We analyze a robust optimal stopping problem in a financial market with volatility uncertainty. This is a zero-sum controller-stopper game in which the stopper is trying to maximize its pay-off against an adverse player which tries to minimize this payoff by choosing the probability measure from a set $\mathcal{P}_t$ of measures who are not necessarily equivalent. In particular, we analyze the upper Snell envelope $Z$ of the reward process $Y$ and by comparing it with the Snell envelope of $Y$ under each individual probability $\mathbb{P}$, we show that $Z$ is an $\mathcal{F}_t \triangleq \inf_{\mathbb{P} \in \mathcal{P}_t} \mathbb{E}_\mathbb{P} [\cdot]$--supermartingale, and a $\mathcal{F}_\tau$--martingale up to the first time $\tau^*$ when $Z$ meets $Y$. Consequently, $\tau^*$ is the optimal stopping time for the robust optimal stopping problem.