased in over six years, with a few refiners receiving extensions. Because highway diesel is currently only available in a single grade and misfueling is a serious concern, an oversupply of near-zero sulfur diesel will be necessary to ensure that it is always available for use in new vehicles meeting the stringent 2007 standards. The phase-in period is shortened to four years for diesel and EPA found that if 80 percent of the highway diesel sold met the 15 ppm sulfur cap there would be sufficient incentive for truck stops to carry that grade and for the fuel to be made available wherever it was needed (EPA 2002).

Several mechanisms were included in the rule to increase flexibility for small refiners, giving them more time to set up financing arrangements, and providing mechanisms to increase the return on investment. Small refiners are given more time to meet the standards or, if they are able to meet the standards on time, they may generate credits, which can be sold to other refiners to help offset costs. Small refiners were also offered the option of meeting the diesel standards at the beginning of the program and extending the deadline for gasoline standards for another three years.

Together with the accompanying tailpipe emission standards, EPA estimated that the total cost of these requirements for reducing sulfur from gasoline alone would be about $5.3 billion and that the health and environmental benefits would be $25.2 billion. For consumers, the cost was estimated to be less than $100 for cars and less than 2 cents per gallon of gas, not including operating costs (EPA 1999).

India

India is ahead of China in terms of mandating reductions in sulfur from transportation fuels. As of 2005, India is requiring that 150 ppm fuel be provided to 11 of the biggest cities and 500 ppm fuel be available nationally. India has also set a standard to be achieved in 2010 of 50 ppm for the 11 cities, and that the nation will be at 150 ppm by that year. India has 17 refineries (15 of which are publicly owned) and the total capacity of all the refineries was 116 million metric tons for petroleum products per year as of 2002 (Government of India 2005).

In August 2001, the Prime Minister of India established a Commission to formulate an *Auto Fuels Policy* for the country together with a road map for implementation. The Commission released its report one year later, and came to the conclusion that it was essential to establish a timetable and fiscal mechanisms for the reduction of sulfur from Indian fuels in order to address India's air pollution problems. The Commission estimated that for the existing refineries to be able to meet a 150 ppm standard for 11 cities and 500 ppm standard nationally by 2005, investments of Rs. 18,000 crore (US$4.1 billion) would be needed. To meet a 50 ppm standard for 11 cities and 150 ppm standard nationally by 2010 would require an additional investment of Rs. 12,000 crore (US$2.7 billion). To achieve EURO III quality fuel throughout the country, the estimate is that a total Rs. 50,000-60,000 crore (US$11.5 billion-$13.8 billion) would be required. Because some refineries in the north-eastern part of the country would not be able to make those investments, the Commission recommended that the government provide one-time assistance to help them remain competitive. The Commission also felt that fiscal support in the form of lower import duties might be helpful to the refineries who were importing crude oil. Price distortions in fuels (i.e. the higher tax on gasoline than diesel) were recommended to be abolished and put in line with international prices. In 2001-2002, taxes on crude and petroleum

products contributed approximately Rs. 35,000 crore (US$8 billion) to the central government. Taxes on auto fuels and vehicles contributed another Rs. 13,000 crore (US$3 billion) (Mashelkar 2002). Most of the recommendations of this Commission were accepted by the government with the notable exception that the fiscal assistance recommended for the refineries was rejected by the government (Financial Express 2003).

Japan

Japan has adopted the strictest fuel quality standards in the world. Ahead of the standard that is required in 2007, Japanese refiners started supplying gasoline and diesel that contain 10 ppm of sulfur, down from 50 ppm at the beginning of 2005. Japanese refiners spent 300 billion yen ($2.92 billion) to upgrade their facilities to meet these stricter standards and they did so before the government requirement because the upgrades were made during regular maintenance cycles and because subsidies were available to early movers.

In 1990-1992, the Japanese government instituted a direct tax incentive to subsidize refinery investments for reducing sulfur in diesel fuel below 2000 ppm. Refineries had a choice of a 7 percent deduction in corporate tax or a 30 percent accelerated depreciation on the purchased equipment. These policy tools were employed again from 1993-1997 when Japanese refineries reduced sulfur in diesel fuels to 500 ppm. To reach the current 10 ppm levels in diesel, the Japanese government allocated 5.2 billion yen as a cash subsidy, allocated on a first-come first-serve basis to encourage companies to comply early. The funds came from the "Oil and Energy Conservation Fund" (Boyle 2004).

