QUANTITATIVE MANAGEMENT RESEARCH INITIATIVE

2021

Activities and Events organized by the Research Initiative (QMI) – ANNUAL REPORT

This document describes the activities organized by the Quantitative Management Research Initiative (QMI) during its ninth year of existence. **For internal use only.**

Draft February 2022

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Quantitative Management Research Initiative
"QUANTITATIVE MANAGEMENT INITIATIVE (QMI)"

1. INTRODUCTION

Hosted within the Fondation du Risque (FdR) and with the support of the Institut Louis Bachelier (ILB), the work conducted within the framework of this Research Initiative is principally carried out by teams from the Université Paris Dauphine - PSL and the ENSAE (Ecole Nationale de la Statistique et de l'Administration Economique). It benefits from a partnership with LFIS Capital.

1.1. The objectives of the QMI

In the post-2007 financial-crisis context, Quantitative Management professionals from the French Financial sector came together in 2010 to create QuantValley to promote Quantitative Finance and its benefits in terms of research, risk management and value creation for investors. The association was joined by GFI and UBS, and thanks to their support, the Quantitative Management Initiative (QMI) was born in early 2012. Today, the Quantitative Management Initiative (QMI), who is supported by LFIS Capital, is investing even more in the promotion of research and the development of interactions between the academic world and the Professional world of Quantitative management and is structured around the following themes:

- Developing quantitative research applied to asset management;
- Facilitating knowledge transfer between academic environments and asset management agents;
- Responding to the research issues of various private partners;
- Encouraging collaboration with one or more companies that are leaders in fields relating to quantitative management;
- Promoting the image of asset management based on quantitative approaches;
- Increasing and consolidating the high level of excellence by organising reflexion, research and training activities on an international scale relating to one or more themes of general interest;
- Reflecting on the evolution of regulation pertaining to asset management.

1.2. Research axes of the QMI

Amongst the research areas of most interest to the QMI are:

1.2.1. Artificial Intelligence

Statistical Signal Processing

Application of signal treatment to the estimation of factorial models, the detection of outliers, the filtering of trends and the robust estimation of Kalman models is an active research field of the IdR QMI. Momentum and trend following strategies are among the first applications of these approaches. Serge Darolles, and his former PhD student Charles Chevalier developed a generic solution to create CTA beta strategies on any global of specific investment universe by aggregating the information contained in a large set of momentum signals. This first piece of research has been published in Journal of Asset Management in 2019. The related outputs of this research are exposed in a working paper that started to be presented in academic conferences in 2018. This topic is particularly relevant when the objective is to allocate money to a portfolio of different trends following systems. The risk of this strategy is then linked to the probability of observe simultaneously breaks in trends characterizing different markets. A second piece of research has been completed in 2021 by the same authors and is forthcoming in Econometrics

and Statistics. This research introduces the concept of CoTrend that generalizes Covariance to Trend Following strategies and revisits the concept of diversification for Trend Following strategies. They plan to continue this strand of research in the coming years, and, to use machine learning techniques to link observed trends to economic environment variables.

Arthur Stalla-Bourdillon and several co-authors test the usefulness of Machine Learning (ML) for sovereign risk assessment and pricing in the euro area. They show that their predictive accuracy compared to traditional econometrics methods and their assessment on what are the most important economic factors behind market perception of sovereign risk (see Belly et al. working paper page 12).

These two last topics are of course related to the following one.

Big data, machine learning and the new sources of information (Google, Twitter)

Eric Benhamou is leading several projects on deep reinforcement learning applied to finance. This research has been presented in several international conferences. The idea of reinforcement is to learn from past experiments to improve learning processes. This approach is particularly suitable for solving portfolio allocation problems through time. Historical portfolio returns may serve to dynamically improve portfolio construction techniques. E. Benhamou leads other projects involving the same techniques and focused on the prediction of extreme events.

Serge Darolles, Gaëlle Le Fol, and Beatrice Sagna with another co-author are working on volume prediction (univariate and multivariate) models using machine learning method. Their first results presented in a working paper show that machine learning technics outperform ARMA and SETAR specification both in and out of sample. Two additional papers will be written in this strand of research. The first one discusses the impact of the discretization step in the tracking of the VWAP price. The second relies all this research on volumes to the development of factor investing strategies.

