



## SCOR CHAIR

### « Risk Markets and Value Creation »

### Activity Report 2018

*Head of the Chair*                      *Christian Gollier*

*Co- Head of the Chair*                *Stéphane Villeneuve*

*Scientific Council :*

- M. André Lévy-Lang, President of the risk foundation
- M. Sébastien Pouget, Director, IDEI
- M. Philippe Trainar, Director of risks, SCOR
- M. Elyès Jouini, Directeur of Finance, Dauphine Institute
- M. Louis Eeckhoudt Professor, School of Management Lille IESEG
- M. Xavier Freixas, Professor, Pompeu Fabra Barcelone University

*Last steering committee, TSE, University of Toulouse 1 Capitole, June 1<sup>h</sup>, 2018.*

## 1 OBJECTIVE

The SCOR Chair "Risk Markets and Value Creation" was created in 2008 and renewed twice in 2012 and 2017 for a period of 2 years. It has been the result of a process of reflection of the SCOR management that has led IDEI researchers to focus their research on different projects detailed below, all having in common: the study of risk sharing mechanisms.

The aim of the chair is to support the theoretical and applied research on risk sharing with the willingness to combine methodologies from financial economics, industrial organization and econometrics.

SCOR Chair Risk Markets and Value Creation » is built around 4 projects involving a team of dedicated researchers. This report will provide below a synthetic presentation of each project.

We would like to emphasize that SCOR Chair "Risk Markets and Value Creation" is a long-term support for research and several working papers from previous years funded by it have been published in 2018.

## 2 DESCRIPTION OF THE PROJECTS

### a) *Ambiguity and Long-term Investments*

#### IDEI Team

Christian Gollier, Professor of Economics TSE

Nicolas Treich, Research Director INRA-TSE

The aim of this research project is to understand long-term investment decisions under various types of uncertainty (small risk, catastrophic risk, ambiguity etc.), and in particular, the role of temporality and long-term interest rates. The typical applications are long term financial, insurance and environmental decisions.

First, we list below the papers published in 2018, funded and described in the past versions of the activity report

#### Published papers

1. Bernard C., C. Rheinberger and N. Treich (2018), Catastrophe Aversion and Risk Equity under dependent risks, *Management Science*, Vol 64, 10, pp. 4471-4965.
2. Dietz, S., C. Gollier, and L. Kessler, (2018), The climate beta, *Journal of Environmental Economics and Management*, 87, pp. 258-274.
3. Gollier C. (2018), Stochastic volatility implies fourth-degree risk dominance: Applications to asset pricing, *Journal of Economic Dynamics and Control*, 95, pp. 155-171
4. Gollier C. (2019), Variance Stochastic orders, *Journal of Mathematical Economics*, 80, pp. 1-8.

Second, we list the ongoing research agenda of this thematic.

#### Working papers

Three research projects have been launched this year. We summarize them below :

1. Gollier C. (2018), On the efficient growth rate of carbon price under a carbon budget, TSE Working Paper, n° 18-952.

In this paper, Gollier uses a normative version of asset pricing theory to determine the efficient level of the growth rate of expected carbon price in the Hotelling's framework under uncertainty. When an intertemporal carbon budget is imposed to fight climate change, abating emissions earlier has a social rate of return that is equal to the growth rate of the marginal abatement cost, i.e., of the carbon price. When future marginal abatement costs are negatively correlated with aggregate consumption, an immediate vigorous reduction in emissions provides a hedge against the macroeconomic risk borne by the representative agent. The growth rate of expected carbon price should therefore be smaller than the interest rate in that case, and the initial carbon price should be large. The opposite is true when this correlation is positive, and the Hotelling's rule applies as a limit case with independence. We calibrate a simple two-period version of the model by introducing infrequent macroeconomic catastrophes à la Barro in order to fit the model to observed assets pricing in the economy.

2. Cherbonnier F. and Gollier C. (2018), The Economic Determinants of risk-adjusted social discount rate, TSE Working Paper, n° 18-972.

In theory, the measurement of the social value creation of any investment project requires estimating its consumption-based CAPM beta in order to compute its associated risk-adjusted discount rate. In order to assist evaluators to perform this task, we link this social beta to the underlying technical and economic environment of the project, such as the price and income elasticities of the supply and demand for the flow of goods and services generated by the investment. When the consumers' willingness to pay and the variable production cost are Cobb-Douglas in aggregate income and quantity, the beta of the infrastructure has a flat term structure and is positive for a normal good. But when the infrastructure has a limited capacity, the term structure of the beta is decreasing. Finally, as an illustration, we explain why an investment in a transfrontier trading infrastructure line should have a negative beta for the country that most often uses the line to export its cheaper good (such as electricity).