United Kingdom (UK)

The United Kingdom (UK) mainly used consumer tax incentives to ease the switch to low-sulfur fuel. First, the duty for ultra-low sulfur diesel (ULSD) was reduced by 1 pence/liter (2 US cents/liter) in 1997 compared with the price for ordinary diesel, with an additional pence added each year up to 3 pence/liter (5 US cents/liter) in 1999. With the original incentive level, a small supply of ULSD was made available in urban areas. When the tax incentive reached 2 pence/liter (3 US cents/liter), ultra-low sulfur diesel reached almost 100 percent penetration with an estimated cost to the government of £400 million at the time (US$696 million at current exchange rates). This loss must be considered in the context of overall escalated fuel duties, which raised overall government revenue substantially. Incentives for clean fuels were accompanied by another policy which awarded Reduced Pollution Certificates (RPCs) to trucks and buses meeting stringent emissions regulations. These RPCs provided vehicle operators with significantly lower vehicle excise duties, which in turn provided a substantial incentive for vehicle manufacturers and operators to invest in advanced pollution-control technology. In 2000, the UK introduced a 1 pence/liter tax differential for ultra-low sulfur gasoline. The UK estimated PM emissions reductions of 21 percent and NOx emissions reductions of 2 percent for the tax differential for low-sulfur diesel alone (Olivastri 2000).

Other European Countries

In the European Union, standards were set to gradually reduce sulfur levels over time. Like in the United States, refineries did not receive financial assistance to upgrade refineries from the government, but policies were designed to give the refineries time and flexibility to achieve the goals. Sulfur levels are currently allowed to be 350 ppm in highway diesel and 150 ppm in gasoline and are scheduled to be reduced to a uniform 50 ppm in 2005, with a 10 ppm uniform

sulfur standard phased in from 2005 to 2009. In addition, many individual countries have used tax incentives to encourage the early introduction of low and ultra-low sulfur fuels.

Cities and countries have also maximized the benefit of the clean fuels by requiring or providing additional tax incentives for pollution control devices. Denmark and Finland both had success in moving the market completely from 500 ppm to 50 ppm sulfur diesel with the introduction of tax differentials amounting to approximately 2-3 US cents/liter. In consultation with refiners, the government of Denmark found that a tax incentive of 0.09 DDK/liter (1 US cent/liter) would result in 100 percent market penetration of low sulfur fuels. The government reduced tax by this amount for ULSD and increased tax by this amount for high sulfur diesel, resulting in a differential of twice the recommended amount. The incentive was introduced on June 30, 1999 and full market penetration was achieved immediately (Olivastri and Williamson 2000). The tax incentive in Finland was designed to be revenue neutral and did not decrease government revenues significantly.

Germany decided to increase taxes for transportation fuels over time and to offset these increased taxes by reductions in pension contributions. Germany increased the tax on non-low-sulfur fuels by 3 pfennigs/liter (approximately 1-2 US cents/liter) in November 2001 for fuels with a sulfur content over 50 ppm. In January 2003, the threshold was decreased to 10 ppm sulfur. The extra tax premium has "prompted a speedy market shift towards tax-privileged low-sulfur and sulfur-free fuels" (Government of Germany 2004).

Low Sulfur Fuels in the Chinese Context

Currently, China has three major oil companies: China National Petroleum Corporation (CNPC), China National Petrochemical Corporation (Sinopec), and China National Offshore Oil Cooperation (CNOOC). They are all ministry-level corporations under the direct control of the State Council.

Prior to 1998

Before 1998, oil exploration, onshore and offshore production (E&P), and refining were separated in China. CNPC was mainly engaged in onshore oil and gas planning, exploration, development and production in China and offshore shallow water areas to a depth of less than five meters. As of 1996, CNPC produced 143.2 million tons of crude oil and 17.2 billion cubic meters of natural gas, accounting for 90 percent of China's total oil output and 77 percent of total national gas output. Sinopec was responsible for formulation of policies for producing refined products and petrochemicals, supervising the construction and operation of refining and petrochemical plants in China, and marketing refined oil products and petrochemicals. In 1996, Sinopec had a refining throughput of 118 million tons and an ethylene output of 2.5 million tons, accounting for more than 80 percent of China's refining throughput and ethylene output. CNOOC was charged with the responsibility of exploration and extraction of offshore oil and natural gas.

