

THE EFFECTS OF WEATHER AND FUEL OIL SHOCKS ON ENEMALTA'S PROFITS

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Abstract. Several electricity companies, including Enemalta, face a regulated maximum consumer price on the electric units they produce and supply on the market. This regulated consumer price gives rise to financial losses for the electricity company because it causes a divergence between the unit cost and the consumer price of each unit of electricity demanded and supplied. Unexpected changes in temperature increase the demand for electricity at the regulated price and cause even larger financial losses for the electricity company. Similarly, unexpected increases in fuel oil costs increase the production cost per electric unit and also widen the financial losses for the electricity company. The long history in Malta of political regulation and social intervention in the electricity market, make it very difficult to transform the regulated consumer price into a market clearing equilibrium one. This paper argues that the only option for the electricity company is to use derivatives to insure away the financial losses brought about by unexpected temperature and fuel oil shocks.

Introduction

In modern economies electricity companies are a vital source in the economic development process since they produce a crucial input needed by households, businesses and manufacturing companies. Electric power is one of the prerequisites necessary to attract foreign direct investment and to enhance faster economic growth. Electricity is also an important utility needed in modern household welfare.

In several countries, governments try to regulate electric utility prices because of the negative effects that high electricity rates would bring on

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households, commercial enterprises and direct production companies using considerable amounts of electric power. Under normal conditions, these regulated maximum electricity prices might be sufficient for the electricity company to break even or even make a small overall profit. However, electricity companies regularly face demand and supply shocks that under a regime of non-market clearing equilibrium prices, will result in significant financial losses for the electric utility companies.

One important source of demand shocks arises from variable weather and abrupt changes in temperature (Bellis, 2000). Large increases in temperature in summer will force the electricity company to produce at above normal operations to meet the extra demand for air conditioning units. Similarly, sudden drops in temperature in winter will also force the electricity company to increase output generation to meet the demand for heating units. If the marginal cost per unit of extra output generation is larger than the marginal revenue per unit collected, the overall profitability of the electric company will decline.

Similarly, an important source of supply shocks originates from unexpected changes in fuel oil prices. Fuel oil is the main input in many electricity power plants and accounts for a very high percentage of total input costs. When the price of crude oil rises, the price of fuel oil and the other oil products will rise in parallel too. Higher cost of fuel oil will imply an immediate and direct rise in the cost of electric power generation. If the electricity company is politically constrained with regard to increasing consumer prices, the increased fuel oil cost will result into a direct and proportional decline in the company's overall profit.

Hence the need to insure away the financial losses that will arise with abrupt swings in temperature and unexpected changes in fuel oil prices. Weather derivatives can be used successfully by electricity generation companies to offset the impact on their profitability of sudden increases and/or decreases in temperature (Simpson, 1998). Weather derivatives have become one of the fastest growing risk management instruments in the United States and Europe (Arditti *et al.* 1999). Their effectiveness is manifested by the fact that the United States Department of Energy has estimated that one-seventh of the United States economy is subject to weather risk (Hull, 2003).

Similarly, fuel oil derivatives can be successfully used to hedge away the financial losses that electricity companies will suffer with unexpected increases in fuel oil prices.

Electricity companies can hedge away the financial price risk that they face using several instruments including futures, swaps, options, exotic options, cross-market derivatives (Risk Publications and Enron Capital, 1998) and even crude oil hedging itself (Krapels and Pratt, 1998).

Enemalta's Position

Enemalta Corporation is comprised of three divisions, namely the electricity, petroleum and gas divisions. The turnover, operating profit and profit before taxation of the three divisions is shown in Table 1 for the years 1996 to 2001. The profits before taxation that are reported in every year by the petroleum division are offset by the losses that are reported each year by the gas and electricity divisions.

The petroleum division enjoys a healthy mark-up on the purchase cost of petrol and diesel, while the electricity division suffers from politically-set maximum consumer prices, volatile fuel oil prices and a constantly increasing national demand for electricity.

The constantly and rapidly increasing demand for electricity can be seen in Graph 1 which compares real GDP at 1995 prices with the total megawatt electricity generated in Malta between 1963 and 2001. Whereas real GDP (in 1995 prices) increased 10.8 times from Lm 130 million to Lm 1.4 billion, actual electricity generated increased 22.4 times from 87 thousand megawatts in 1963 to 1.9 million megawatts in 2001. Hence, in the last forty years, the demand and supply of electricity has risen at more than twice the rate of growth of real GDP.