Hector Chan with two co-authors are studying in their working paper "Currency and Stock Returns: An Example of Market Inattention" the impact of currency shocks of the pricing of stocks. They show that some anomalies observed on the pricing of risk asset may come from market participants inattention.

A « Quantitative Finance » session leaded by Gaëlle Le Fol and Serge Darolles, Members of the QMI, has been organised virtually at the Computational Financial Econometrics (CFE) conference in London in December 2021 (see past conferences).

Finally, we have organized in February 2021 our third Hackathon – AI and ML in Asset management, online for the first time. 96 participants/41 teams. See page 22.

Risk Premia

Serge Darolles is working with Charles Chevalier on the characterization of a Multi-asset Trend Following Risk Premia that can be used to explain the cross-sectional dispersion observed in the CTA space.

The paper "Diversifying Trends" is also related to this research and forthcoming in Econometrics and Statistics. The main objective of this research is to extract what is in common between trends observed on different markets.

Serge Darolles, Gaëlle Le Fol, and Gulten Mero use regime switching models to model the size risk premium in a dynamic framework and prove that past static approaches may lead to erroneous conclusions, for example on the disappearance of this premium. The paper is forthcoming in Finance (see publications page 15).The same team are currently extending this approach to another well-known risk premium i.e., the value one. Preliminary results are available, and the next year will see the publication of the corresponding results in a working paper.

Finally, Paul Ehling and Costas Xiouras in their project "Asset Pricing with Endogenous beta", funded in 2018, study the cross-section of expected returns in a new theoretical framework where betas are determined endogenously. Their theoretical analysis shows that the stocks' betas fluctuate significantly over time and are affected by both the state of the economy and the individual stock states i.e., their characteristics. This research was presented at the CFE conference in London in December 2021.

1.2.2. Risk & Crowding

Risk disaggregation and portfolio allocation

A change in the structure of a fund's client base affects the potential mismatch between the liquidity of its assets and liabilities. An asset/liability approach for liquidity management is therefore critical and requires a client behaviour model. Serge Darolles, Gaëlle Le Fol and Ran Sun are working on investor's behaviour and the consequences on funding liquidity risk.

Marius Zoican is working with a co-author on a new project where they look at institutional investor attention. They build a model where analysts who compete for scarce investor attention to maximize volume for brokerage houses end up clustering in a small subset of stocks. They find that it explains 21.39% of the cross-sectional variation in analyst coverage. This research has been presented at the Asian Finance Association in China in July.

Hugues Langlois in the project "Forecasting Portfolio Weights", funded in 2018, proposes a new methodology to compute dynamic mean-variance optimal portfolios. The originality of his approach is to directly forecast portfolio weights. This research was presented at the CFE conference in London in December 2021 and in a webinar launched in 2021, see page 18.

Hector Chan and a co-author make a link between crowding and liquidity in their paper "Crowding and Liquidity Shocks". They propose a new measure of crowding using short interest information and show that crowding may explain a significant part of the poor performance of quantitative strategies during liquidity crisis.

Contagion and funds flows

Serge Darolles, Gaëlle Le Fol and her PhD Student Beatrice Sagna work with another co-author on some multivariate volume prediction methods applied to the circulation of liquidity within a portfolio. This paper research has been presented several times at some international conferences in the past and they are currently working on a new version of this paper.

Serge Darolles, Gaëlle Le Fol and Ran Sun work with another co-author on fund flows predictions, clustering effects and over-dispersion with implications on fund liquidity risk.

Fabrice Riva and a coauthor investigate the impact of Exchange-Traded Funds (ETFs) on their constituent securities. They find that, after the switch, constituent stocks experience greater commonality, both in returns and in liquidity. The effect on return commonality appears stronger for the least liquid stocks included in the ETF. Also, they present evidence that ETF arbitrage is the transmission mechanism of the comovements. Moreover, they show that the comovements do not appear excessive.

Estimation risk for portfolios

In a paper forthcoming in Journal of Econometrics, Jean Michel Zakoïan and a co-author are testing the existence of moments in the framework of GARCH processes, which is of particular interest as the existence of moments can be crucial for risk management, for instance when risk is measured through the expected shortfall (see publications page 15).

Ophélie Couperier is also working on risk measures and on backtests of risk measures in two working papers, with different co-authors. Her research has been presented at several international conferences (see Diffusion of Research page 16).