1998 Restructuring

In 1998, the Chinese central government decided to restructure the oil and petrochemical industries by forming two new vertically integrated companies, the new CNPC and Sinopec. The assets of Sinopec and CNPC were reorganized along geographical lines, and the two companies transferred subcompanies to each other based on their locations. Sinopec is now in charge of all assets in eastern and southern China while CNPC is in charge of assets in western

and northern China. The two corporations are allowed to expand their marketing activities, especially retail business, into each other's territory. Table 1 shows the oil and gas reserves and production capacity, and refining capacity of the new CNPC and Sinopec after the 1998 restructuring.

After restructuring, CNPC and Sinopec accounted for about 90 percent of crude oil production in China, and they were responsible for over 75 percent of natural gas output. Their combined oil refining capacity accounted for 95 percent of the Chinese total, and their combined ethylene cracking capacity accounted for 90 percent of the national total (Zhang 2004).

Table 1 New CNPC and Sinopec after 1998 Restructuring

	New CNPC	*New Sinopec*
Oil reserves (billion tons)	4.1	1.2
Gas reserves (billion cubic meters)	76	4.3
Oil production capacity (million tons)	107	36.3
Gas production capacity (billion cubic meters)	14.8	2.4
Refining Capacity (thousand tons / year)	87.8	125.24

In 1999, CNPC and Sinopec also initiated major internal restructuring with the intent to establish a structure of a modern large corporation. They divided core businesses (i.e., oil and gas enterprises, refining and petrochemical enterprises, marketing enterprises, and pipeline and transportation companies) and non-core businesses (i.e., technical and social service enterprises and diversified companies). CNPC and Sinopec then grouped their core business into joint stock companies and listed them on the international markets (i.e., Petrochina and Sinopec). After the PetroChina and Sinopec were listed on global stock markets in 2000, CNPC held 90 percent of PetroChina's total equity. Sinopec Group held 56.06 percent of Sinopec's total equity, and four state institutions (the State Development Bank, and three asset management companies, Cinda, Orient and Huarong) own 22.73 percent.[2] CNOOC was listed on the international stock market in the following year, and the parent company holds 70.6 percent of CNOOC's equity.

Recent Production and Financial Performance

Table 2 shows the recent production levels of oil, natural gas and oil products by PetroChina, Sinopec and CNOOC. PetroChina was dominant in crude oil production in China, while Sinopec owned the majority of refining capacity. Comparing Table 2 and Table 1, it is evident that the refining capacity of PetroChina and Sinopec increased considerably in the early 2000s, although their oil production capacities did not increase much. Consequently, in 2004, 36 percent of crude oil processed at Chinese refineries was imported.

Table 3 provides the financial performance of the three companies in recent years. Sinopec's total revenue increased from 326.4 billion yuan to 619.8 billion yuan, and its profits (before tax) increased from 24.9 billion to 59.6 billion during 2001 to 2004.[3]

[2] This is the result of the central government policy called "debt for equity". Debts were written off on paper by transferring those debts as equity owned by state banks and asset management companies. The policy aims to help large state companies to reduce their debts and financial performance. Sinopec Group now holds 67.92% of the total equity of Sinopec.
[3] According to Sinopec's 2004 report.

Table 2 Assets and Productions of PetroChina, Sinopec and CNOOC [a]

	PetroChina	*Sinopec*	*CNOOC*
Crude oil production (million tons)	109.54	38.60	24.72 (domestic)
Natural gas production (billion cubic meters)	24.88	5.86	N.A.
Refining capacity (million tons)	120.0	155.2	Several projects are under construction
Refined oil (million tons)	98.43	124.2	
Major final products (million tons)	61.51	80.83	
Gasoline	21.26	23.58	
Diesel	37.27	50. 89	
Kerosene	2.96	6.36	

a Data source: websites of PetroChina, Sinopec and CNOOC. Data regarding PetroChina were for 2003; while data concerning Sinopec and CNOOC were for 2004.
b High sulfur oil processed: 27.4 million tons.

