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Watch the price of carbon!

CEPS Commentary

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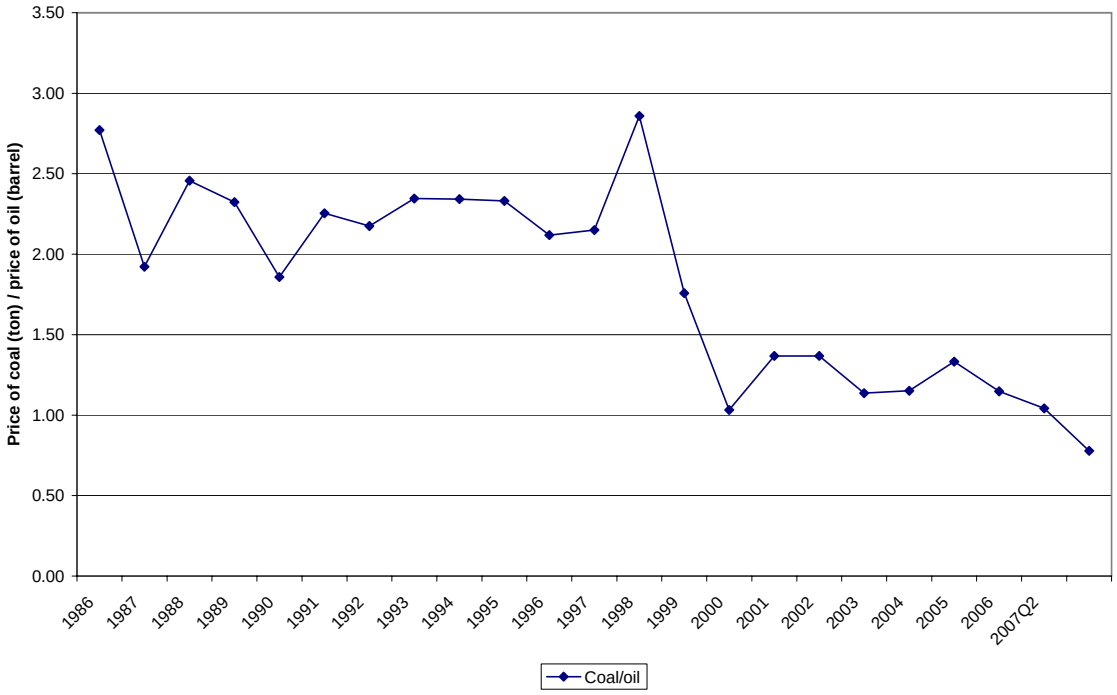
World leaders have just finished intensive discussions on how best to reduce emissions of the greenhouse gas CO_2. The agreement reached at Bali represents only a 'road map', which should make it easier to attaining the target of a new agreement on limiting CO_2 emissions once the Kyoto Protocol expires in 2012. Since the Kyoto Protocol came into force in 2002, the scientific evidence for the need to curb CO_2 emissions has strengthened even further and in most industrialised countries public opinion firmly supports the goal of limiting global warming.

However, the first years of the 21st century have also witnessed an important change in relative prices that will make it more difficult to achieve meaningful reductions in CO_2 emissions. The key development over the last years is simply that the price of coal has fallen considerably relative to the price of crude oil, as the figure below illustrates.

Long term evolution of the relative price of coal



This figure documents that the *relative* price of coal (here measured as the average of the price of coal in Asia and Europe relative to that of crude oil) has halved since the turn of the century. This has occurred despite an increase in the nominal price of coal because the price of oil has

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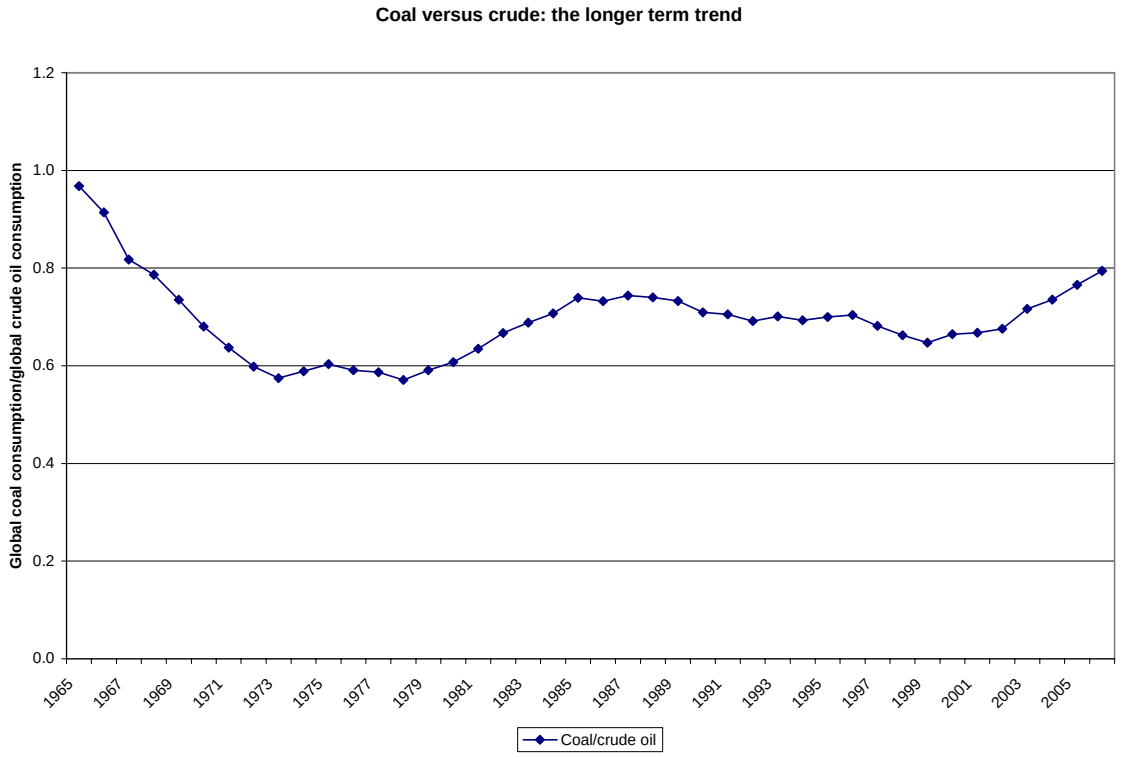
increased much more, the most recent run up in oil prices added a further leg to this trend, but most of the reduction in the price of coal had already occurred by the year 2000.