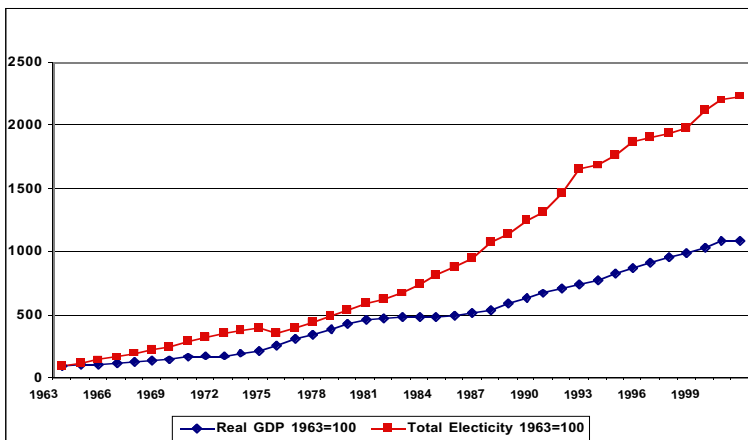
Apart from the constantly increasing national demand, Enemalta's electricity division is constantly facing two shocks: one from the demand side due to the increased unpredictability of winter and summer temperatures, and the other from the supply side due to the increased volatility of fuel oil prices.

Table 1
Enemalta's Turnover and Profits ('000s)

Period	Turnover	Gross Profit	Operating Loss*	Loss before Taxation**
Electricity Division				
1996	34203	2128	-4497	-12757
1997	37116	3742	-3123	-13047
1998	40853	10386	1464	-3489
1999	42657	9204	-982	-9633
2000	48039	5118	-5335	-9661
2001	51528	2310	-7367	-11734
Petroleum Division				
1996	71224	14308	11939	11754
1997	79514	13213	10280	10368
1998	78330	14510	11959	12267
1999	81156	17631	15413	15898
2000	108668	15974	9409	11597
2001	103179	10520	3701	5936
Gas Division				
1996	2489	259	-532	
1997	2528	59	-774	
1998	3154	854	-76	
1999	3386	1072	-17	
2000	3336	-46	-1191	
2001	3121	247	-980	

Source: Enemalta Group: Annual Report and Financial Statements

Figure 1
Real GDP and Total Electricity Generated



The volatility of winter and summer temperatures can be seen in Graphs 2 and 3 which depict the maximum, average and minimum temperatures recorded in every February and August between 1922 and 2000. The other winter and summer months register similar patterns. It is clear from Graphs 2 and 3 that the average temperature in February and August varies from year to year; as do the maximum and minimum temperatures. Moreover, the difference between the maximum and minimum temperatures also varies from year to year and on average, is increasing over time.

In winter, a positive demand shock for electricity will occur when the average temperature suddenly falls from the previous year. In summer, a positive demand shock for electricity will occur when the average temperature suddenly rises from the previous year.

The volatility of fuel oil prices which represents supply shocks for the generation of electricity can be seen in Graphs 4 and 5. Graph 4 depicts the monthly average price of Brent crude for the last 33 years (January 1971 to December 2003), while Graph 5 shows the monthly volatility of daily prices for the last 11 years (January 1993 to December 2003).

