The purpose of this dissertation is to answer an important question: How should we plan policy for climate change that is inherently uncertain? To address the issue, this dissertation develops an integrated assessment model of climate change and the economy with fat-tailed risk and learning.

The following sub-questions are dealt with throughout this dissertation.

1. How can we test the Weitzman’s Dismal Theorem numerically in the general expected utility framework?
2. What is the effect of emissions control with regard to the tail effect of fat-tailed risk?
3. What is the effect of learning with regard to the tail effect of fat-tailed risk?
4. Does learning with research investment enhance the learning effect? What is the optimal level of research and development investment in climate science?

Regarding the first research question, the problem is that uncertainty is bounded by definition in a numerical framework with a finite number of states of the world. Therefore, all empirical moments exist and are finite, which is not consistent with the meaning of fat-tailed distribution in an analytical setting. To address this issue, a new method that investigates the curvature of variables of interest such as optimal carbon tax against uncertainty is suggested. More specifically, the evolution of simulated variables of interest against uncertainty is investigated.

Regarding the second research question, we define and classify the terms ‘fat tail’ and the ‘tail effect’ and investigate on how each type of fat tail propagates to the other types of fat tail. Specifically, we focus on whether or not the fat-tailed distribution of climate sensitivity leads to unbounded optimal carbon tax. The main finding is that optimal carbon tax does not necessarily accelerate as implied by the Weitzman’s Dismal Theorem.

The answer to the third research question is related to the role of emissions control. Emissions control has an implicit influence on welfare in that carbon emissions produce information on the true state of the world through temperature increases. Thus, the benefits of emissions control are reduced when there is learning compared to the no-learning case. Since learning has value, this should be accounted for when the decision on emissions control is made. Interestingly, as the effect of uncertainty grows, the learning effect also grows.
Finally, the answer to the fourth research question is that the decision maker opts for fast learning since it leads to a thin-tailed distribution of welfare. In other words, the decision maker chooses to increase the rate of learning since the benefits of learning are greater than the costs of learning. Indeed, the optimal expenditure in climate science is far greater than the current level of expenditure. Consequently there is a need for larger expenditures in climate observations and research. Such investment has value in that the possibility of negative learning decreases and the rate of learning increase.