The relative price coal/crude oil is important for the debate about global warming because coal consists only of carbon, whereas an important part of crude oil (a 'hydrocarbon') consists of hydrogen atoms. For this reason, the use of coal leads to much higher CO_2 emissions (per unit of energy created) than the use of crude oil. One needs about 1.5 tonnes of oil to generate the same amount of thermal energy as one tonne of crude oil. The same argument applies, a fortiori, also to natural gas, whose calorific content, to an even greater extent than that of oil, is based on hydrogen atoms. Nevertheless, the discussion here concentrates on oil, since its price is more widely known. Oil, however, is really just shorthand for hydrocarbons since the price of gas has so far usually followed that of oil. Moreover, at least in Europe, gas prices are contractually indexed to the price of oil.

The current low relative price of coal presents a serious obstacle in the way of achieving the goal of reducing CO_2 emissions since it encourages the substitution of oil with coal. This is already happening (and has happened in the past), as can be seen from the figure below which shows global consumption of coal relative to that of oil.



The evolution of relative coal consumption fits very well that of the relative price of coal. During the 1960s, when the price of oil was very low, consumers massively substituted coal for crude oil. This practice changed when the price of oil shot up in 1973. The relative high price of coal during the 1980s, illustrated in the first figure above, then led again to substitution away from coal starting towards the end of that decade. More recently the use of coal has clearly accelerated along with the decline in its relative price.[1]

The main area where this is possible (and indeed happening on a large scale) is in electrical power generation and to some extent in steel production. Any switch towards or away from coal on a large scale needs heavy capital investment, and hence the mix of energy input is largely

[1] Other factors have of course also been at work: during the 1960s, private transport strongly expanded and more recently electricity consumption has grown significantly, as the service sector is now the main engine of growth.

determined by the nature of the capacity already installed (coal-fired versus gas-fired power stations) in the short run. However, for all new investment, substitution can follow relative prices. This means that a long period of low coal prices (relative to hydrocarbons) will guide investment towards coal-intensive uses, which will be difficult to reverse later should the relative price change again (lock in effect). Given that China is likely to install over the next decade more new power generation capacity than already exists in all of Europe, this implies that the current level of high oil prices provides an incentive to make the Chinese economy even more intensive in carbon than it would otherwise be, given the country's vast reserves of coal. This situation will be very difficult to reverse even if China's energy demand growth slows down once its income per capita comes closer to that of the OECD average.

The relative price of coal will thus have an important impact on the energy mix used by consumers. But the relative price of coal can stay low only if the increased demand can be satisfied by an elastic supply response. This should be the case since the known reserves of coal are worth hundreds of years of production and in reality the supply of coal has grown over the last 5 years by 30%, although the price of coal has increased rather less than that of oil. By contrast, the production of crude oil has increased only by around 9% over the same period, indicating that the supply of crude oil is much less elastic than that of coal.

It is often thought that high oil prices could contribute to lower CO_2 emissions because they make energy more expensive, thus encouraging lower energy consumption. But this view overlooks the fact that a high price of oil relative to coal encourages the substitution of a hydrocarbon with pure carbon, thus increasing the carbon intensity of energy use. The supply of coal is abundant, especially in the new emerging energy giants China and India, and is relatively elastic. This implies that the price of coal is likely to stay low, thus encouraging an increase in the carbon intensity of energy use everywhere. Reaching the goal of reducing CO_2 emissions will thus be even more difficult than generally assumed if oil (and thus also gas) prices remain at present levels.

The latest World Energy Outlook from the International Energy Agency has already forecast, under a business-as-usual scenario, an increase in the share of coal in global energy use. But business has not been 'as usual' over the last five years, with one-half of the increase in global energy consumption coming from coal, thereby prompting acceleration in global CO_2 emissions. Sustained high hydrocarbon prices will intensify this trend making it highly unlikely that the goal to reduce CO_2 emissions can be reached.