3. Armantier O., Foncel J. and Treich N. (2018), Insurance and Portfolio Decisions: a Wealth Effect Puzzle, working paper.

In this paper, the authors study empirically households' portfolio and insurance decisions, two opposite risk retention tradeoffs. We identify common determinants (e.g. subjective expectations, risk attitude) and frictions (e.g. liquidity constraints, financial literacy). We also find that risky investments and insurance coverage both increase with wealth, making insurance a normal good. This result appears to be a puzzle as we fail to explain it convincingly with standard and behavioral theory. Empirical evidence suggests that the puzzle is robust, economically relevant, and driven in part by "mistakes": the poor tend to invest too conservatively, while the rich tend to over-insure.

## **b) Dynamic Corporate Finance**

### **IDEI Team**

Jean-Paul Décamps, Professor of Mathematics TSE

Alex Guembel, Professor of Finance TSE

Stéphane Villeneuve, Professor of Mathematics TSE

First, we list below the papers, funded, described in the past versions of the activity report that have been accepted in 2018.

1. Décamps Jean-Paul and Stéphane Villeneuve « A two-dimensional control problem arising from dynamic contracting theory », Finance and Stochastics, Vol 23, 1, pp. 1-28, (2019).

## Topics of interest for the next future

### 1. « Managerial Compensation with Two-sided Limited Liability Constraints » by D. Possamai, A. Réveillac and S. Villeneuve

In this paper, we examine optimal managerial compensation in a continuous-time principal-agent model in which both players are risk-averse and protected by limited liability. The two-sided limited liability assumption imposes strong constraints on the contract: it cannot impose negative payments to the agent, and the principal's promise keeping is restricted to cash within the firm. We characterize recursively the set of implementable contracts with two variables: initial investment and agent's utility. By means of the theory of BSDE, we embed the principal-agent problem into the class of Markovian stochastic control problems under state constraints and characterize the principal value function and the optimal contract in terms of HJB equations. A key result of our study is that investors face a tension between the opportunity to provide incentives for the manager and the risk of being dispossessed of a large part of their shares.

### 2. « Automating high-skill jobs subject to moral hazard » by Vincent Téna

Due to the current advancements in artificial intelligence and robotics, high-skill jobs are now at risk of automation. This paper explore the trade-off between the task delegation to an agent subject to an inherent agency friction and the automation of the production at a sunk cost. In our dynamic agency framework, a real option models the threat posed on worker by the risk of automation. We characterize the optimal contract and we find that if automation is not sufficiently profitable to be implemented from the outset, neither the presence of the option to automate nor its value changes the way termination occurs. Ex-ante, the agent extracts a lower expected value from the contract in presence of the option, irrespective of his bargaining power. It leads ex-post to smaller payments and an earlier expected layoff. We highlight testable implications and their relation with findings in labor economics.

### 3. « Managerial Turnover and Long-term Investments » by A. Guembel and S. Villeneuve.

This paper studies that one firm's contracting choices exert an externality on other firms, via its effects on the labour market for managers. If one firm terminates its manager following poor performance, it augments the pool of managers available for hiring to other firms. This in turn increases other firms' incentives to also terminate their manager. As a result there may be multiple equilibria, one of which exhibit high managerial turnover.

## **c) *Longevity risk, long term care and (social) insurance***

### **IDEI Team**

Helmuth Cremer, Professor of Economics TSE  
Catarina Goulao, Researcher INRA  
Jean Marie Lozachmeur, Researcher CNRS  
Pierre Pestieau, Professor of Economics University of LIEGE  
Emmanuel Thibault, Professor of Economics University of Perpignan

In this research's project we consider four main questions: the optimal design of a long Terme care (LTC) social insurance given the market and the family, the reimbursement rule: coinsurance or flat benefit, the political support of LTC social programs, the social transmission of modifiable risk factors affecting healthy aging and finally the role of social norm and family altruism to explain informal care. We study these various aspects by

using tools from the risk theory, microeconomics analysis, macroeconomic dynamics, optimal taxation, health economy, public economics and/or insurance theory.

