Examining Energy Consumption Subsidies in China

Laying the Groundwork for a Cleaner Environment

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Abstract

This paper is based on the idea that the removal of energy subsidies that have associated negative environmental effects could well be the most logical first step for environmental protection. Artificially low government controlled consumer prices in China inflate demand beyond equilibrium levels. At the same time, as a result of these low prices, power generators and oil refiners often experience difficulties in covering their costs of production and are sometimes forced to limit output. In order to reduce resulting shortages, the government has been known to directly subsidize production and supply, sometimes enabling overconsumption. Household energy consumption in China has been intentionally subsidized across fuels (electricity, gasoline, and diesel) and time. With regard to industry, there are also indications of consumption subsidies, particularly for refined oil products. More detailed price-gap analyses are needed over space, sectors and time. It is hoped that the information and analyses provided in this paper can offer some insight into the successful removal of environmentally degrading subsidies to energy consumption in China.

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Introduction

Much effort has gone into developing elaborate systems involving permit trading or emissions taxes in hopes of providing a framework for curbing air pollution and greenhouse gas emissions. Instead of considering the implementation of complex market instruments or the incorporation of environmental externalities into the market system however, this paper is based on the idea that the removal of energy subsidies could well be the most logical first step for such environmental protection. Although there may be many social policy justifications in favour of subsidies, they also tend to cause many problems including negative environmental effects. Pure market prices provide signals for the allocation of goods to their most productive uses. Unless subsidies are perfectly applied to correct pre-existing market failures, they distort market prices and cause inefficiencies.

The initial goal of this research was to quantify the various forms of energy subsidies in China and estimate associated effects such as reductions in local air quality, increases in greenhouse gas emissions, and economic costs. Through researching the subject, however, it was discovered that it is very difficult to identify the various forms of energy subsidization in China, let alone quantify them. The scarce literature available on the subject neither presents a consistent view of the types of Chinese energy subsidies nor of their magnitude.

This paper aims to gain greater perspective on energy subsidies in China by using the available literature to explore the salient features of the past and present. Various perspectives on the topic have been taken into account in order to generate an unbiased portrayal. The paper has been written focusing exclusively on those subsidies that incite greater polluting emissions: subsidies to energy consumption. The paper primarily focuses on price controls as a major form of subsidies to energy consumption.

This survey paper incorporates up-to-date information regarding Chinese energy subsidies. The analysis goes beyond that which numerical calculations of general price-gap differentials can provide alone: an attempt is made to delve into government pricing and regulatory intentions and the resulting outcomes for industry and individual consumers.

The regulatory framework in China is in a period of flux, and the international markets constantly provide new price information. Current analyses, information, and measurements are therefore crucial to making effective decisions. It is hoped that the information and analyses provided in this paper can offer some insight into the successful removal of environmentally degrading subsidies to energy consumption in China.

Energy Use in China

Up until the late 1970s, China used a full command and control approach to development. The government pushed the economy towards a highly inefficient form of heavy industrialization. Instead of focusing on its comparative advantages in resources such as labour, China chose a development strategy based on capital and technology in which it was relatively weak. Between 1949 and 1978, the amount of energy required to produce a unit of economic output grew several times over. Further, as the county's economic resources were diverted away from agriculture, a significant threat of famine arose (Rosen and Houser, 2007).

In the late 1970s, however, China began an economic reform from a command and control to a more market-oriented system that triggered a period of strong economic growth. Institutional reforms and the beginnings of price liberalization in many domestic and international markets encouraged the movement of capital and labour to more productive uses.

China saw massive migration of labour from the agricultural sector to the light manufacturing industry, as well as capital accumulation and increased productivity.

Following the beginnings of reform, heavy industry energy-intensity improved greatly. Profit incentives were a huge driver in firms taking concrete action to limit energy use in attempts to minimize costs. A given firm increasingly had to deal with competition from domestic state-owned and private firms as well as competition from abroad. This competition gave further incentive to minimize energy costs. As energy prices also became partially liberalized, their prices began to rise, adding another disincentive for over-consumption. Finally, as international markets opened-up, energy-intensive Chinese firms increasingly gained access to technology that was much more energy efficient (Rosen and Houser, 2007).

Reforms also included the conversion of many government energy ministries and their holdings into state-owned enterprises (SOEs) allowing decision making to be based much more on market, rather than political, considerations. Although this conversion was an integral move in the development of energy markets, it left the government without much human capital to oversee the energy sector as employees of the dissolved ministries went to work for the SOEs. Resulting problems of insufficient resources for planning, oversight and enforcement in the energy sector exist today (Rosen and Houser, 2007).

In July 2008, the National Development and Reform Commission (NDRC) announced that the newly formed National Energy Administration (NEA) had commenced operations. The new institution took over many administrative tasks that were being performed by the State Electricity Regulatory Commission (SERC), the Ministry of Commerce and the NDRC itself. Up to date, the NEA employs just over 100 people, and has limited powers under the NDRC however (Li, 2008c).

Over the past decade, China has experienced increasing foreign and domestic demand for goods produced by heavy industry including the iron, steel, cement, plate glass and chemicals sectors. Foreign countries have, in effect, been outsourcing energy-intensive production to China. China has also been producing more energy-intensive goods (such as steel and cement) for booming local infrastructure expansion and modernization, as opposed to importing them (IEA, 2007). Intensified economic competition among different areas of the country has also contributed to the boom in heavy industry: heavy industry has been very profitable, and every city or province wants its own factories to get a piece of the pie. According to the 2008 version of the China Statistical Yearbook, industry now accounts for 43% of GDP (National Bureau of Statistics, 2008).

China has seen a reversal in the post-reform downward energy-intensity trend addressed above. The sheer amount of energy required to feed the heavy industry boom outweighs the savings in energy that the previous achievements in energy efficiency provided (Rosen and Houser, 2007). The country now faces resulting problems of emissions-related environmental degradation. The problems are made all the more serious by the growing importance of consumption-led energy demand (as opposed to the traditional investment-led energy demand), which will likely ensure a high growth in energy demand for many years to come (see "Further Considerations" section for more discussion).

China is now the second largest consumer of energy world-wide behind the United States (BP, 2008). In 2007, industry accounted for 72% of final energy consumption while the household, transportation, and agricultural sectors consumed 10, 8, and 7 percent respectively (National Bureau of Statistics, 2008). Demand for all forms of energy has been rapidly rising in the past few years. In this paper we will focus on coal, electricity and oil.

Resulting Pollution and its Effects

Energy-related emissions are an extremely important issue in China today. A direct consequence of China's energy-intensive economy, these emissions are slowly degrading the environment, causing negative health effects, and contributing to worldwide greenhouse gas emissions (IEA, 2007). In spite of the global attention received by greenhouse gas emissions and climate change, however, China's primary concern is that of local effects. (IEA, 1999; IEA, 2007)

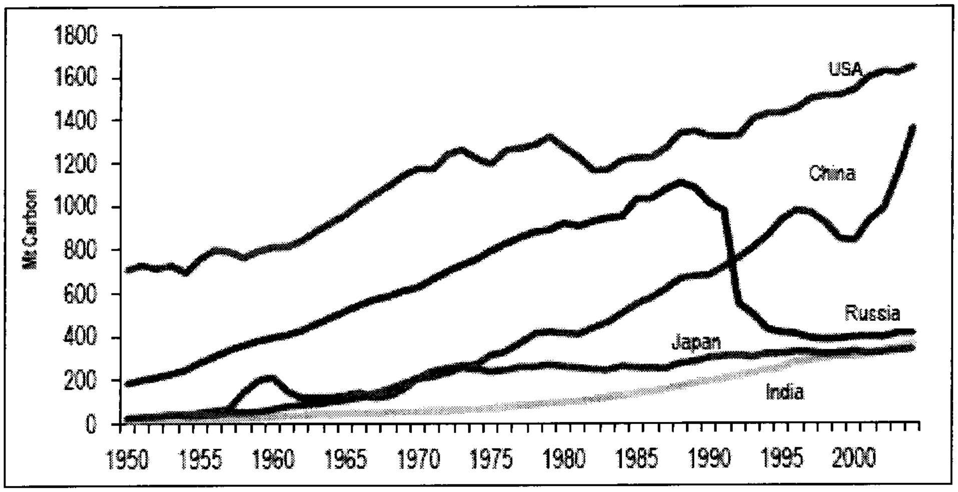
Emissions per unit of GDP in China are high relative to the Western world partly because it consumes 20% to 40% more energy per tonne of output than OECD countries. However, per capita emissions are low compared to the Western world, which reflects relatively low GDP per capita (Rosen and Houser, 2007).