Figure 2
Maximum, Average and Minimum Temperatures
February 1922 - 2000

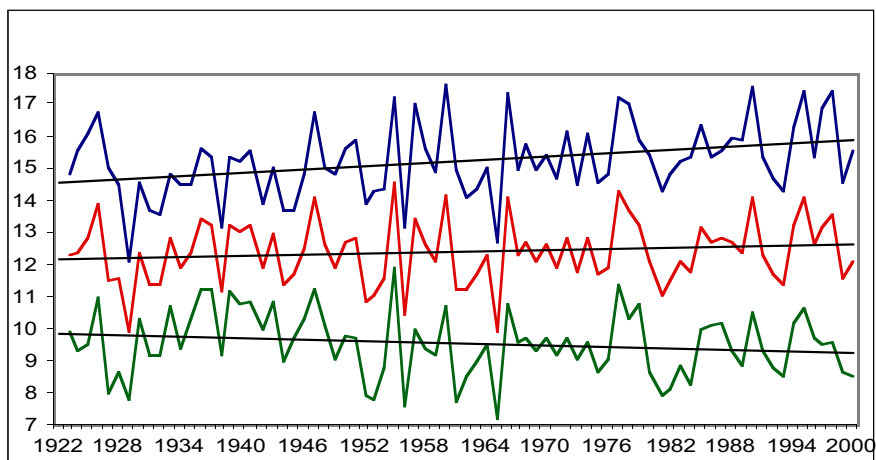


Figure 3
Maximum, Average and Minimum Temperatures
August 1922 – 2002

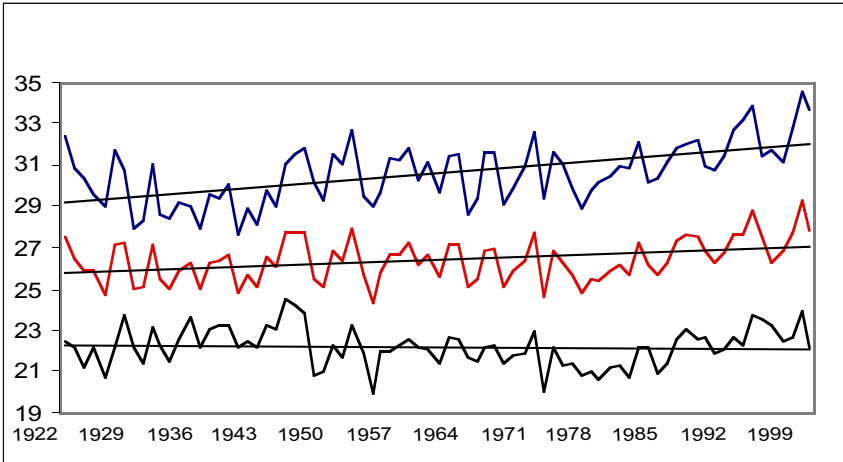


Figure 4
Brent Crude Monthly Average Price

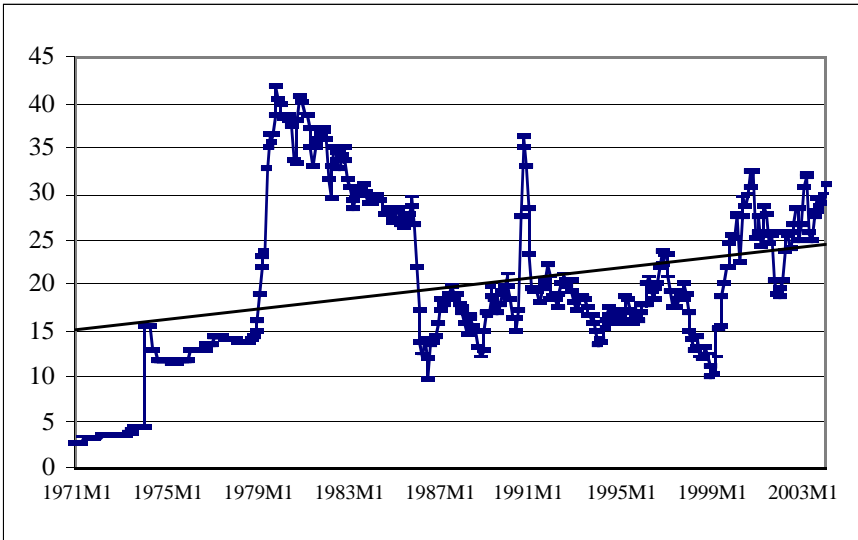
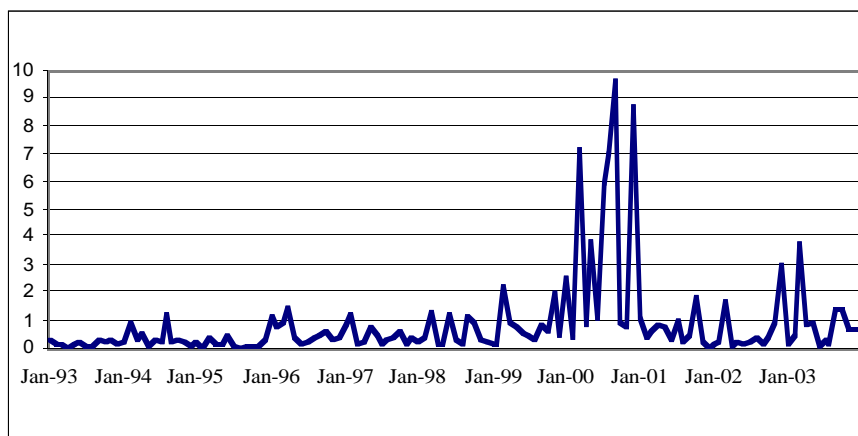


Figure 5
Monthly Volatility of Brent Daily Price



From Graph 5, one notices that monthly volatility was extraordinarily large during the year 2000 and higher than normal during parts of 2002 – 2003. A positive supply shock for electricity occurs when the average monthly price of Brent crude unexpectedly increases over the previous period.

Supply and Demand Shocks

The main problem for several electricity generation companies, including Enemalta, is that electricity consumer prices are "politically" fixed and are difficult to change on a regular basis. This effectively means that consumers face a perfectly elastic supply curve at the determined price and the final quantity of megawatts of electricity produced will be solely determined by consumer demand.