List of the works published in 2018 in a peer-reviewed economic journal and in TSE working papers

1. Attanasi, G.M., D'Albis, H. and E. Thibault, An experimental test of the under-annuitization puzzle with smooth ambiguity and charitable giving, TSE Working Paper, n. 18-932, July 2018.
2. Canta, C. and H. Cremer, Uncertain altruism and non-linear long-term care policies, TSE Working Paper, n. 18-924, may 2018.
3. Cremer, H. and P. Pestieau, Social insurance for LTC and inter vivos gifts, German Economic Review, 19, 351-364, 2018.
4. Cremer, H. and P. Pestieau, Taxing pensions, in Robert Holzmann and John Piggott (editors): The Taxation of Pensions, MIT Press, 37-50, 2018.
5. Cremer, H. and K. Roeder, Income taxation of couples, spouses' labor supplies and the gender wage gap, TSE Working Paper, n. 18-951, September 2018.
6. D'Albis H. and E. Thibault, Ambiguous life expectancy and the demand for annuity, Theory and Decision, 85, 303-319, 2018.
7. Klimaviciute, J. and P. Pestieau, The Public Economics of Long Term Care. A survey of recent contributions, Annals of Public and Cooperative Economics, vol. 89, 2018.
8. Klimaviciute, J. and P. Pestieau, Long-term care social insurance. How to avoid big losses? International Tax and Public Finance, 25, 99-139, 2018.
9. Pestieau, P. and G. Ponthière, The public economics of long term care, in Martin Guzman, ed., Towards a Just Society : Joseph Stiglitz and 21st Century Economics, Columbia University Press, 493-507, 2018.

Topics of interest for the next future

- 1 -- Long term care insurance with deductible and family altruism.

In a number of papers (Dreze et al., 2016, Klimaviciute and Pestieau, 2017a, b), Arrow's theorem of the deductible has been applied to the case of LTC insurance. We want now to extend this result to a setting where the family plays an important role. We also want to test empirically to what extent family altruism influences the purchase of LTC insurance.

- 2 -- Longevity, dependence and bequests.

In this research we want to study the design of an optimal taxation of inheritance in a world in which individuals differ in their risks of both mortality and dependence and in which the government cannot distinguish between the bequests motives and only observes their timing. As it will appear, the solution is going to depend on the social welfare criterion adopted. We plan to use two polar criterions: a function and the equalization of ex post lifetime utilities.

We also would like to study the interaction between longevity, dependence and bequest in an OLG model when those three variables are endogenous. Both dependence and longevity depend on genetic and environmental factors but also on individual choices such as health care and living habits. Bequests are both accidental and

altruistic. After a positive analysis we turn to the possibility of using policy tools to maximize the generational steady state utility.

### 3 -- LTC policy with nonlinear strategic bequests.

The aim of this project is to study the design of LTC social insurance and its interaction with private insurance when children differ in the degree of altruism. Parents do not observe their children's altruism, but they can commit to a bequests rule specifying bequests conditional on the level of informal care. In the "laissez-faire", the help provided by less altruistic children is distorted downwards in order to minimize the rent of altruistic ones. Social LTC insurance is designed to maximize a weighted sum of parents' and children's utility. Intuitively, the optimal uniform public LTC insurance depends on the parents' attitude towards risk. Our conjecture is that a nonuniform policy conditioning LTC benefits on bequests provides full insurance even for the risk of having children with a low degree of altruism. Under the optimal public policy, informal care always increases in the children's' welfare weight, irrespective of the parents' degree of risk aversion.

### 4 -- Economic performance when LTC expenses, health investment and life expectancy are endogenous.

This project examines how the virtuous circle between growth and longevity can be maintained when there is a possibility of dependency in old age. In our environment where individuals' survival to the retirement age is random, health investment gives rise to two opposing effects on accumulation and hence growth. First, health investment directly diverts resources away from productive use. Second, it results in an increased life expectancy which in turn encourages capital accumulation. One of the innovative features of our approach is that the possibility of LTC expenses for elderly. Our conjecture is that LTC expenses may force the agent to save in order to face higher health expenditures which is positive for capital accumulation and life expectancy, but not for individual welfare. Understanding these effects and the competition between LTC expenses and health investment is crucial for the design of LTC policies both for private insurance providers and for public authorities.

## d) *Econometrics of risk, volatility and predictability of asset returns*

### IDEI Team

Christian Bontemps, Professor of Economics, ENAC and TSE

Nour Meddahi, Professor of Economics, TSE

First, we list below the papers, funded, described in the past versions of the activity report that have been accepted in 2018.

1. Prosper Dovonon, Silvia Goncalves, Ulrich Hounyo and Nour Meddahi, « Bootstrapping high-frequency jump tests », forthcoming Journal of the American Statistical Association.
2. Tim Bollerslev, Nour Meddahi and Serge Nyawa, « High-Dimensional Multivariate Realized Volatility Estimation », forthcoming Journal of Econometrics.

