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Long Run Trends in the Price of Energy and Energy Services

Roger Fouquet[1][2]

Energy prices have risen considerably since the beginning of the twenty-first century. It is valuable to place these price rises within a historical context. Many peaks preceded the price hike of 2008, and there will, no doubt, be many more. However, if future trends follow past ones, then it is tempting to conclude that the long run trend in individual and average energy prices will be generally stable or downward. This policy briefing also highlights the tendency for long run trends in the price of energy and of energy services to diverge. That is, since the Industrial Revolution, energy efficiency improvements have led the price of energy services to fall far more than the decline in the price of energy. This is an important distinction because commentators have a tendency to focus on energy prices, even though consumers are ultimately interested in the services that energy provide. This divergence in the long run has major implications for forecasts of future energy use and carbon dioxide emissions, welfare improvements and the evolution of economies.

Keywords: energy prices, energy services, long run.

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1. Introduction

Rapidly rising energy prices in the first decade of the twenty-first century led many to ask about their long run trends (Maugeri 2009). To provide a long run perspective on energy prices, this note builds on an article published in the *Review of Environmental Economics and Policy* (Fouquet 2011a). This policy briefing also highlights the differences between trends in prices of energy and of energy services. This is an important distinction because commentators have a tendency to focus on energy prices, even though consumers are ultimately interested in the services that energy provide, such as space and water heating or cooling, powering of appliances, illumination and transportation (Goldemberg et al. 1985).