China's heavy reliance on coal is the major contributor to local emissions: in addition to CO_2 and NOx, 85% of SO_2 emissions emanate from coal burning in power plants and other industries (IEA, 1999). SO_2 is the most significant regional air pollutant and leads to serious health problems, creates acid rain, damages infrastructure, and produces smog. SO_2 caused over $60 billion in direct economic damage in 2005 (Rosen and Houser, 2007). Further, approximately $32 billion and $34 billion in damage was caused by CO_2 and particulate emissions respectively (World Bank, 2005).

It is clear that for a long time, the central government's primary focus has been on economic development and GDP growth at all costs in efforts to accommodate a rapidly growing labour force. As noted below, when energy supplies were limited for power production in the late 1970s and early 1980s, the government quickly decided to encourage greater coal production by allowing small mines to enter the market, because this was the easiest and fastest way to solve the issue of coal shortages (Rosen and Houser, 2007). The environment suffered the consequences. Important adjustments to the coal pricing system have since been put in place however (see "Coal" section for a discussion). China has taken steps in an attempt to limit air pollution, such as a levy on SO_2 emissions. The attempts have been relatively ineffective, however, for reasons such as the small size of levies, lack of compliance, and lack of government enforcement (Rosen and Houser, 2007).

The effects of China's pollution are felt in neighbouring countries and beyond. Neighbouring countries experience the same hazardous effects from Chinese pollution as experienced within Chinese borders. Most of the extended global impact from China's emissions, however, come in the form of CO_2 emitted by industry, and again mainly from coal burning (Rosen and Houser, 2007). Figure 1 shows the progression of CO_2 emissions in China compared to those of selected countries from 1950 up to 2004. In 2006 (not shown), China's CO_2 emissions surpassed those of the United States by 8%, making it the world's largest emitter (Netherlands Environmental Assessment Agency, 2007).

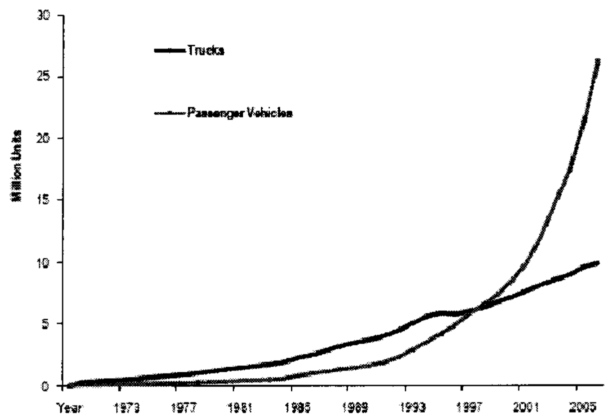
Figure 1: Carbon Dioxide Emissions from Fossil Fuel Combustion, cement Production and Gas Flaring, (MT Carbon)



Source: China Energy Databook, 2008

Individual consumption-driven demand for electricity and refined oil will become an increasingly important part of Chinese energy consumption and account for a greater part of energy-related emissions as the population becomes wealthier. For example, Figure 2 shows that personal transportation is becoming an increasingly important issue as the fleet of cars and trucks on Chinese roadways is expanding exponentially. Per capita energy consumption may currently be low relative to the western world, but such levels may be rivaled in the not-too-distant future.

Figure 2: Stock of Civilian Motor Vehicles



Source: China Energy Databook 2008

The adoption and development of new pollution mitigating technology is an important element in the fight against pollution. National emissions caps and world-wide trading systems are also extremely important steps, albeit very difficult to organize and enforce. A logical first step in the battle against pollution, however, is the removal of all subsidies for the consumption of primary energy. According to standard microeconomic theory, such action could cause a quick drop in energy use, a rise in energy efficiency, and a sizeable decrease in related pollution.

Definition and Measurement of Subsidies

According to IEA (1999), "An energy subsidy is any government action that concerns primarily the energy sector and that lowers the cost of energy production, raises the price received by energy producers, or lowers the price paid by energy consumers." Governments provide energy subsidies for various reasons, including development, employment, poverty alleviation, and energy security. Subsidies can be provided through direct financial interventions as well as indirect administrative interventions. Specific forms of subsidies include, but are not limited to, price controls, government ownership, import and export restrictions, transfers, grants, preferential loans and cross-subsidization. Subsidies can be provided to producers, consumers or a combination of both, depending on their form and the government's intentions.

Koplow (2004) outlines two major subsidy measurement approaches, the program-specific approach and the price gap approach. The program-specific approach is said to capture transfers whether or not they affect the end-market price, but does not address ultimate pricing distortions. The price gap approach is said to capture pricing distortions yet understates the full value of supports because it ignores transfers that do not affect end-market prices

The purpose of this paper is to focus on energy subsidies that affect energy consumption and related emissions; therefore the price-gap approach is sufficient (discussed below). This paper does not explicitly apply the price-gap approach to calculating subsidies. However, it is important to understand the methodology of the approach and what exactly it attempts to measure in order to set a framework for identifying aspects of the Chinese energy sector that are perhaps used to provide energy consumption subsidies.

The price-gap approach aims to measure the degree to which the end-user price of a domestic good is subsidized. The approach does not focus on what form the subsidy takes nor on whether the initial subsidy(ies) was given to producers or consumers. Rather, it compares actual end-use prices with reference prices. The reference price (usually) represents the true economic cost of the energy being sold. It is determined by making transportation and distribution adjustments to the border price in the case of internationally traded goods, or to the cost of production in the case of non-traded goods.

There are three ways of calculating the reference price depending on whether a country is a net importer, a net exporter or does not trade the energy internationally. If a country is a net importer, the reference price is calculated by taking the import cif (cost, insurance, freight) price, adding transportation costs, and adding internal distribution cost as well as applicable value added taxes. If a country is a net exporter, the reference price is calculated by taking the export fob (free on board) price, subtracting transportation costs (as the goods aren't shipped to port for domestic sales), and adding distribution costs as well as applicable value added taxes. In the case that a good is not traded internationally (such as electricity in China's case), the reference price is calculated by determining the cost of production and adding distribution costs and applicable value added taxes.

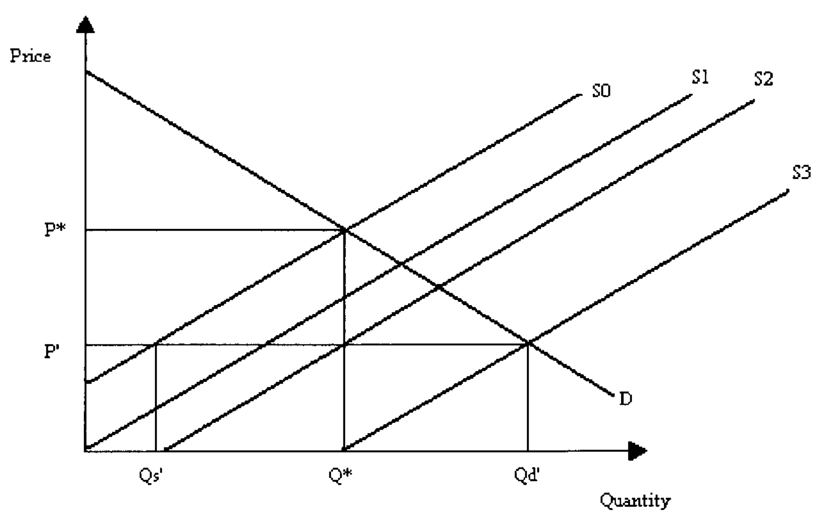
In the following excerpt, Houser (2008), writing about coal, makes an important point about determining whether consumer subsidies exist in the presence of price controls.

