9 Conclusion

This chapter discusses the main conclusions drawn in this thesis. The conclusions will be made along the lines of the research questions defined in the introduction.

9.1 Time preference

Chapter 2 reviewed the existing literature on time preference and showed that the violations of the constant discounting model are extensive. It also discussed their implications for medical decision making and presented several examples of applications to health-related behavior. It made clear that incorporating the observed violations of the standard model into new models is able to explain anomalous health-related behavior and can be exploited to improve policy recommendations.

Chapters 3 and 4 contributed to the empirical literature on time preference by introducing new measurement methods and performing experimental measurements of discounted utility with these methods. In Chapter 3 a new method to measure intertemporal preferences was proposed, where first utility of money is elicited in a nonparametric way. Moreover, the method elicits utility in an intertemporal domain, so that a uniform setting is used throughout the entire measurement process. Thereafter, time preference can be elicited, correcting for

utility curvature as determined in the first stage. The method was subsequently tested in an experiment. It turned out that intertemporal utility was concave for gains and convex for losses, consistent with a hypothesis of Loewenstein and Prelec (1992). However, utility curvature had not much influence on time preferences. It did lower the gain-loss asymmetry somewhat, but the difference in discount factors between gains and losses remained significant. Another interesting result is that I found this asymmetry even though I used a neutral frame. Therefore, I rejected Shelley's (1993) conjecture that the gain-loss asymmetry can be explained by a framing effect. Further, I found the generalized hyperbolic discounting model of Loewenstein and Prelec (1992) to describe the data significantly better than the constant discounting model, whereas other hyperbolic discounting models gave a similar fit as the constant discounting model. An implication thereof is that impatience is decreasing monotonically over time, and, hence, hyperbolic discounting is not merely caused by an immediacy effect as in quasi-hyperbolic discounting.

A way to measure the degree of time inconsistency, i.e. the deviation from stationarity, without needing information about the utility function for money, was proposed in Chapter 4. This measure was subsequently used in an experiment. Violations of both constant and hyperbolic discounting were found and, instead, discounting was increasing over time, contrary to most of the previous evidence. These results make clear that observed time preferences depend heavily on the elicitation procedure. The experiment of Chapter 3 used a choice procedure and expressed delay in terms of months and years, whereas Chapter 4 made use of a matching procedure and expressed delay in terms of months only. Another important difference concerns the response scale. Chapter 3

had money as response scale, whereas Chapter 4 had time as response scale. More research on the influence of the procedure is therefore warranted.

Chapter 5 investigated time preference for future lifetime. It proposed a risk-free method for measuring the utility of life duration. The advantages of this method over existing methods are that it is not distorted by probability weighting and that is does not need the inclusion of the problematic outcome death. The results of a questionnaire confirmed that respondents find this method easier to answer than both the certainty equivalence method and the tradeoff method, which both measure utility under risk. Utility of life duration was measured in an experiment and compared regarding the three methods. The certainty equivalence method yielded more concave utility than the risk-free method, but this difference was no longer significant after correction for probability weighting. The results of the tradeoff method, which is not distorted by probability weighting, did not differ significantly from those of the risk-free method. It therefore seems that the risk-free method is able to provide a reliable measure of utility and is easy to apply for practical purposes.

Another remarkable finding was that utility could be described better by an exponential function than by the popular power function. These results lend support to a constant *absolute* risk posture over life years instead of a constant *relative* risk posture. This is in contrast to other studies that did not find this result (e.g. Abellan-Perpinan et al., 2006), and is some evidence against the QALY model proposed in the seminal study of Pliskin et al. (1980), because that model requires a linear or power utility for life duration function. An exponential utility for life duration function, on the other hand, has the interesting property that it

corresponds with constant discounting of future life years, which is common practice in health economics.

9.2 Universality of utility

In addition to measuring time preference, the methods developed in this thesis gave the possibility to compare utility in different domains. Chapter 3 compared utility of money elicited in an intertemporal domain to previous findings on utility elicited in risk and uncertainty domains. The findings were rather similar, indicating a universal concept of utility.

Chapter 5 tested whether utility of life duration in a certainty domain differed from utility of life duration in a risky domain. No significant differences were found when correcting for probability weighting. Keeping in mind that probability weighting is a bias that is distinct from utility curvature, this finding is again evidence in favor of universality of utility. These results have important implications. For instance, they support the transferability of utility through different domains and as such support the common practice among health scientists to apply TTO scores (time domain) and standard gamble utilities (risk domain) in economic evaluations (welfare economic domain). Moreover, these results reject the common view in economics that utility is context dependent.

9.3 Time tradeoff method

This thesis has applied the risk-free method of Chapter 5 to TTO valuations in order to investigate the role of the utility of life duration in the TTO method. First, in Chapter 6, I explained how to correct TTO scores for utility of life duration curvature with the risk-free method and estimated the size of this correction. Due to the concave shape of the utility functions, the corrected TTO scores were significantly higher than the uncorrected ones. The magnitude of this difference was approximately 0.05 (6%).

Chapter 7 dealt with procedural invariance of the TTO method. There I considered the influence of utility for life duration on the disparity between two TTO procedures. It was found that correcting for utility of life duration diminishes this disparity, although a large and significant gap remains. This is probably caused by loss aversion.

Finally, Chapter 8 considered the constant proportional tradeoffs property. The existing evidence on this property was reviewed and a new test was performed that investigated whether utilities of life years were traded off in a constantly proportional way. CPTO turned out to hold neither for ordinary life years nor for utilities. This result implies that the QALY model for decision making in health needs reconsideration as a descriptive model for individual preferences over health outcomes.