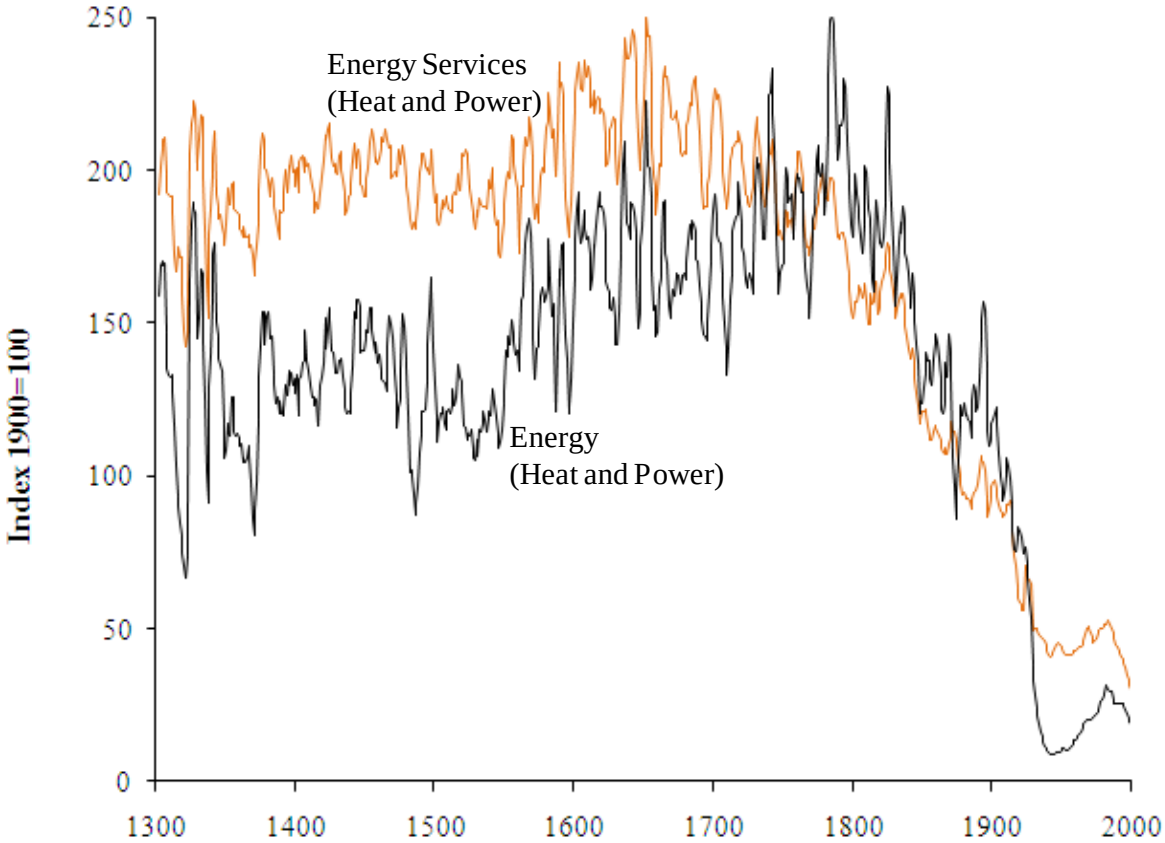
2. Long Run Trends in Energy Prices

The broad trend over the last seven hundred years in British prices associated with energy and their services was first upwards, as the expanding economy faced increasing pressures from consuming mostly limited renewable energy resources, and then downwards, as fossil fuels replaced them (see Figure 1).

Energy prices - associated with biomass fuels and fodder for horses (known as provender), before the diffusion of coal and steam engines - rose up to the nineteenth century, reflecting the growing pressure on land and, thus, agricultural products and the lack of large-scale substitutes. It appears that economic growth met by renewable energy sources resulted in higher prices – although not as a national energy crisis as suggested by Nef (1926).

However, these experiences in Britain – a small, densely populated island - do not imply that economic growth dependent on renewable resources is destined to suffer increasingly higher prices (Allen 2009, Fouquet 2011b). In fact, Figure 1 shows that the decline in the price of energy services (at the time, heating and power) began in the mid-seventeenth century. This was the result of more efficient horses

being used. At the same time (but not shown in Figure 1), transport services were also improving. Thus, within the confines of the renewable energy system, there were attempts to resolve the problems posed by growing demands for resources.



Source: Fouquet (2008), Allen (2007) * Five-year averages

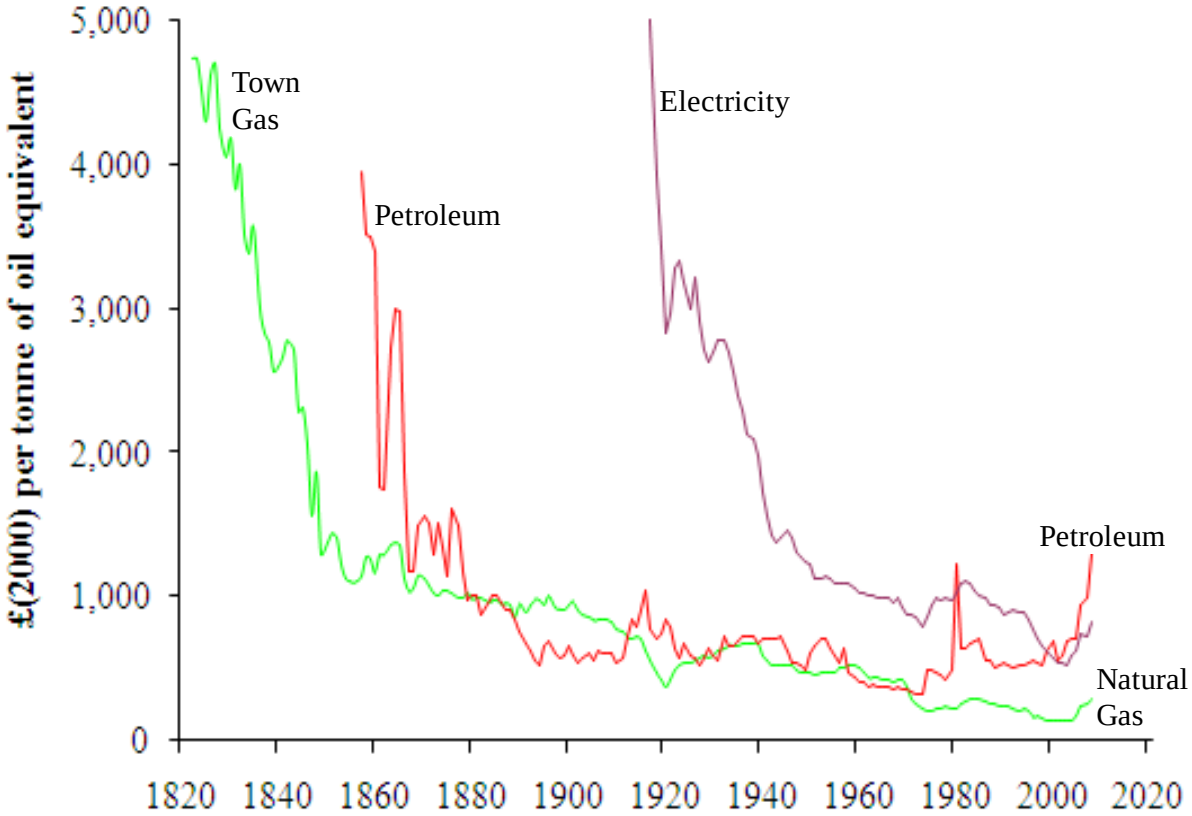
Figure 1. Average Price of Energy and of Energy Services (Heating and Power) in the United Kingdom (1300-2000)*