> (…) price controls alone do not necessarily indicate subsidization. Prices can be set by government at a level above or below market price. A better indicator of whether a controlled coal price provides a subsidy to coal buyers is to look at the profit margins for the coal mining companies. If coal miners are profitable at the government set price, then it is hard to make the case that consumers are being subsidized at their expense. In fact, in such instances a transition to a liberalized competitive market could lower prices rather than increase them. (Houser, 2008, p.2)

Using producers' profit as an indication of consumer subsidy has some appeal. However, consider the situation where the domestic cost of production is below the border price. In this case the border price calculated for an exported good can include a certain level of super normal profit for producers. If price controls hold domestic end-user prices below the border price but above the cost of production, a price-gap analysis would indicate the presence of a consumer subsidy whereas a profit analysis would not, provided producers still earned a normal rate of profit. In such cases, a price-gap analysis provides the best indication of subsidy. In spite of super normal profits, the opportunity cost of local sales remains the border price. By forcing producers to sell at a lower domestic price, the government is effecting a transfer of wealth from producers to consumers. This form of transfer is inefficient since it requires individuals to consume the good in order to receive the transfer. An efficient transfer would tax the firms' excess profits and redistribute them in a lump-sum manner, without distorting the prices of particular goods.

For the purpose of this paper, it is helpful to understand the interplay between price controls and consumption. A government's choice to hold the price of certain energy goods at artificially low levels, while making subsidy payments to the producers of these goods, can have different effects on consumption depending on the magnitude of the former intervention relative to the latter. Figure 3 illustrates the problem. Quantity demanded (Qd') for a good at the artificially low price (P') will be greater than equilibrium quantity demanded (Q*) at the equilibrium price level (P*), whereas quantity supplied (Qs') will be lower than (Q*). A shortage thus occurs (Qd' > Qs'). The government then chooses to subsidize production in order to reduce or eliminate the shortage. The effect of subsidizing production is to shift the supply curve down, as shown by S_1, S_2, and S_3 in the figure. If the subsidy is relatively small and only shifts supply to S_1, then excess quantity demanded will remain at the controlled price (P'). Moreover, in this case there will be rationing that forces consumers to consume less which in turn will cause pollution emissions to be lower than in equilibrium (Q*), notwithstanding the price control. If the subsidy is larger and shifts supply down to S_2, consumption and emissions will be at the equilibrium level (Q*), yet excess quantity demanded will remain. Finally, if the production subsidy is large enough to shift supply to S_3, consumption and emissions will be greater than the equilibrium level (Q*). At this point shortages are eliminated and there is overconsumption relative to quantity demanded in an undistorted market (Q*). Thus, the effect of the price control on consumption and emissions will depend upon the size of the subsidies offered to producers to close the demand-supply gap. As discussed below, China uses this combination of price control and producer subsidy for refined oil, and certain electricity markets.

Figure 3: The Effects of an Artificially Low Price on Supply and Demand

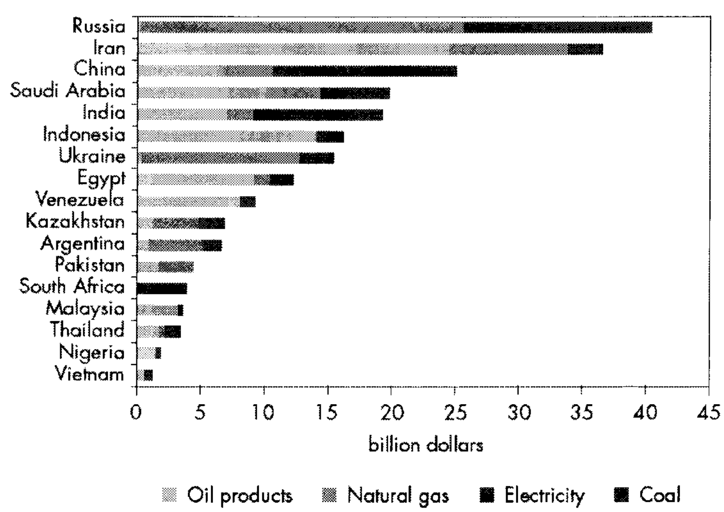


Regulation, Pricing, and Subsidies in China

Reflecting a shift in government attitudes, OECD countries have generally eliminated direct energy subsidies and no longer use price controls (IEA, 1999). According to Rosen and Houser (2007), energy prices in China have been converging to world prices over the past three decades, yet an accurate assessment of the present situation is difficult to conduct due to "local idiosyncrasies in pricing, dual supply channels for many legacy SOEs, arrears (both permitted and not) and other factors" (p.10).

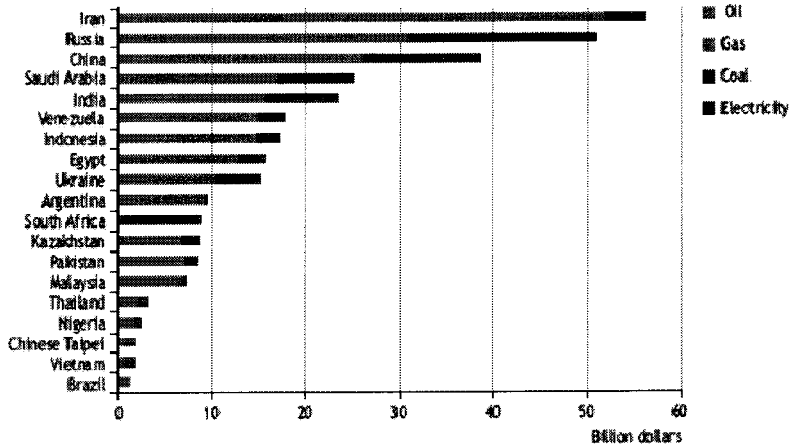
Figures 4 and 5 reproduce comparative graphs from IEA (2006) and IEA (2008b) of the "economic value of energy subsidies" across non-OECD countries in 2005 and 2007 (presumably all financial and administrative interventions seen as subsidizing the production or consumption of a fuel are included). The program-specific approach referred to by Koplow (2004) was likely applied here. China was found to have the third largest energy subsidies worldwide in 2007 at approximately US$38 billion. In 2005, China's total value of subsidies was also third largest, at approximately US$25 billion.

Figure 4: Energy Subsidies by Fuel in Non-OECD Countries (2005)



Source: IEA, 2006

Figure 5: Energy Subsidies by Fuel in Non-OECD Countries (2007)



Source: IEA, 2008b

Table 1 presents price-gap measurements of Chinese energy subsidies for 1998 and 2005, based on data from IEA (1999) and IEA (2006). For each fuel type, the table presents a weighted average of consumption subsidies across consuming sectors. Subsidies to individual consuming sectors were calculated using the price-gap method on a fuel-by-fuel basis prior to taking the weighted averages. According to the table, subsidies to electricity consumption were eliminated (on average), whereas the subsidy rate for gasoline and diesel consumption, among other fuels, rose from 1998 to 2005. Because China does not trade electricity, the decrease in the average subsidy rate to electricity consumption was most likely due to internal changes such as the beginnings of electricity reform in 2002 (discussed below). In contrast, the increase in the subsidy rate for gasoline and diesel consumption could be explained in large part by price rises on the world market (discussed below) as opposed to internal policy changes.

Table 1: Consumption Subsidy as Percentage of Reference Energy Price

	Gasoline	Auto Diesel	Liquified Petroleum Gas	Kerosene	Light Fuel Oil	Heavy Fuel Oil	Electricity	Natural Gas	Coal	Steam Coal	Coking Coal	Total
1998	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	38.2%	18.7%	N/A	8.3%	73.1%	10.9%
2005	5.0%	13.0%	18.0%	3.0%	0.0%	0.0%	0.0%	45.0%	17.0%	N/A	N/A	N/A

Source: IEA, 1999; IEA, 2006

The next subsections will individually examine the markets for coal, electricity and oil, in order to get some perspective on the history and current status of energy subsidies in China.

Coal Sector

Background

China is endowed with 13% of the world's coal reserves. Demand for coal has grown 12% annually since 2001 (Rosen and Houser, 2007) In 2007, China was by far the largest producer and consumer of coal with 1289.6 and 1311.4 million tonnes oil equivalent representing 41.1% and 41.3% of the world's share respectively (BP, 2008).

As seen in Table 2, electric power generation accounts for 51% of Chinese coal consumption, whereas 43% is consumed by industry directly. Consumption of both electricity and coal have increased dramatically over the past three decades. 80% of Chinese electricity is generated through coal burning (IEA, 2007).

