Economics of Non-renewable resources

A nonrenewable resource is a natural substance that is not replenished with the speed at which it is consumed. It is a finite resource. A non-renewable resource (also called a finite resource) is a natural resource that cannot be readily replaced by natural means at a pace quick enough to keep up with consumption. Fossil fuels such as oil, natural gas, and coal are examples of nonrenewable resources. Humans constantly draw on the reserves of these substances while the formation of new supplies takes eons.

Most of the resources used today are non-renewable, exhaustible. While we were concerned with the optimal rate of use of the resource in case of renewable resources, our concern in case of non-renewable resource is to find the optimal rate of depletion of the resource. It is important to understand the effects of different rates of exploitation. Since the resource will be exhausted at some point of time in the future, the important questions to be asked are

- How long the resource is going to last
- What should be the optimal price of the resource
- What is the switch point?
- Does the backstop technology come in use in an efficient way?

The optimal rate of depletion is given by Hotelling's rule, named after Harold Hotelling. This rule states that the price of any resource in any time period 't' is equal to the price in some initial period compounded at a given discount rate. Therefore, the owner would be indifferent between extracting the resource now and extracting it afterwards in case the discounted value of the resource remains unchanged. This implies that the resources in the grounds are treated as capital assets. Till now, we have assumed that the extraction cost is zero. However, if we do introduce some positive extraction costs in our model, the optimal price of the resource in all time periods will change. The optimal price of the resource will now be given by the sum of the marginal extraction cost of the resource and the marginal user cost (also referred to as royalty or the resource rent which is the appreciation in the value of the resource that has not been extracted). Our problem now, is to find a way to determine the initial optimal price as well as the time period in which the resource will be exhausted. For determining these two, we introduce the concept of the "price of the backstop technology". Since the resource under consideration is an exhaustible one, the price of the resource is going to be higher as lesser and lesser quantities of it are available. In other words, the exhaustible resource will be supplied at a very high price. At some point of time, even though the resource may not have been fully exploited, the price of the resource may be so high, that some alternate technology or resource which was not economically viable earlier becomes viable. This particular point is referred to as the switch point.

Now, we have the optimal price path given by the Hotelling's rule. We also have the price of the backstop technology. Therefore, we can work in a reverse direction and figure out the initial optimal price. The optimal price will "deplete the resource at a rate which smoothly permits the transition from the existing resource to a backstop resource".

Effects of change in parameters

In this section we look at the effect on the rate of resource depletion and the original price of changes in the parameters we have used so far in our analysis. These parameters are the discount rate, the price of the backstop technology, the stock of the resource, the cost of extraction and the demand for the resource.

Parameter which undergoes change	**Change in the parameter**	**Initial optimal price**	**Time period for which the resource is used**	**Mechanism**
Discount rate	Increases	Decreases	Decreases	Higher discount rate leads to more rapid exhaustion of the resource Resources become more valuable in the present than in the future
Price of the backstop technology	Decreases	Decreases	Decreases	Since the backstop technology becomes cheaper, the switch point is reached earlier
Stock of the resource	Increases	Decreases	Increases	Increase in the stock through discoveries of new reserves or new extraction technologies pushes the price path outward and

				downward, thus lowering the initial optimal price
Cost of extraction of the resource	Decreases	Decreases	Decreases	Recall that(optimal price = extraction cost + marginal user cost) Therefore, a decrease in the extraction cost leads to a decline in the initial price
Demand for the resource	Increases	Increases	Decreases	If demand increases, then the demand curve will shift outwards and consequently the price path of the resource will shift inwards (to the left). Hence, price will increase and the resource will be depleted sooner