As mentioned before, for energy prices, the decline occurred later, at the beginning of the nineteenth century with the increased use of the steam engine. The average price series for energy in Figure 1 is heavily dominated by the price of power fuels until the second half of the nineteenth century, as

provender, the fodder for horses, (as well as food and water power, which are not included here) was replaced by cheaper coal. Without the switch to fossil fuels, the growth of the British economy (and possibly many other economies) would have been severely constrained and may have faced further increases in the average energy prices.

Economic transformations that were taking place in the nineteenth century led to the innovation, development and expansion of markets for a whole series of new energy sources and technologies. In particular, new fuels, such as town gas (which was derived from coal) and kerosene (made from petroleum), and then electricity were being used. Swiftly after introduction, their prices fell dramatically (see Figure 2).

For example, despite great volatility in the first decades, by 1900, the price of oil had fallen six-fold in forty years and remained comparatively stable for more than fifty years (Hamilton 2011). Like coal for heating in the seventeenth and eighteenth century (see Fouquet 2011a), the strong dependence on oil for transportation has led the United Kingdom government to rapidly increase the tax rate over the last twenty years – in 2000, three-quarters of the price of gasoline was revenue for the government (Sterner 2007) - and the trend in prices reflects this process, rather than providing clear evidence of growing long run resource scarcity. So, while many have focused on the volatility in petroleum prices in the last few decades, and the signs of short run supply shortages associated mostly with political disturbances, the history of petroleum has been (to a great extent) one of declining and then stable prices with occasional peaks.



Source: Fouquet (2008), Allen (2007)

Figure 2. Prices of New Energy Sources in the United Kingdom (1820-2008)

The tendency for markets to offer new energy sources and for consumer to substitute between them implies that even if individual fuel prices may rise in the long run (and there is limited evidence to support this for fossil fuels), average energy prices reflect the substitution between sources towards cheaper energy services. Thus, in general, where resources are not limited by land availability and substitution is possible, we might expect average energy prices to trend downwards. The downward trend over the last two hundred years corroborates earlier studies (Adelman 1995, Livernois 2009) suggesting that, in the eyes of the market (and despite some commentators concerns), energy resources have been perceived to be `unlimited´.

3. A Comment on Future Trends based on the Past

However, energy prices have risen considerably since the beginning of the twenty-first century (see Figures 2). Undoubtedly, global demand for energy services and, thus, energy has soared, especially as the Chinese economy has expanded. This growth placed considerable pressure on energy supply infrastructure, which fed through into higher energy prices.