Table 2: Consumption of Fuel by Sector

	Coal	Crude Oil	Gasoline	Diesel Oil	Fuel Oil	Electricity	Total
Industry (Excluding Electric Power, Gas and Water Production and Supply)	43.2%	99.5%	9.9%	11.6%	49.7%	60.3%	64.1%*
Production and Supply of Electric Power and Heat Power	51.0%	0.0%	0.4%	2.1%	14.8%	14.2%	7.0%
Transport, Storage and Post	0.3%	0.5%	50.1%	54.4%	14.8%	1.6%	7.8%
Household Consumption	3.1%	0.0%	7.9%	1.6%	0.0%	11.1%	10.1%
Agriculture, Forestry, Animal Husbandry, Fishery and Water Conservancy	0.9%	0.0%	4.5%	15.0%	0.0%	3.0%	3.1%
Construction	0.2%	0.0%	3.6%	3.5%	0.4%	0.9%	1.5%
Wholesale and Retail Trades, Hotels and Catering Services	0.3%	0.0%	6.4%	4.8%	0.6%	2.8%	2.2%

*72% including Electric Power, Gas and Water Production and Supply

Source: National Bureau of Statistics, 2008[1]

Traditionally, coal prices were set through contract negotiations at the annual coal conference that brings together miners, buyers and government authorities. The government authorities set coal prices at levels they deemed appropriate (Melanie and Austin, 2006; IEA, 2007). Contract prices were generally set below market levels in order to encourage production by heavy industry.

The late 1970s and early 1980s marked the beginning of coal sector pricing reform, as coal shortages associated with booming economic growth forced the government to allow private mines to produce and sell coal to cover deficiencies; coal production had previously been reserved for state mines. This liberalization provided an opportunity for out-of plan sales and profits, which led to a boom in private coal mining during the 1980 and 1990s (Rosen and Houser, 2007).

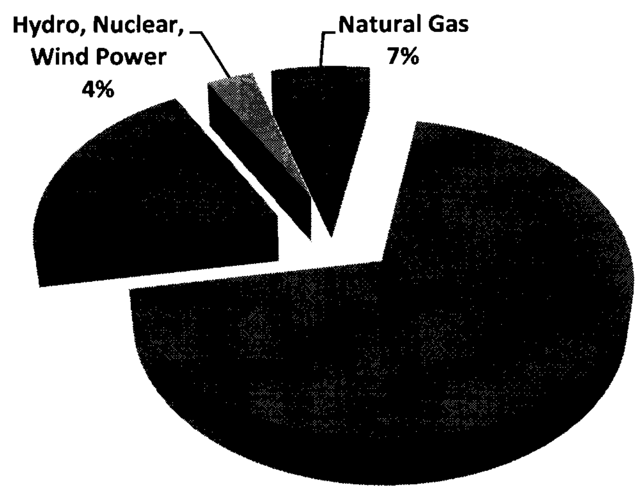
[1] Definitions of "Gas", "Heat Power", "Storage" and "Post" are not provided.

In 1993, a two-tier system for coal sales was officially established. The proportion of coal that state mines were required to sell for power generation (i.e. thermal coal) at annually set "in-plan" prices was reduced; the remainder of coal for power generation was to be sold at market prices in spot markets. In addition, coal destined for most other uses could be sold entirely in spot markets (IEA 2007; Rosen and Houser 2007).

The adoption of the two-tier system was an important move toward market liberalization. However, the pricing system became increasingly ineffective. In spite of slight government raises in "in-plan" contract guide prices, there was a widening gap between "in-plan" and "outside plan" prices for power generation coal, making it more and more difficult to get parties to settle contracts at the annual conferences. High spot market prices made contract sales less and less attractive for producers. From 1993 to 2006, half of coal prices for electricity generation was determined in-plan while the other half was determined outside the plan (IEA, 2007).

Efficiency and conservation measures taken by the government such as the promotion of alternative fuels allowed China to decrease the share of coal in the energy mix from 80% in 1990 to 70% in 2002 (Melanie and Austin, 2006). However, this proportion has stopped decreasing in the last few years due to increased electricity production which is heavily reliant upon coal. Figure 6 shows that the current proportion remains at around 70%.

Figure 6: China's Energy Consumption by Fuel (2007)



Source: National Bureau of Statistics, 2008

Between 2002 and 2005, China experienced periodic power outages due to the combination of high electricity demand, an ineffective coal pricing system, lack of power generation capacity, and inadequate transportation infrastructure. Because of a failure to quickly finalize coal contract prices, as well as rail transport constraints in times of peak electricity demand, the necessary amount of coal was not made available to existing power generating plants. The associated excess demand for coal caused spot prices to rise substantially in 2004 (IEA, 2007; Rosen and Houser, 2007; Yang, 2006).

Spot market price stabilization for thermal coal was temporarily achieved in 2005. Coal production increased from 2002 to 2005 through the re-opening of previously closed small mines. Further, coal contract negotiations at the 2005 annual coal conference were finalized much more quickly than those for the two previous years (Melanie and Austin, 2006). In 2006, at the opening of the coal conference, the NDRC announced that coal sales to power generators would be determined freely without state-involvement "within a reasonable range". The move was made in hopes of closing the gap between in conference prices and spot prices (IEA 2007; Melanie and Austin, 2006).

Only 4 Chinese companies hold coal export licenses, these include China Coal Group Corporation, Shenhua Group Corporation, Shanxi Import and Export Group Corporation, and Minemetals Group Corporation. Export quotas (i.e. the maximum amount of coal allowed to be exported) are generally equally allocated across the firms. China's key coal export markets include Japan, the Republic of Korea, and Taiwan (IEA 2007).

Subsidy Analysis

The government's policy of keeping most state-mine coal prices at artificially low levels prior to 1996, as well as similar limitations on the price of thermal coal for power generation prior to 2007, provided substantial subsidies to coal consumption. Haley (2008) finds that $11.16 billion in subsidies for thermal coal and $916.39 million in subsidies for electricity were given to China's steel industry in 2008. The study claims that these subsidies are responsible for China's growing share of world steel exports as subsidized coal inputs allow Chinese steel firms to undercut international prices. Although the study applies the widely accepted price-gap method in order to measure the various energy subsidies, it does not provide detailed calculations for the results. Specifically, the author uses reference prices described as "industry-specified world prices (…) as indicated by the international industry associations for steel" (Haley, 2008).

Houser (2008) writes "The problem with price-gap analysis in this instance is there is no "world price" for coal. (…) coal prices can vary dramatically between countries given domestic infrastructure, mining technology, proximity to ports, etc." (p.2). The appropriate reference price is the Chinese border price for coal.

In mid-2008, due to high coal prices and controlled electricity prices (discussed in the next subsection), the government felt the pressure to regress in terms of coal market liberalization by capping prices in the previously liberalized thermal coal market. Central and provincial governments felt that coal prices were getting too high as the price of thermal coal had risen 80 yuan per ton over the previous 2 years partially due to high demand for electricity as well as the closing of many small coal mines prior to the Beijing Olympics (Yang and Li, 2008). In June 2008, the province of Shangdong placed limits on the price of thermal coal destined for local power generation. Coal producers were obliged to carry out their existing contracts at capped prices, increase production, and lower prices over the following months (Yang, 2008a). Soon after, the NDRC announced that national price caps on coal would be put in place. These price caps were the first price intervention in the coal market since its liberalization in the late 1990s potentially signaling a reversal in policy (Yang and Li, 2008).

National price caps on coal destined for power generation did not initially have the desired effect. Coal supplies to generators tightened even further as thermal coal was sent to sectors other than power generation where higher prices could be obtained. The government subsequently implemented stricter regulations limiting the prices of thermal coal while securing coal supplies for power plants (Li, 2008b). In spite of the government attempts to cap coal prices, in October 2008 the coal industry's profits had risen 140% year over year to 139 billion yuan (Li, 2008a).

