Executive Summary

Households are both investors and consumers. Their portfolio choices hinge on their beliefs about the future of the economy. The latter will also determine their consumption habits. Thus, we expect financial markets to convey some information on future changes of the real economic activity. In this thesis, we analyze the interplay between investors' beliefs, market movements and the real economic activity using the risk aversion implied by option prices. More precisely, we use options on the S&P 500 to construct a risk aversion index for the United States. We then study the relation between this index and the future real economic activity, as well as its connection to the equity premium. We now give a brief overview of our work.

Starting from a complete market model, we show how to map option prices into the absolute risk aversion of a representative agent. The market model comprises of two assets: the market portfolio and a risk-free security. We do not make any assumption on the dynamics and on the distributional properties of the market portfolio, besides those required for a complete market model. Furthermore, we remain agnostic on the preferences of the representative agent. Such approach entails the lowest possible risk of model mispecification, even if it still suffers from the overly restrictive assumptions of consumption-based asset pricing. Under this setting, we model the Arrow-Pratt absolute risk aversion coefficient as a three-variable function. The three determinants are: the observation time, the time to maturity of the options and the future states of the world. For each observation date, we represent the different risk attitudes as a bivariate random field over the moneyness-maturity domain. Each realization of this random field is a surface which we term: *risk aversion surface*. Therefore, we can study the dynamics of risk aversion surfaces through the Karhunen-Loève decomposition of a random field. We implement this decomposition using a Galerkin scheme based on Gauss-Legendre quadratures. The surface reconstructed from the first 66 KL factors perfectly matches the original one. The first KL factor acts as a level component for the risk aversion surface. Consequently, we use such factor as our risk aversion index and call it: RAX.

The empirical part of this thesis comprises of three sections:

1. We start with a preliminary analysis of the risk aversion surface. In line with the findings of Ait-Sahalia and Lo (2000) and Bliss and Panigirtzoglou (2004), the average risk aversion surface

shows a U-shape in the moneyness domain and an overall decreasing term structure. As market conditions deteriorate, the U-shape gives way to a decreasing pattern across the moneyness domain. Such a shift is in a on-to-one relation with the increased demand for (deep) out-of-the-money put options. Similarly to what happens for shocks in the implied volatility surface, also the risk aversion surface slowly reverts to its average shape. Always in this first part, we examine the behaviour of RAX over time. Our index is counter-cyclical, negatively related with financial markets conditions and positively correlated with some well known indexes of financial and macroeconomic uncertainty. Much like other measures of markets' fear and uncertainty, it posses a linearly decaying auto-correlation and a strong first order auto-regressive component.

2. We then study the relation between RAX and changes in the real economic activity. To this extent, we run eight linear models, each with a different target variable. We consider: industrial production, unemployment rate, real personal consumption expenditure, real personal consumption expenditure for durable goods, real personal consumption expenditure for non-durable goods, retailers sales, housing starts and total capacity utilization. For all the regressions, we include five well established predictors of future real economic activity. RAX exhibits a negative and statistically significant relation with most of these macroeconomic variables. The relation becomes stronger as we increase the prediction horizon. We show that the sign of this relation is stable over time by refitting the model 90 times with an expanding estimation window. For prediction horizons of at least a quarter, RAX outperforms[1] both the CBOE VIX and the level of the implied volatility surface for the S&P 500. For the one month forecast horizon we have mixed evidence, as the VIX/IV-surface outperform RAX once we include the COVID-19 related dates in our analysis, i.e. April and May 2020. This evidence suggests that RAX generates an information set different from those spanned by VIX/IV-surfaces. Hence, RAX is not redundant in the literature.

3. Finally, we document a negative and statistically significant relation between RAX and the one-month ahead equity premium. A negative relation contrasts with the findings of Bollerslev et al. (2009), Bollerslev et al. (2015) and Feunou et al. (2018) on the variance risk premium, a

[1] Here and in what follows, outperforms means that statistical significance is better.

commonly used proxy of market risk aversion. Such negative correlation persists once we control for some well known predictors of the equity premium. As in the case for the real economic activity, RAX dominates the CBOE VIX and the level of the implied volatility surface for the S&P 500 as a predictor of the equity premium. This evidence confirms that our risk aversion index spans a different information set than the CBOE VIX or the implied volatility surface.

In both regression analysis, we control for the degree of persistence of the predictors and for endogeneity using the IVX methodology of Kostakis et al. (2015).