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Table 3 Financial Performance of PetroChina, Sinopec and CNOOC [a]
(billion yuan)

	PetroChina [b]	*Sinopec [b]*	*CNOOC [b]*
Total assets (billion yuan)	808.28	460.1	153.3
Sales income (billion yuan)	475.29	619.78	70.92
Total profits	72.67	59.61	24.22
Income tax	28.84	17.82	7.50
Retained profits	36.02	32.28	11.77

a Data are based on the three companies' annual reports.
b Data concerning PetroChina were for 2003; those concerning Sinopec and CNOOC were for 2004.

Table 4 Domestic Oil Product Markets of PetroChina and SinoPec [a]

	PetroChina [b]	*Sinopec [b]*
Gas stations	15,231	30,063
Oil product sold (million tons)	60.51	94.59
Retail market share in that year	40.8%	56.3%

a Data sources: websites of PetroChina and Sinopec.
b PetroChina's data were for 2003; while Sinopec's data were for 2004.

PetroChina and Sinopec together accounted for over 90 percent of oil products sold in China (see Table 4). For Sinopec, 56.3 percent of its total oil products were sold by the retail channels (53.25 million tons), 20.8 percent were sold to big users directly (19.65 million tons), and 22.9 percent were sold through wholesale channels (21.69 million tons).

Product Pricing

In 1998, to make Chinese oil companies and domestic markets prepare for China's entry to WTO, the Chinese central government decided to link domestic crude oil and oil product prices

with international markets. CNPC and Sinopec negotiated onshore crude oil prices with each other, based on the prices of imported oil with similar specifications. Prices for oil products (gasoline and diesel) were supposed to be consistent with international prices (particularly with the Singapore market). The State Development and Planning Commission (SDPC) determined the "guidance prices" for oil products for different provinces, and CNPC and Sinopec had the discretion to determine the actual retail prices for a local market within 5 percent of the "guidance prices." When the fluctuation of trade prices for gasoline and diesel in the Singapore market was more than 5 percent, SDPC was supposed to adjust domestic gasoline and diesel prices accordingly.

In 2001, the central government made modifications to the China oil product pricing scheme. The prices of oil products were now linked not only to the Asian market, but also to European and American markets. When international crude oil prices increased, the central government was supposed to increase the domestic prices of oil products as well to reduce the pressure on domestic refineries. Similarly, when international crude oil prices decreased, the domestic prices for oil products were supposed to be lowered in order to reduce the shock on domestic oil producers. Meanwhile, Petrochina and Sinopec now have the discretion to determine the retail prices of oil product in a local market within 8 percent range of the "guidance prices".

Since December 7, 2003, because of the continual increase of international crude oil, the National Development and Reform Commission has raised domestic gasoline and diesel prices several times. In Jiangsu market, the guidance price for gasoline was 3.36 to 3.60 yuan per liter ($1.57 to $1.68 per gallon) in March 2005. While in Beijing market, #93 gasoline cost 3.92 yuan per liter ($1.83 per gallon) in the same period. The prices of oil products in China, however, are still much lower than those in most developed countries.

Production of Low Sulfur Fuel

From July 1, 2002, PetroChina and Sinopec provided diesel with sulfur content of 2000 ppm (originally 10,000 ppm), and from July 1, 2003, they started providing gasoline with sulfur content lower than 800 ppm (previous standard 1000 ppm). From Oct 1, 2004, PetroChina and Sinopec provided gasoline and diesel consistent with Euro II standards (500 ppm) in Beijing market.

From July 1, 2005, the two companies started providing gasoline and diesel consistent with Euro II standards; and provide gasoline and diesel consistent with Euro III standards to Beijing markets (150 ppm and 350 ppm respectively).

Feasibility of Government Options in the Chinese Context

A key lesson from international experience is that the most important task for Chinese policymakers is to set clear, long-term regulatory signals so that refiners can optimize their investment strategies to minimize the costs of upgrading refineries to produce cleaner fuels. The industrialized countries have all set standards and timetables for producing near-zero sulfur fuels. China may wish to take a step-by-step approach, but the government should set a long-term plan for eventually requiring ultra-low or no sulfur fuels so that refineries know that they must meet this goal. Providing a clear, long-term regulatory goal is important because the refiners may decide that it is more cost-effective to leapfrog directly to these low-sulfur fuels when making their upgrading investments.