Topics of interest for the next future

- 1- « Return profitability and Risk Management » by N. Meddahi and M. Yamashita

When various risk measures are computed, it is often assumed that the conditional mean of an asset return is constant. However, it is well documented that the predictability of returns increases as the horizon of prediction

increases. This paper assesses the impact of ignoring such possible predictability of returns on computing risk measures, especially Value-at-Risk (VaR). For this purpose, we study the term structure of VaR when the conditional mean of returns is actually time-varying, and when one (correctly) assumes it to be time-varying and when one (wrongly) assumes it to be constant. We first study a state- space model with constant volatility and then GARCH model proposed by Heston and Nandi (2000). For each model, we compute VaR analytically with known parameter values, and show that the impact of ignoring time-variability of the mean is non-negligible. Simulation studies show that, when one has a parameter uncertainty, estimating a model with time-varying conditional mean yields VaR that is closer to the true VaR in expectation, even though a model with constant mean is often times not statistically rejected. In the empirical studies, we estimate a GARCH-in-Mean model which has a time-varying mean and a GARCH model with a constant mean. We compare their predictive ability by Diebold-Mariano test and find that the GARCH-in-Mean model outperforms GARCH model for horizons over 10 days. We also consider a model with Realized Variance (RV) and find that including RV leads to a better forecast.

## 2- « Volatility Regressions with Fat Tails » by J. Kim and N. Meddahi

Nowadays, a common practice to forecast integrated variance is to do simple OLS autoregressions of the observed realized variance data. However, non-parametric estimates of the tail index of this realized variance process reveal that its second moment is possibly unbounded. In this case, the behavior of the OLS estimators and the corresponding statistics are unclear. We prove that when the second moment of the spot variance is unbounded, the slope of the spot variance's autoregression converges to a random variable when the sample size diverges. Likewise, the same result holds when one consider either integrated variance's autoregression or the realized variance one. We then consider a class of variance models based on diffusion processes having an affine form of drift, where the class includes GARCH and CEV processes, and we prove that IV estimations with adequate instruments provide consistent estimators of the drift parameters as long as the variance process has a finite first moment regardless of the existence of finite second moment. In particular, for the GARCH diffusion model with fat tails, an IV estimation where the instrument equals the sign of the (demeaned) lagged value of the variable of interest provides consistent estimators. Simulation results corroborate the theoretical findings of the paper.

### 3 SUMMARY OF THE ACTIVITIES OF 2017 FUNDED BY THE CHAIR

#### a) *Steering committee*

The activity of the chair is coordinated with the SCOR representatives through the steering committee which meets at least once a year. The latest steering committee was held on June 1st 2018 in the presence of Philippe Trainar director of the SCOR corporate foundation for science, Xavier Freixas as an ILB representative, Christian Gollier and Stéphane Villeneuve as IDEI representatives.

The orientation committee of 2018 has approved the convention that has been voted by Scientific Council of the Foundation SCOR on June 20, 2017. The convention for the renewal of the partnership is currently under application.

The committee is an opportunity for IDEI researchers to present their research results and enables the SCOR representatives to express their needs in terms of research. It also determines the orientation of applied research to meet the needs expressed by the SCOR management. Monitoring is done in two ways: the delivery of research papers and the development of internal seminars. Hence, SCOR teams are in constant contact with the IDEI researchers.

Philippe Trainar has recommended through the steering committee that Toulouse researchers continue to work on the following themes in the next two years: ambiguity risk and long-term allocation; mechanism of coverage of the dependency; effective risk-sharing mechanisms under limited liability constraints and robust risk measures.

#### b) *Events and Conferences organized by the chair:*

- The Chair SCOR has organized a conference celebrating the 60th birthday of Jean-Charles Rochet that held on May 31 - June 1, 2018 in Toulouse School of Economics. Among the speakers were Bruno Biais ( TSE- HEC ), Fabrice Collard ( University of Bern ), Jean-Paul Décamps ( TSE ), Gabrielle Demange ( PSE – EHESS ), Ivar Ekeland ( Université Paris Dauphine ), Xavier Freixas ( UPF Barcelona ), Hans Gersbach ( ETH Zurich ), Thomas Mariotti ( TSE ), David Martimort ( PSE – EHESS ), Hervé Moulin ( University of Glasgow ), Martine Quinzii ( University of California, Davis ), Lars Stole ( The University of Chicago Booth School of Business ), Jean Tirole ( TSE ), Stéphane Villeneuve ( TSE ). See the program at the end of the document.