The global recession is allowing energy producers and suppliers time to expand reserves and, more importantly for short and medium term prices, infrastructure (Maugeri 2009). Greater expansion of natural gas reserves will, no doubt, also assist long term trends. And, the development of technologies to tap unconventional natural gas reserves at lower cost than would have been possible a decade ago implies very large fossil fuel reserves (Stevens 2010). In 2010, the current global primary (modern) energy consumption was 12,000 mtoe (million tonnes of oil equivalent) or 500 Exajoules (BP 2011). An estimate of global fossil fuel reserves is close to 30 million mtoe (Rogner 2000 p.168). This is nearly 2,500 times the current annual global primary energy consumption. Unconventional natural gas reserves are particularly important – roughly 80 percent of the total. But, even for oil reserves, the estimate is more than 450 times the current annual global oil consumption. Thus, even allowing for economic and population growth, fossil fuels are abundant (at least, for many years to come), and atmospheric limits for assimilating greenhouse gases will probably be reached well before fossil fuel limits.

Although there are abundant resources, many of them are at higher costs than Saudi oil or gas extracted in Qatar. So, there is likely to be a gradual shift over the next few decades to costlier fossil fuels. However, just like in past centuries, energy producers of the twenty-first century have strong incentives to lower their costs of production. In fact, they face fiercer competition than ever, and are only likely to keep their market shares and their shareholders happy if they find ways of lowering costs. So, future fossil fuel

prices will be influenced by these two opposing forces, higher costs of production and the incentives to lower them, and it remains to be seen which of these forces will dominate.

Placed in a historical context, it is clear that many peaks preceded the price hike of 2008. Between the seventeenth and the nineteenth century, commentators anticipated coal prices to rise, with grave impacts on the economy. Temporary hikes were faced, but price trends, in the long run, stayed remarkably stable. Suppliers continued to deliver - finding new and deeper reserves, and hiring more workers and capital to meet the demand. In the 1920s, the new energy sources, petroleum and electricity, temporarily struggled to meet the rapidly increasing demand for personal transport, power and lighting. Prices peaked, and then the capacity of petroleum and electricity industry expanded to meet the new needs. Similarly, in the 1970s observers were expecting permanently higher energy prices. Yet, from the mid-1980s, and despite more peaks, nearly twenty years of low energy prices followed. So, despite many peaks in the past, markets adjusted. Suppliers found new reserves and built greater infrastructure. Consumers, where possible, reduced wastage, increased efficiency and substituted to cheaper sources. And, long run trends in individual prices continued a relatively stable and slightly downward trend.

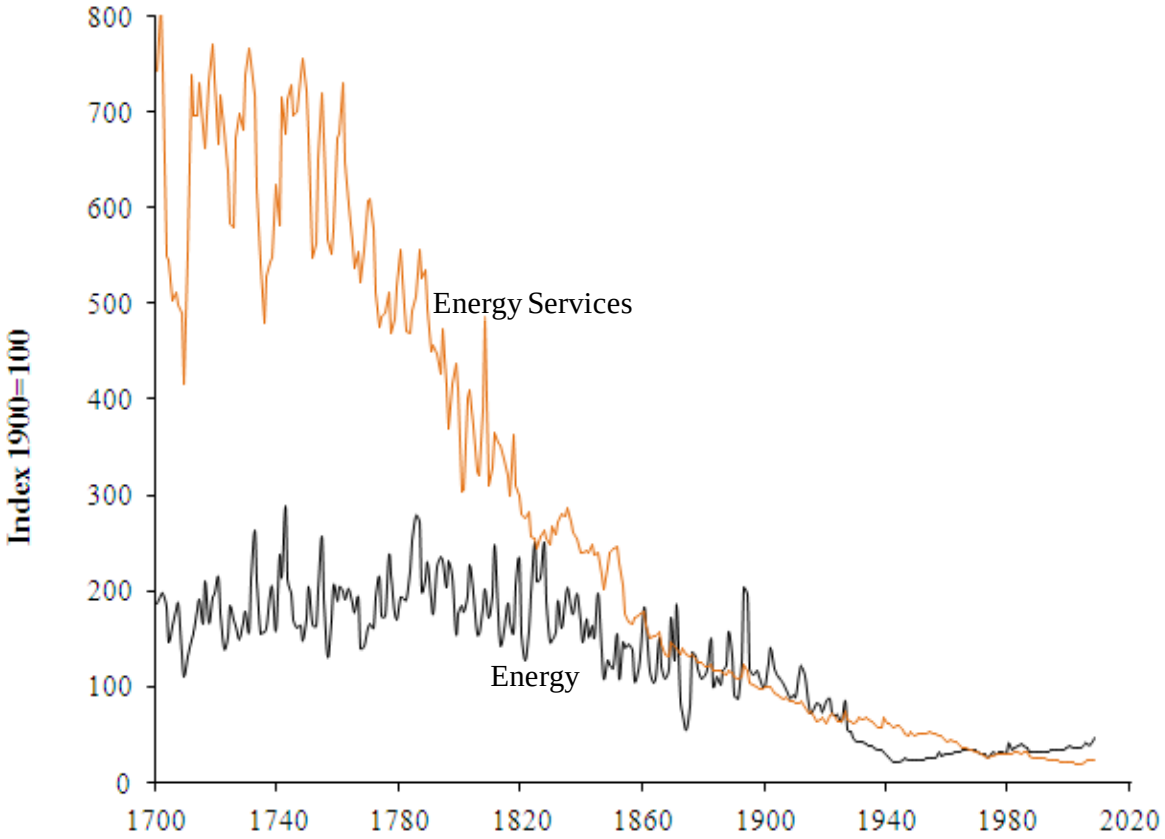
It is possible that future trends will not follow the same patterns as past trends. But, if they do, then it is tempting to conclude that the long run trend in individual prices will be generally stable or downwards, although peaks can be expected. And, the long run trend in average energy prices will be downwards, because of the tendency to substitute towards the cheaper fuel.