Export restrictions are another tool that governments can use to manipulate domestic prices. Although export quotas exist in China, they have not been restrictive in the past few years as the liberalized domestic coal market and associated high coal prices have encouraged suppliers to sell the bulk of their product locally. Domestic coal consumption increased by approximately 60%, from 1.7 billion tonnes in 2003 to 2.7 billion tonnes in 2007 (National Bureau of Statistics, 2008). The aggregate coal export quota in 2003 was around 100 million tonnes and has been gradually decreasing (Melanie and Austin, 2006). It is predicted that the quota will be in the vicinity of 50 million tonnes for 2009 (China Coal Resource, 2009). It should be noted that if there comes a time when coal producers are prevented from selling what they desire on the international market, thus creating an artificially high supply domestically, the quotas could be considered as providing a subsidy to Chinese consumers.

Finally, indirect subsidies are provided to the coal industry through the rail system. In spite of heavy congestion, half of coal transportation in China is accomplished by rail. The Ministry of Railways has majority control on rail lines and charges artificially low tariffs to many groups of users. Coal is delivered to power plants at a price below cost. The IEA estimated that these tariffs were 20% below cost in 1999 (IEA, 1999). Additionally, the construction of new coal shipping rail lines are financed through loans from the Ministry of Railways which are seldom repaid.

Electricity Sector

Background

In 1995, China became the world's largest electricity consumer (Yang, 2006). The Chinese electric power industry is the second largest in the world, with an average annual growth rate of 10.8 percent (Pittman, 2008). A large part of electricity is produced by generators close to Northern coal mines and then transmitted through high voltage lines to consuming areas in the South in order to cut down on coal transportation costs. Prior to reform, production, transmission and distribution of electricity was controlled by the central government (Yang, 2006; Rosen and Houser, 2007).

In the 1980s, the same coal shortages that caused the government to open up coal production to private mines encouraged the opening of the power generation market to investment by parties outside the central government. County level governments, SOEs, and foreign investors began to enter the power generation sector. Increases in wholesale prices (prices at which generators sell to the electricity grid) were also permitted. By the end of the 1990s, power generation was divided at about 50-50 between SOEs and other generators. Transmission remained under government control, however, causing grids to develop at a relatively slow pace (Yang, 2006).

In 2002, the government approved a reform plan for the power sector. In attempts to increase competition, the assets of the State Power Corporation were divided into two transmission companies (the State Grid Corporation of China, and the Southern Power Grid with captive markets in the North and the South respectively), five state owned power generating enterprises (China Huaneng, China Datang, China Huadian, China National Power, and China

Power Investment) and four service companies (Melanie and Austin, 2006; IEA 2007). The various types of power generators were supposed to compete with each other in order to win contracts from the two existing grid companies. Yet, competition has been limited as the government remains a monopoly buyer. The NDRC sets individual generation prices which power generators can charge for their electricity (Yang, 2006; IEA, 1999). In 2003, the State Electricity Regulatory Commission was formed to provide guidelines for investment, tariffs and end-user charges across all levels of the electricity sector but has only limited powers under the NDRC to date (Melanie and Austin, 2006; Yang, 2006; IEA, 2007).

The power outages that began in 2002 were in part caused by booming electricity demand, high coal prices (the cost of coal constitutes around 70% of total power generation costs (Yang, 2006)), and artificially low electricity prices. Certain power generators even began investing in coal mining operations in order to ensure a more stable coal supply and avoid increasing spot prices (Melanie and Austin, 2006). The power shortages were ultimately eased by electricity rationing and a steady increase in online power generation (as well the previously mentioned increase in coal production) (Melanie and Austin, 2006; Yang, 2006).

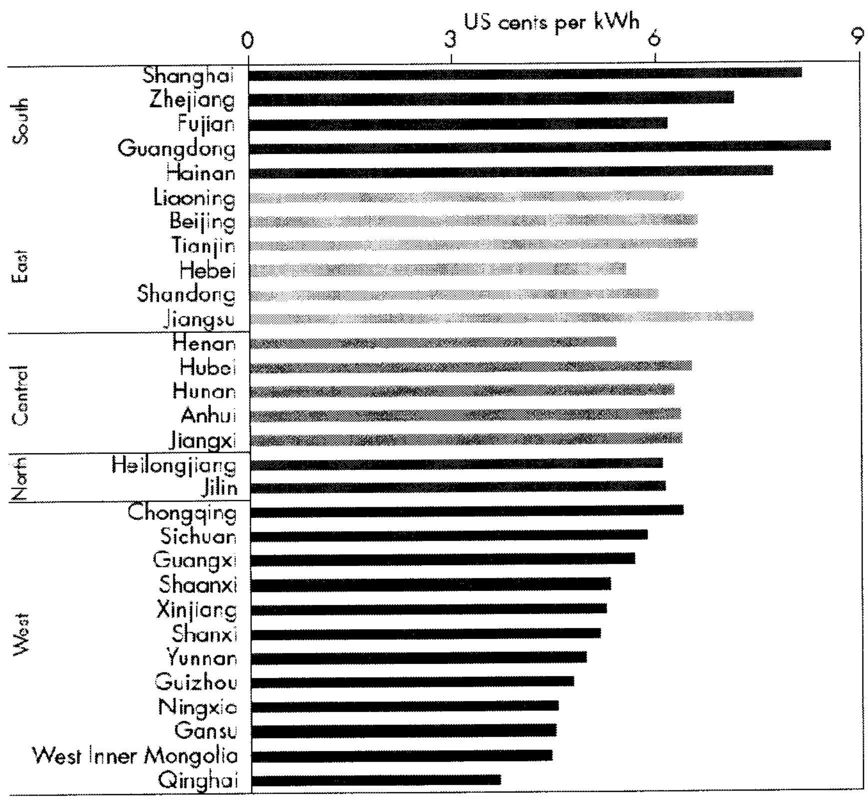
As an additional and perhaps more important remedy to the power industry's problems, the government also attempted to better harmonize coal and electricity pricing. In 2004, the NDRC enacted a new system linking wholesale power prices charged by generators to variations in thermal coal prices. When coal prices increase by 5% or more in a 6 month period, an automatic adjustment to wholesale electricity prices was supposed to take place. This would allow generators to pass on up to 70% of increases in coal prices to retail customers (albeit more heavily weighted on industrial and commercial rather than residential sectors) through the grid (IEA, 2007). Up to date however, presumably due to the government's fears of inflationary effects and political backlash, the system has passed through price hikes on very few occasions. Electricity prices have increased very little in comparison to the price of thermal coal (Rosen and Houser, 2007).

In selected regions, China has also experimented with regional wholesale electricity markets where generators sell the majority of their production at annual long-term contract prices, while the remainder is traded on short term markets (Yang, 2006). However, in spite of the establishment of the price linking system and the increase in the amount of players in the power generation sector, there has not been substantial reform in terms of achieving market pricing in the electricity sector.

As mentioned above, the NDRC determines the prices at which it purchases electricity for the grid on a generator by generator basis, based on individual production costs. As a result, there are almost as many different prices as there are electricity generators. At the same time, the government controls the price at which electricity is sold to end-users. This system diverges from what has developed in other countries: "International practices tend to allow the electricity wholesale market to determine the tariffs on the generation side while an independent regulator regulates transmission and distribution price." (Yang, 2006, p.14). In China, the government is instead lobbied in one direction by power generators who want prices high enough to cover their expenses and in the other direction by provincial pricing bureaus that want prices low enough to keep their businesses viable and residents happy.

The end-user electricity price is set through a "catalogue system" introduced in the 1960s. The price varies across areas as well as sectors, in theory enabling the government to raise prices to energy intensive industries in order to encourage greater energy efficiency. Specifically, end-use electricity prices are made up of the combination of a non-negotiable "grid" selling price set by the central government, and extra "charges and fees" to arrive at the ultimate "retail" price. The central government sets a guide for the retail price, but there is some room for adjustments for local circumstances and policy goals by major municipal and provincial governments (Yang, 2006; IEA 2007). It has been claimed, however, that there have been substantial abuses by lower levels of government in terms of following the correct pricing procedure (Yang, 2006). Figure 7 provides an example of variations in end-use prices across provinces in 2006, while Table 3 is an example of pricing variations across sectors within a particular province.

Figure 7: End-Use Prices by Region and Province (2006) [2]



Source IEA 2007 (Based on NDRC 2007 data)

[2] Assumed to be end-use prices averaged across sectors, although IEA does not specify.