Consumers are expected to face a normal downward demand curve for electricity units with less units demanded as the price of electricity is increased. If there is a sudden unexpected increase in temperature during summer, this will give rise to a higher demand for electricity. For every price per unit, the quantity demanded will increase shifting the demand

curve to the right (Baumol and Blinder, 2001). The same thing will happen if there is a sudden unexpected fall in temperature during winter. For every unit price, the quantity demanded of electricity will increase also shifting the demand curve to the right.

The supply of electricity units is governed by rising marginal cost for higher output of electricity generated (Ferguson and Gould, 1975). This results from the fact that not all generators have the same output efficiency. Hence the most efficient generator is used first, then the second most efficient is employed and so on. Thus the electricity company faces a normal upward sloping supply curve.

Higher fuel oil prices cause a negative supply shock leading to higher cost of producing every additional megawatt hour and forcing the supply curve of electric output to shift upwards. The cost of producing every additional megawatt hour will be increased as a result of the rise in the input cost of fuel oil needed to generate each additional unit of electricity.

Loss for Electricity Company

If the regulated maximum price is set below the equilibrium market price, as usually happens, consumers will demand more units of electricity than they would under market clearing conditions. The electricity company will have to produce a greater number of electric units, and at a higher cost, than it would under flexible market prices. Hence under these conditions, the electricity company will have to incur a financial loss per unit of electricity it produces. The loss will be the difference between the cost of producing each unit (which is larger than the market equilibrium price) and the regulated maximum consumer price (which is smaller than the market equilibrium price).

As already explained, weather shocks induced by an unexpected rise in temperature in summer, or an unexpected fall in temperature in winter, will shift the demand curve to the right and cause consumers to demand more units of electricity at the regulated maximum price. Consequently, the electric company will have to produce this increased number of units at an even higher cost than normal (due to the increasing marginal cost in production reflected in the upward sloping supply curve). Hence under

non-market clearing prices, a weather shock will increase the loss per unit of electricity produced.

The effect of rising fuel costs will similarly increase the losses for the electricity company as explained, higher fuel costs will shift up the supply curve of electricity because every quantity of electric units supplied will simply cost more to produce. Under normal conditions, without the presence of any temperature shocks, consumers would demand the normal amount of electric units at the regulated maximum price (which however is a larger amount than under market clearing prices). Higher fuel costs however cause the cost of production of these consumer units to be higher and consequently increase the loss per unit for the electric company by the increased fuel unit costs.

If higher fuel costs (negative supply shock) are re-enforced with unexpected increases in temperature (positive demand shock), the financial loss for the electric company will be even larger than under the scenario of one shock alone. A temperature shock will cause consumers to demand more electric units than under normal conditions, while a fuel shock will cause an increase in the production cost of these larger amounts of electric units. Hence the financial loss for the electric company will increase due to the increased unit production costs on a larger amount of electricity units demanded and supplied.

Minimising Unexpected Financial Losses

Electricity companies like Enemalta that face a regulated maximum consumer price for their output, find themselves in a difficult position. Removing the regulated price and allowing the market for electricity to clear through flexible and adjustable prices would stop the financial losses and would tend to bring the quantity of electricity demanded and quantity supplied in equilibrium, at the market clearing price. Market clearing electricity prices however, are difficult to establish in Malta due to the long history of political regulation and intervention in this market. An alternative to the financial losses would be for the electricity company to use weather and fuel oil derivatives to insure away any unexpected losses resulting from undesirable temperature and fuel oil shocks.

Weather derivatives are growing with a fast pace in the United States and Europe specifically to help companies insure large unexpected losses brought about by huge swings in temperature (Dischel, 1999). In the situation witnessed above the electricity division of Enemalta can use weather derivatives to insure itself against an unexpected increase in financial losses brought about by sudden changes in temperature. Moreover, fuel oil derivatives can also be used by the electricity division of Enemalta to insure itself against large unexpected increases in fuel oil prices.

When Enemalta faces both temperature and oil price shocks, then both weather and fuel oil derivatives can be used to minimise unexpected financial losses brought about by being forced to accommodate larger electricity demand at higher costs per unit. Weather and fuel oil derivatives will therefore help insure the electric company from unexpected losses brought about by these demand and supply shocks (Mordecai, 1998).

The case for using weather and fuel oil derivatives may become more clear if they are perceived as being like other normal financial instruments used by economic agents to insure away their underlying risk exposures (Briys, 1998). Electricity companies, including Enemalta, insure their turbines and generation machinery, sensitive parts of their power stations, and even normal road vehicles. The yearly annual insurance premium would seem relatively very small compared to a major unexpected breakdown of a power station. Similarly the electricity division of Enemalta can use weather and fuel oil derivative instruments to insure away the major financial risk that it faces from unsustainable financial losses brought about by large unexpected changes in weather and fuel oil prices.

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