Non-renewable resource exploitation and anticipations over demand

Compare how an otherwise similar increase in the demand for a non-renewable resource can affect its price and extraction paths when it is anticipated to when it is not anticipated. (NB The use a four-quadrant graph will help. Assume that the choke price increases also with the demand curve.) In the first case, assume that you are now at time 0 and that the change is anticipated to occur at a future specific date, say at date t_0. In the second case, you are now at date 0 and the change occurs at that same future time t_0, but it is a total surprise. Assume zero cost of extraction. Compare the two cases and interpret.

As we have seen, a present-value maximization of the non-renewable resource must respect the following conditions:

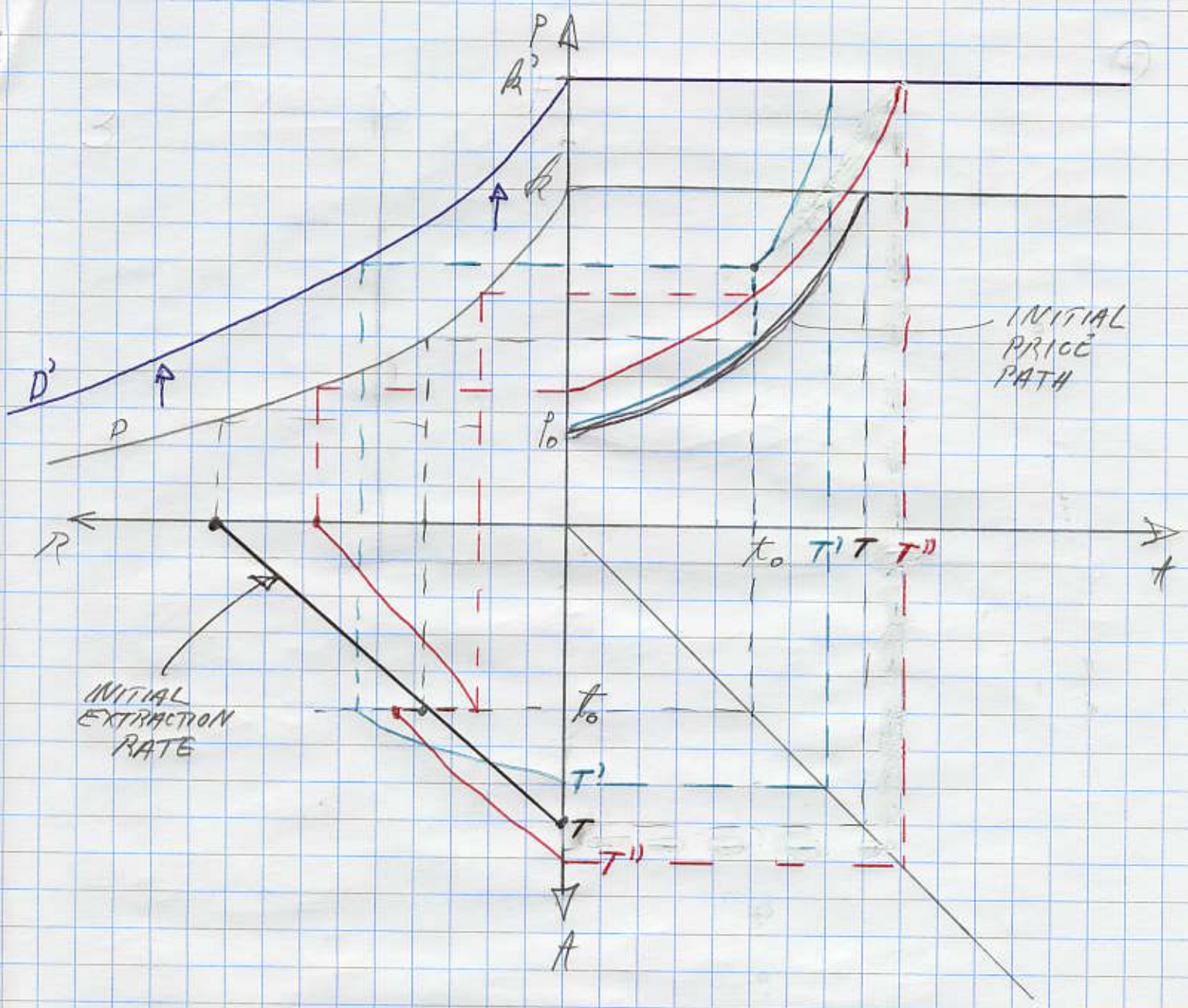
(1) The Hotelling rule: As long as the resource is being extracted, its net price increases at the discount rate;
(2) No resources are left in the ground;
(3) Choose the highest possible price path.

Note that conditions 2 and 3 taken together imply that as the price reaches the choke price, extraction stops and the resource is exactly depleted. Assume that the initial price path on the graphic respects those conditions (in black).

a) **Unanticipated increase in demand** The price must jump up at time t_0 because otherwise, given the higher demand, the resource would be depleted before reaching the new choke price (green curve on graphic). If the resource were depleted early, there would be an anticipated jump in the net price, which would violate the Hotelling rule.

The example given in the graphic shows that the resource is depleted faster than would have occurred without the increase in demand, i.e. $T' < T$. But in reality, we do not have enough information to tell if the resource gets depleted faster or slower than before. All we can say for sure is that there is a price jump at t_0.

b) **Anticipated increase in demand** Since the increase is anticipated, the Hotelling rule can be respected. Indeed, if a price jump were anticipated, extractors would expect an infinite rate of return at time t_0. They would react by extracting less today in order to benefit from that high return, thus driving prices up (price path in red). In equilibrium, the price path must be "smooth" and increase at the discount rate. However, since the demand jumps at t_0 for a given price, the extraction rate does jump up at t_0, as illustrated by the red extraction path. And again, we cannot tell wether the resource will be depleted faster or not; this will depend on the exact shape of the demand curve. After t_0, the green price path must be above the red one because there is less stock left in the unanticipated case, hence $T'' > T'$.



GREEN: UNANTICIPATED INCREASE IN DEMAND.

RED: ANTICIPATED INCREASE IN DEMAND.