The Importance of the State-Owned Companies

In the Chinese context, Sinopec, Petrochina, and the China National Offshore Oil Corporation are three very important state-owned companies. Despite the fact that they have been partially privatized, these companies are among the largest firms under the supervision of the State-Owned Assets Supervision and Administration Commission, which directly reports to the State Council. Financially, these companies generate significant profits and also contribute a large portion of the central government's tax revenue. In 2003, for example, Sinopec and PetroChina together accounted for 3 percent of the central government's tax revenue.[4]

Setting Fuels Prices in China

The question of increasing fuel prices through a fuel tax has been hotly debated in China for several years even though China's fuel prices are relatively low by international standards due to the lack of fuel taxes. The dual rationales in the past for increasing fuel prices have been to increase revenues for transportation projects and to encourage fuel-efficiency in vehicles. China is unusual in that the government not only determines the fuel tax, but it also determines the retail prices of gasoline and diesel as well. If the government were to allow some or all of the costs of upgrading the refineries to be passed on to consumers, China's currently low fuel taxes are an advantage because the new incremental costs could be absorbed without causing gasoline and diesel prices to become nearly as expensive as they currently are in most other countries. On the other hand, because the prices are so carefully regulated and rarely changed, price differences would be easily noticed by consumers. The government has argued that it is better to wait to impose a fuel tax until oil prices fall so that the impact will be felt less, but since the incremental costs for refinery upgrades are expected to be fairly small, this argument is less compelling.

Another issue related to price-setting is that even though the low-sulfur fuels will be more expensive to produce, they cannot be allowed to be more expensive at the pump because consumers will not make the shift to the low-sulfur fuel if it is more expensive. All the evidence from Europe indicates that it is important to have a tax differential so that the low-sulfur fuel is cheaper than the high-sulfur fuel in order to shift the market to the cleaner fuels. Higher taxes can be imposed on high-sulfur fuels to offset the increased costs of the low-sulfur gasoline and diesel. In China, the government will certainly want to consider how to mitigate the effect of marginally higher fuel prices on farmers.

Co-Benefits for Energy Security

The Chinese government has expressed concern in the past about provoking inflation through the increase of fuel prices, but China's leadership has also expressed great concern about China's growing reliance on imported oil. The Chinese government issued fuel efficiency standards for passenger cars to promote more efficient use of oil in China, and any additional increases in the price of fuels would provide additional fiscal incentives to promote energy efficiency. If China were to allow the costs of refinery upgrades to be passed on to the consumer to help finance the shift to low-sulfur fuels to protect health and the environment, it would benefit China's energy security as well as helping to provide cleaner air. Perhaps these additional benefits will make it easier for China's government to justify a small price increase.

Advantages and Disadvantages of China's Situation

[4] Data from their annual reports and China's State Administration of Taxation.

An advantage to China's structure of state ownership is that the government can decide to temporarily accept lower profits for the oil companies when the investments are initially made. The government can also readily provide low or no-interest loans to the oil companies through the state-owned banks to help finance the upgrades. By setting the standard over a long time horizon, the government can provide some flexibility to the refiners because if they know they must meet certain standards over time, they can plan to make the upgrades when it is most cost-effective and efficient to do so. It may be difficult for the Chinese government to discipline its own firms to enforce the new sulfur standards both at the refinery and also at the pump, so this challenge must be addressed. Not only will the refineries have to make the upgrades, but the government also needs to check that the cleaner fuels are really being sold at the pump as advertised. This will require significant resources to establish a monitoring, verification, and enforcement regime not only for cleaner fuels but also for in-use vehicles.

Conclusion

In the end, the Chinese government must decide how the refinery upgrades required to produce cleaner fuels will be paid for. A plausible solution may be that the government decides to let a percentage of the costs be passed on to consumers and a percentage be absorbed by the companies and government so that overall the burden is shared by both producers and consumers. This way, the likelihood of inflation is diminished while the large economic and social benefits related to cleaner air and public health are maximized.

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