Table 3: Electricity Pricing in Guangdong Province (1999)

($US/MWh)

End-users	Grid selling price	Power Construction Fee	Three Gorges Fund	Extra Local Fuel Fees	City Fees	Total
Large manufacturing	65.46	2.42	0.85	13.77	1.69	84.18
Other manufacturing	79.35	2.42	0.85	14.37	1.69	98.67
Commercial	110.87	2.42	0.85	15.10	1.69	130.92
Residential	72.46	2.42	0.85	3.62	0.00	79.35
Agricultural irrigation	37.44	2.42	0.85	0.00	0.00	40.70

(Table from Yang, 2006)

Subsidy Analysis

Prices in the electricity sector are not determined by the market. In spite of introducing competition in the power generation sector, the government controls the prices at which it purchases electricity for the grid, as it is a monopsony buyer. The government, centrally and provincially also tightly controls end-use pricing.

The government is generally reluctant to raise electricity tariffs due to concerns about inflation. However, it is difficult to make an encompassing statement regarding whether subsidies exist for electricity consumption. Retail prices vary across consuming sectors, consuming areas, and time. Further, although the central government could be setting a "reasonable" market price, analysis can be further complicated by provincial non-compliance in pricing, or simple non-payment.

As seen in Figure 4, IEA (2006) found evidence of subsidies for electricity in 2005. However, information provided in Table 1 indicates a zero subsidy rate for electricity for the same year. The discrepancy likely lies in that Figure 4 represents an aggregate amount of subsidies provided for each fuel type which may include subsidies to production that are not passed on to consumers as well as cross-subsidies (again, the program-specific approach to subsidy calculation was probably used). Table 1 on the other hand presents a weighted average of subsidies (calculated through the price-gap method) to consumption, incorporating the pricing situation of all sectors and areas into one number.

Using a weighted average to describe the situation regarding Chinese subsidies to electricity consumption can be misleading however. Conducting a price gap analysis on a regional or provincial basis could provide a better understanding of the prevalence of electricity subsidies across China. Prices vary from region to region and official central government prices are not always respected or imposed. The few price rises imposed by the central government have been met with strong provincial resistance, non-conformity, and even non-payment (Rosen and Houser, 2007). As with failure to comply with government regulations in other respects, such as non-payment of emissions taxes, the aforementioned incidences could be seen as consumption subsidies in themselves. De facto subsidies are beyond the scope of this paper, however.

Further, conducting a price gap analysis on a sector-by-sector basis (e.g. industry versus residential) could also be beneficial in pin-pointing where subsidies are provided. In the case of electricity, the cost-of-production approach to calculating the reference price for a price-gap-analysis is appropriate as the good is, in general, not traded.

Households receive a low, subsidized rate for electricity. Through personal communication (via-email) with the IEA it was revealed that residential electricity prices were cross-subsidized to the tune of US$7 billion in 2005. This means that China has been known to tax electricity use in certain sectors or areas partly in order to maintain artificially low residential prices. The Chinese government is extremely reluctant to raise prices for the residential sector, which is incidentally the only consumer group that requires a special hearing for price hikes. The IEA (2007) further stated that with regard to electricity pricing for industry, prices and price differentials across sectors were being designed to support industry rather than provide incentives for efficient use of energy.

As evidenced by periodic power outages, power generators have been forced to limit production from time to time. Rises in coal prices combined with controlled end-use electricity prices make it very difficult to cover production costs. As mentioned above, Houser suggested that a sign of whether subsidies to given products exist is to look at producers' profits. The fact that end-use prices do not cover production costs implies that subsidies to consumers exist in these cases. The government nonetheless allows little or no change in prices paid to generators. The grids themselves have been shown to make meager profits (Rosen and Houser, 2007).

As mentioned in the previous subsection, power generators' difficulty in covering costs prompted the Chinese government to once again start capping coal prices destined for power generation. The choice of coal price caps as opposed to the liberalization of end-use electricity prices is a strong sign that the government still leans on a general policy of price control over free-market pricing. This type of decision making will likely perpetuate energy shortages in China. As long as upstream prices can rise while downstream prices are held relatively fixed, China will face shortages and will consequently be pressured to subsidize production. In this vein, the chief information officer for industry website China Energy Net said "China's government-controlled power system has blocked efficient communication between the supply side and the demand side, so the price fails to reflect the market demand" (Li, 2009). The same government price controls also hinder efficient communication in the opposite direction as prices fail to reflect production costs.

However, in July 2008, for just the third time since the introduction of the price pass-through mechanism in 2005, the NDRC lifted electricity tariffs. Electricity grid tariffs were raised by 4.7%, yet exemptions were provided to residential and agricultural consumers, among others (Gerson Lehrman Group, 2008). Coal prices began to fall in October and November, but the high average price of coal in 2008 caused large losses for power generators. The five biggest power producers posted aggregate losses of 30 billion yuan (Li, 2009).

Oil Sector

Background

Oil demand has increased by 9% annually since 2001 (Rosen et al, 2007). China is within the top 5 largest petroleum producing countries outside the Middle East. In 2007, China consumed 368 million tonnes of oil, whereas it only produced 186.7 million tonnes. China therefore had to import just over 50% of crude oil to meet domestic demand, making it the 3rd largest importer behind the United States and Japan (BP, Statistical Review 2008).

China National Petroleum Corporation (CNPC), China Petroleum and Chemical Corporation (Sinopec) and the China National Offshore Oil Company (CNOOC) were all formed in the 1980s, prior to which they were part of different government ministries. In general terms, the oil market was vertically segmented: CNOOC operated in the realm of deepwater exploration, CNPC was in charge of inland and shallow water exploration as well as production, and Sinopec focused on refining (IEA, 2007). In 1998, the State Economic and Trade

Commission further reorganized the Chinese oil sector by transforming CNPC (locally known as PetroChina) and Sinopec into independent, vertically integrated oil companies in hopes of increasing competition (IEA,2007). Retailing was divided into monopoly zones on the whole, however (IEA,1999).

At the same time, a new pricing system was put into place. The companies themselves could now set wholesale and refinery gate prices in line with Singapore spot markets as well as adjust retail prices within a set range of the State Planning and Development Commission baseline prices (IEA,1999). Prices were later linked to markets in Rotterdam and New York as well. The pricing system managed to keep pace with international prices for a short period of time. When the price for international crude began to rise substantially, however, the government stopped allowing proportional rises in the price for refined oil products (Yan, 2008). As seen in the "subsidy analysis" section below, attempts to maintain a reasonable amount of production and minimize shortages have been supported directly out of government budgets as well as absorbed by national companies

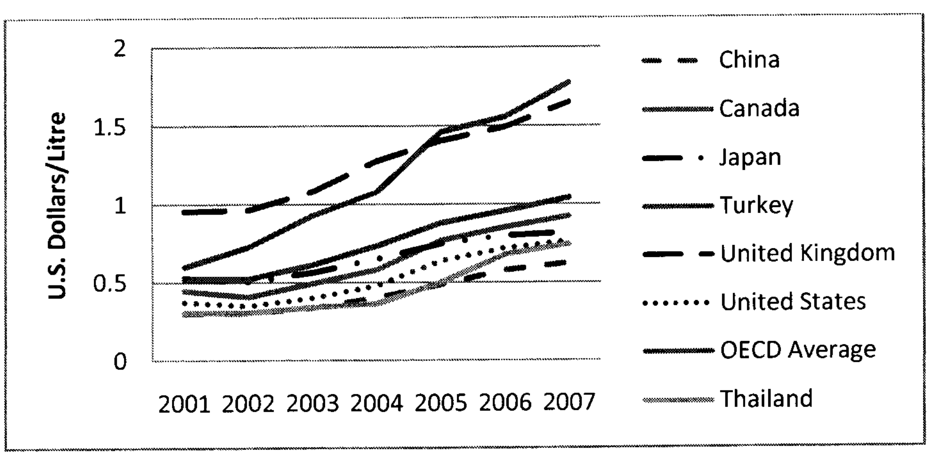
CNPC, Sinopec and CNOOC currently dominate the Chinese oil sector. All three companies are vertically integrated, yet remain the strongest in their respective original areas of focus. Sinochem, a fourth state-owned operation, is not vertically integrated, but is currently expanding into downstream operations. Other independent firms exist in the refining sector (Rosen and Houser, 2007).