- Workshop on Longevity and Dependence, SCOR headquarter, November 30th 2018. See the program at the end of the document .

#### c) *Presentation in connection with the Chair :*

We list below some talks that have been made last year in connection with the research initiative

- Helmuth Cremer presented his works at « Journées Louis-André Gérard-Varet (LAGV) à Aix-en-Provence) » and at the European Health Economics Workshop (EHEW) in Paris and at the annual congress of the International Institute of Public Finance (IIPF) in Tampere.

- Helmuth Cremer presented « Who will take care of granny : the economics of Long-Term Care ? » at the « ISA lecture à l'Université de Bologne ».

- Jean-Paul Décamps presented « Integrating Profitability prospects and cash Management » at Center for Mathematical Economics, Bielefeld.
- Jean-Paul Décamps presented « Integrating Profitability prospects and cash Management » at the Workshop on Stopping Time Problems in Game Theory, Economics and Finance, Stony Brooke.
- Christian Gollier presented « Aversion to Risk of Regret and Preference for Positively Skewed Risks » at Conférence "Time, Uncertainties & Strategies IV ».
- Christian Gollier presented « Efficient Discount System: The Risk and Time Dimensions » at the Annual Conference of CBA, Washington.
- Christian Gollier presented "Les investissements à long terme : que doit-on financer ? » at Séminaire de recherche Sciences Po / Banque de France.
- Christian Gollier presented the Keynote lecture at 2018 International Workshop on the Economics of Climate Change and Sustainability, University of Bologna.
- Christian Gollier attended the round table at Conférence en l'honneur de Jean-Charles Rochet on « L'apport académique à l'industrie de l'assurance et de la réassurance ».
- Christian Gollier presented « Climatedonomics : embedding climate risk in economic analysis and decisions » at Conférence SCOR, Paris.
- Christian Gollier presented at the Symposium in Honor of Martin L. Weitzman, Harvard.
- Pierre Pestieau presented his works in Washington (World Bank and IMF) and at the Annual Congress of the International Institute of Public Finance (IIPF) in Tampere.
- Stéphane Villeneuve participated on the round table organized by la revue d'économie financière on the topic « l'industrie de l'assurance au XXIème siècle ».
- Stéphane Villeneuve delivered a lecture on the principal-agent problem at the 11th European Summer School in Financial Mathematics, Ecole Polytechnique.
- Stéphane Villeneuve presented « A two-dimensional control problem arising from dynamic control Theory » at the Conference « Stochastic modeling and financial applications », Verona.

#### **d) 2018 Scor Prize:**

During the 45th annual seminar of the European Group of Risk and Insurance Economists, the prize "SCOR-EGRIE 2017 for the best paper written by a young economist" was awarded to

*Wanda Mimra, Janina Nemitz and Christian Waibel for the article " Voluntary Pooling of Generic risk: a health Insurance experiment ".*

The jury was chaired by Michael Hanselmann, Ludwig-Maximilians University Munich, executive secretary of EGRIE.

The SCOR-EGRIE prize for best paper written by a young economist is organized under the responsibility of the "Risk Markets and Value creation" chair and is sponsored by the SCOR Foundation for Science and the Risk Foundation.

During the EGRIE seminar, another prize, sponsored by the Risk Markets and Value Creation Chair is also awarded: the SCOR-Geneva Risk and Insurance Review Award Best Paper Award for the best paper published in the journal Geneva Risk and Insurance Review. In 2018, the prize was awarded to

*Justina Klimaviciute for her paper "Long-term care Insurance and Intra-family Moral Hazard: Fixed vs Proportional Insurance benefits".*

#### **e) Prize and Award**

**- Nour Meddahi has been appointed fellow of the Econometric Society.**

**- Nour Meddahi became member of the board of the Journal of Econometrics.**

#### **f) PhD Student and Internship**

In 2018, Vincent Téna from the University Toulouse 1 Capitole has pursued a Ph-D thesis under the supervision of Stéphane Villeneuve on Incentives, Dynamic contracting and Limited liability. He wrote his first working paper untitled « Automating high-skill jobs subject to moral hazard » that has been described in Section 2 b).

The Risk Markets and Value Creation Chair has funded Vincent for a short-term visit at Erasmus University on fall 2018.

# APPENDIX

- Program of the Workshop on Longevity and Dependence, SCOR headquarter, November 30th 2018.