4. Divergences in the Price of Energy and Energy Services

William Nordhaus (1996) first identified this divergence for the price of lighting and of the fuels used for lighting. While the very broad trends in the prices of energy and energy services are similar (upwards then

downwards), especially since the Industrial Revolution, Fouquet (2011a) shows that their trends have diverged. In other words, the divergence is general to all energy services (heat, power, transport and lighting) rather than specific to lighting.

The last two hundred years has been a period of exceptional technological innovation in history. The cost of generating services has changed greatly as a result of the ability to use resources more efficiently, rather than just from the price of the resource. Consequently, focussing exclusively on the long run trend in energy prices might be responsible for misleading conclusions.



Source: Fouquet (2008), Allen (2007)

Figure 3. Average Price of Energy and of Energy Services in the United Kingdom (1700-2008)

Divergences between trends in the prices of energy and their related services have major implications for the process of studying long run trends in energy markets and climate change. First, as Nordhaus (1996) pointed out, focussing on energy prices in the long run dramatically underestimates the welfare gains to the consumer and should affect traditional measures of the overall consumer price index. The data examined here indicate that, in the long run, people have also been able to heat their homes, push and pull objects, and move people and goods, as well as light their homes, far more cheaply than a simple examination of the consumer price index would suggest. These services have radically altered people´s lives. This evidence further supports the argument that we need to alter the way consumer price indices are measured.

Second, as a result of the radical price decreases, the incentive has been for the economy and society to become more heat-, transport- and light-intensive. Looking forward, while more research is needed to ascertain whether heating and power prices will fall, we can anticipate substantial further improvements in transport and lighting efficiency. Thus, the global economy is likely to become even more mobile and dependent on lighting. This obviously has major implications for both energy markets and climate change.

Third, building on this last point, modellers need to try to estimate the income and price elasticity of the demand for heat, power, transport and light (see, for instance, Fouquet and Pearson 2012), as these drive the behaviour associated with energy consumption and greenhouse gas emissions. After all, focussing only on energy rather than energy services will produce misleading estimates of consumer responses to long run income, price and efficiency changes.

Of course, all the price trends presented do not incorporate the externalised costs of energy use, whether related to air pollution or climate change. There is evidence that these external costs are not necessarily a constant, and change at different phases of economic development (Fouquet 2011c). Thus, to get a truer

measure of the costs of energy use to society, it would be necessary to incorporate the long run trends associated with energy markets, energy efficiency improvements and external costs.

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