Subsidy Analysis

Artificially low Chinese prices for refined oil goods such as gasoline and diesel are in place today in order to shield consumers from the inflationary effects of rising international crude oil prices. In contrast, when world oil prices hit a multi-year low in 1998, there was the reverse problem of people smuggling refined oil *into* China, which indicates that domestic oil products had become comparatively overpriced (IEA, 1999).

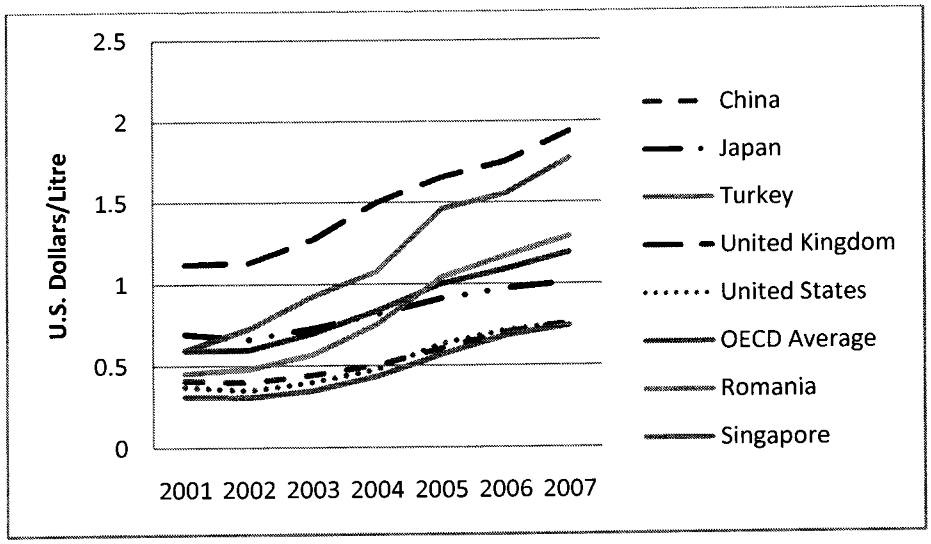
Figures 8 through 10 compare refined oil product prices in China to those in selected other countries. Barring the possibility that China has substantially lower refining costs for gasoline and diesel than the other countries listed, the fact that China's domestic prices are and have been consistently lower than other countries reflects the role of subsidies. One would also expect a pronounced divergence in the rate of increase in prices between China and the other countries for the years 2007 and 2008 (not shown), during which international crude oil prices spiked.

Figure 8: Automotive Diesel Prices for Commercial Use



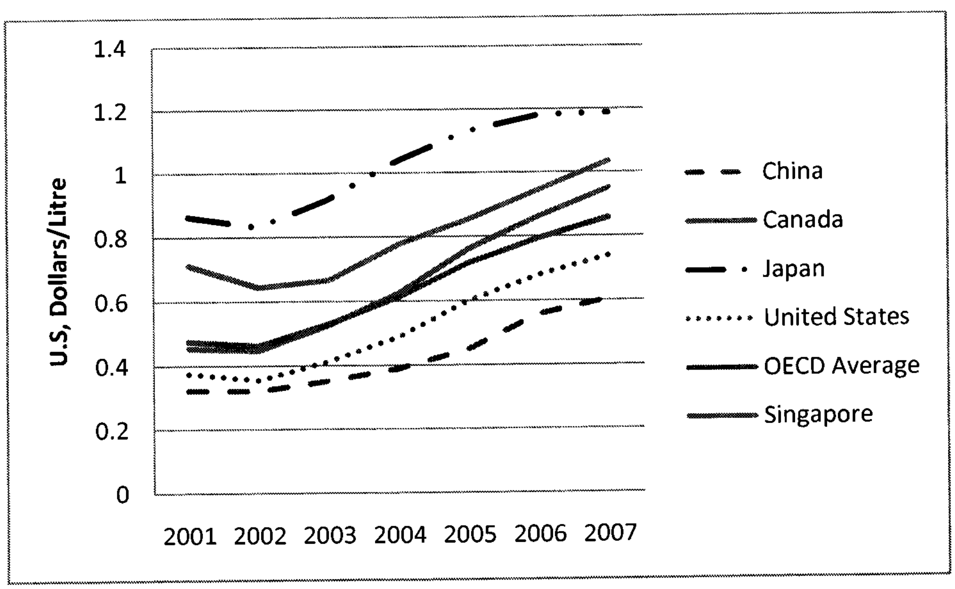
Source: IEA, 2008a

Figure 9: Automotive Diesel Prices for Non-Commercial Use



Source: IEA, 2008a

Figure 10: Regular Unleaded Gasoline Prices



Source: IEA, 2008a

During 2007 and 2008, international crude oil prices rose rapidly. According to CAPP (2009), the near-month futures price of West Texas Intermediate oil (on the New York Mercantile Exchange), rose from US$54.35 in January 2007 to as high as US$134.02 per barrel in June 2008 (monthly average prices), representing an increase of almost 150% in just 18 months. Further, as an indication of the fluctuation of world oil prices with regard to the period covered by Table 1, oil prices (WTI) rose from US$12.49 per barrel in January 1999 to US$65.54 per barrel in January 2006 (monthly average), representing an increase of 425% over the concerned period (CAPP, 2009).

However, prices for Chinese refined oil products did not increase accordingly during the same periods, as they were purposely limited at low levels. In the middle, domestic refiners found themselves financially squeezed. As a result, shortages of diesel and gasoline became a serious problem, as refiners and gas stations at times limited or suspended their operations to cut their losses. Meanwhile refiners with export licenses tended to increase the proportion of refined products destined for the international market (Yang, 2008b).

To deal with this problem, the Chinese government attempted to encourage production by offering refiners 400 yuan per ton of diesel or gasoline produced for local consumption. This compensation was not incentive enough, as the offer had little effect on production. (Li, 2008d) As a result, in order to secure local supply, the government imposed tighter restrictions on exports of refined oil products, making it more difficult to obtain the necessary licenses (Yang, 2008b).

As with generators and electricity subsidization, the plight of refiners is a useful indication of whether or not the consumer price of gasoline and diesel are being subsidized. Refiners' profit margins have, in fact, been negative or very thin. Rosen and Houser, (2007) claim that the industry lost US$5 billion in 2006. Further, JP Morgan predicted that at international crude and domestic refined oil prices prevailing in June 2008, refiners would lose a total of 180 billion yuan (around US$26 billion) for the year (Li, Yang and Li, 2008). However, it should be noted that international crude prices began to fall shortly thereafter.

In an interview with Caijing Magazine, Morgan Stanley's chief economist for greater China, Wang Qing, said that the Chinese government provided $US27 billion in subsidies to help refiners in 2007, representing 0.8% of China's GDP that year. Wang also estimated that the country was on track to hit US$100 billion in subsidies in 2008. (Li, Yang and Li, 2008)

On June 20, 2008, the NDRC finally allowed retail price hikes of 16% and 18% for gasoline and diesel respectively. Exceptions were provided for public transportation, taxi drivers, farmers and low income families however. The move was made in order to decrease the gap between high international crude prices and low domestic prices for refined products. (Yang and Li, 2008; IEA, 2008b)

A proper price-gap analysis should be conducted in order to determine what level of subsidy currently exists for refined oil products and which consumers are most heavily subsidized.

Energy Subsidies and Emissions

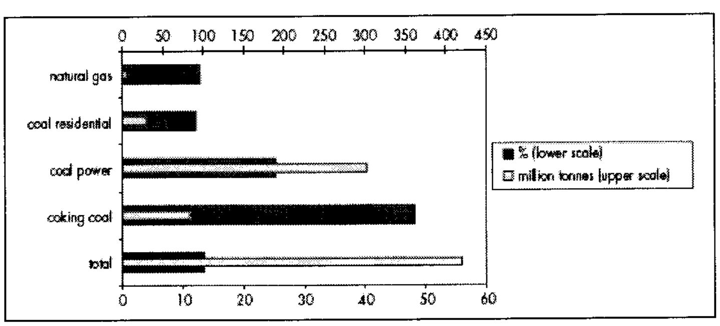
IEA (1999) examines the potential effects of the removal of subsidies to energy consumption on associated CO_2 emissions in several countries. A constant-elasticity inverse demand function is used to describe the relationship between prices and quantities demanded: $Q = P^{\varepsilon}$. The change in consumption from the removal of an artificially low price control is calculated as $\Delta Q = Q_0 - Q_1$. Simple manipulation yields:

$\ln Q_1 = \varepsilon * (\ln P_1 - \ln P_0) + \ln Q_o$.

P_0, Q_0, P_1, and Q_1 represent the actual end-use price and quantity and the reference price and quantity respectively. In order to determine the price gap's impact on CO_2 emissions, the decrease in consumption from the removal of the price gap was multiplied by the relevant carbon dioxide emission factor: $\Delta Q * CO_2EF$. A different emission factor exists for each fuel type.

The study found average distortions in Chinese energy prices of 11%. It was estimated that the removal of price distortions would lead to energy savings of 10% and to a 13% reduction in CO_2 emissions. (Note that in this case, China was necessarily in an overall state of over-consumption with regard to the types of energy considered, as the removal of price controls was shown to decrease consumption.) It was also noted that the largest returns in energy savings and reduced CO_2 emissions would be achieved by the elimination of subsidies in the coal sector (IEA, 1999). Figure 11 shows the results by energy type.

Figure 11: Reductions in CO_2 Emissions through Subsidy Removal



Source: IEA 1999

The IEA study only undertakes explicit emissions reductions calculations with regard to CO_2 emissions. It is important to extend these calculations to other polluting emissions, particularly those with hazardous local effects (such as SO_2) as these are of greatest concern to Chinese government. Further, in order to help government prioritize its efforts, the effect of the removal of subsidies to *each type of fuel* (e.g. thermal coal, coking coal, gasoline, diesel, electricity, etc.) for each polluting gas considered (e.g. CO_2 , SO_2, etc) should be identified. It could also be beneficial to narrow calculations even further in order to determine the effects of the removal of specific subsidies (e.g.subsidies to gasoline consumption for personal transportation) on emissions (as opposed to grouping all gasoline subsidies together). All calculations need to be up-to-date in order to provide accurate and relevant information.

Further Considerations

State-owned enterprises in China receive many benefits such as cheap land, large depreciation allowances on capital, soft loans and the lack of requirements to pay out dividends to the shareholders (i.e. the public). These benefits could be an indirect subsidy to energy consumption if some of the benefits get passed from energy producing SOEs to consumers in the form of sub-market prices. Perhaps more importantly, the benefits that energy consuming SOEs receive enables them to consume more energy, not by reducing energy prices for consumption, but by creating greater budgetary space ate prevailing energy prices. These subsidies to energy consuming enterprises (not to energy consumption directly) could be keeping unviable business alive, or allowing inefficiencies leading to increased energy use and pollution (Rosen and Houser, 2007).

Another important topic is that of current energy consumption trends in China. Although heavy industry and investment-led energy demand are today seen as the drivers of energy consumption, Rosen and Houser (2007) predict that consumption-led energy demand (e.g. heating, cooling, and transportation) will be the driving force in the future. They write:

> (…) Chinese households are reaching income levels at which energy-intensive consumer goods, like air conditioners and automobiles, are within reach. Historically, when countries reach $5,000 per capita GDP, the commercial and transportation sectors start to surpass industry as energy demand drivers. China's per capita GDP today is $2,000, up from about $200 in 1978. But in more affluent coastal provinces, per capita GDP has surpassed the $5000 mark. (p.14)

Figure 2 supports this view. As the graph shows, the number of passenger vehicles on the roads of China has been growing exponentially since 1995. Transportation now accounts for the greatest growth in oil consumption (Rosen and Houser, 2007).

The elimination of consumer subsidies for diesel, gasoline and residential electricity is seemingly not considered to be a pressing issue at the moment. This issue will likely be at the forefront of energy debate in China in the future, however. China should perhaps consider a system to gradually phase out these subsidies before getting stuck in a political dilemma at a point when consumers are more vocal about, accustomed to, and dependent on energy-subsidized lifestyles. According to IEA (2008b), the removal of subsidies to oil products would have a significant effect on demand, and therefore emissions, especially in the long term.

Conclusion

As the IEA (1999) did for CO_2 emissions, it would be beneficial to combine current price gap analyses of China's energy situation with relevant price elasticities of demand and emission factors in order to get some perspective on how much energy could be saved and by how much associated emissions could be reduced by removing particular energy subsidies. Such analysis need not be limited to CO_2 emissions. An analysis regarding emissions such as SO_2 would likely be very useful as the Chinese government is primarily concerned with emissions causing serious local environmental degradation.

It would also be interesting to see a study on how widespread non-compliance with government regulations are. Specifically, an examination of the severity of the violation of current emissions regulations as well as associated environmental and economic cost could provide a clearer picture and pressure the government to take stronger action on enforcement. Studying failures to comply with central government price hikes for energy, such as in the electricity sector, could provide equally useful information.

Finally, an extremely important consideration in energy subsidy removal in China is how to convince the government to remove them. In addition to being prepared to deal with political backlash, the government must be convinced that efficiency and economic savings associated with subsidy removal outweigh the perceived benefits of keeping them in place. As far as focusing on emissions, the government is seemingly willing to work towards the reduction of local air pollution. China has taken a stance that reducing GHG emissions is not a top priority, and that it is up to the developed world to take the lead on this particular issue. However, since local air pollution and GHG emissions come largely from the same source (burning of fossil fuels), there is an opportunity to address the latter by encouraging Chinese leaders to address the former. OECD (2007) provides a discussion of this challenge.

Energy pricing in China varies over time, sectors, and space. An analysis of subsidies can be most telling if the analyst focuses on particular consumers separately (e.g. industrial, commercial, residential). Further, calculations of consumer subsidies over space (e.g. by province or major municipality) could provide greater insight into where subsidization is most pervasive (especially with regard to electricity pricing).

Upstream markets in China, such as the markets for coal and crude oil, have largely been liberalized yet downstream prices, such as the prices of refined oil products and electricity, remain tightly controlled by the government. However, it is important to understand that price controls do not necessarily imply subsidies. A government-set price could just as easily be higher than the equilibrium market price than below it.

Further, prices set at artificially low levels do not always represent intentional subsidization on the government's part. In certain instances, China's subsidization of the consumption of particular energy products may be a result of the government's failure to accurately predict or adjust to the true equilibrium price. Such cases mainly occur in the short-term as necessary pricing adjustments can be made in time. In other cases, however, the government intentionally keeps prices for consumers at artificially low levels. This could occur for many reasons such as social policy and hopes of stimulating or maintaining economic growth. In these cases the government would be the most apprehensive to raise prices, as it is reluctant to abandon original policies, and fears inflationary effects as well as political backlash.

Analyzing producers' profit margins can be a useful tool in indicating whether consumer prices are set at artificially low levels. If producers cannot cover their production costs, which is a re-occurring problem for power generators and oil refiners in China, prices are likely set below equilibrium levels. Nonetheless, the price gap approach to measuring subsidies to energy consumption is the most robust approach, as it accounts for subsidization in the case of super normal profits.

In order to determine whether the government is intentionally keeping prices at artificially low levels, it would be helpful to determine whether the reduced prices persist over time for a particular fuel, and or a particular consumer group. In China's case, household consumption has been intentionally subsidized across fuels (electricity, gasoline, and diesel) and time. As for energy consumption subsidies to the industrial sector, although intentional subsidization likely takes place (especially for refined oil products), it would be useful to look at respective time-series price-gap analyses.

Tangible transfers of money from the government to a given party tend to receive much attention when analyzing subsidies and are the focus of much criticism. In China, however, these transfers are in large part a consequence of price controls. In many cases, transfers to producers are not in themselves an independent choice to subsidize as with direct operating subsidies, but a manifestation of the chosen pricing level and structure. Decisions behind end-use pricing are where the choice to subsidize truly lie in China's case. In this case, artificially low prices cause subsidizing grants and transfers, and not the other way around. These government grants to producers are used to fight shortages that are induced by the artificially low pricing. So long as such transfers are large enough to bring production beyond the original equilibrium level, there will be over-consumption.

China is aware of the inefficiencies in the pricing of many of its energy products as well as the associated environmental effects. In response, China has been making structural and policy changes across sectors and has been making progress over the past few years. Sizeable energy subsidies do remain, however, and China needs to keep pushing for their elimination.

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