Alternative Risk Premia

Given the sharp increase of the number of alternative risk premia discovered by academics and practitioners, several issues need to be addressed: the factor construction methodologies, the consequences for portfolio diversification, the persistence of the alternative risk premia.

Regarding the first two issues, Marie Lambert et al. are working on construction rules of risk factors and the design of smart beta strategies. A proper methodology to stratify stock universe into style buckets is key for the design of persistent risk factors, asset allocation and performance attribution (See Fayes et al. working papers page 12).

Marie Lambert et al. also works on the design of alternative risk premia capturing non-linear payoffs. The working paper on the gamma trading of hedge funds have also been presented at several conferences and seminars.

Regarding the persistence of the alternative risk premia, Serge Darolles and Marie Lambert are working on the economic cycle of alternative risk premia and the change in business model from active to passive management for those investment strategies. Serge Darolles has presented the paper at the AMF Scientific committee in November 2021. Serge Darolles and Fabrice Riva created a course on this topic for M1 level students. This course presents the theoretical foundations and proposes numerous practical applications, with the idea to use the Python language to develop arbitrage strategies based on market anomalies.

On the same topic of alpha persistence, Serge Darolles, Gaëlle Le Fol and Gulten Mero used on a regime switching approach to study the existence of risk premia in their paper forthcoming in Finance (see publications page 15).

Derivatives in Asset Management

This new strand of research is related to the arrival of Jean-Guillaume Mémin in the research team following the Call for PhD applications of 2019 (See Activity report 2019). Jean-Guillaume is doing his PhD thesis, under the

supervision of Serge Darolles, at LFIS Capital, on the optimal use of derivatives in the design of trading strategies. Basically, different solutions exist to implement a trading idea, and the initial objective of this thesis was to develop a theoretical framework to study which is the best implementation solution – taking a position on the spot or using derivatives.

If this piece of research is still the long-term objective of the thesis, the current work is focusing the optimal implementation of carry strategies using derivative instruments. We have now the full access to Optionmetrics data, with the possibility to extend the basic notion of carry to any instrument of the volatility surface (maturity and moneyness). The different measures of carry are then used to predict future returns, with the idea to filter the more informative portion of the volatility surface.

The paper "Do ETFs increase the comovements of their underlying assets?" of Fabrice Riva and a coauthor definitely fall also into the category of derivatives in asset management as they use a novel identification which exploits the switch from synthetic to physical replication of a large French ETF.

1.2.3. Implementation challenges

Listed market liquidity

Looking at serial correlations, Serge Darolles, Gaëlle Le Fol and Ran Sun are working on hedge funds liquidity and managers' skills (See Working papers page 12).

Fabrice Riva is for his part, with two co-authors, working on ETF liquidity (See Working papers page 12). Marius Zoican and another researcher are also working on ETF liquidity ("The value of ETF liquidity"). They find that identical ETFs can exploit different investor clienteles to charge different management fees for holding identical portfolios. Highly liquid ETFs can extract 0.47 bps in higher fees than their competitors for each 1 bp of narrower bid-ask spread. This research has been presented in numerous international conferences in 2020 and in 2021 (see page 18). It received the award of Best paper semifinalist (Microstructure), Financial Management Association 2021 and is now Revise and Resubmit (round 2) at Journal of Finance.

In their project "Stock Market Liquidity and Trading Costs of Asset Pricing Anomalies", Tamara Nefedova, with some co-authors, uses transaction-level data from Ancerno to investigate implicit cost dynamics and estimate transaction costs associated with trading asset-pricing anomalies. They find that the related costs are considerably lower than documented by previous studies. On the same topic, Charles Chevalier and Serge Darolles used proprietary trading data to analyze the transaction costs associated with the implementation of systematic trend following strategies. They show in their working paper "Futures Market Liquidity and the Trading Cost of Trend Following Strategies" that the decrease in the volatility of commodity markets implies an increase of the leverage needed to meet the fund investment objectives. An increase of the total amount of transaction costs paid by the funds follows, with as consequence a decrease in the fund returns.

The paper "Market Impact Decay and Capacity" by Hector Chan extend previous works on market impact by considering more flexible forms of the function measuring the link between the order size and the price impact. He shows that these more realistic specification may lead to very different results and change the forecast capacity of the usual arbitrage strategies.

Algo and/or High frequency trading

Optimisation of the VWAP (Volume Weighted Average Price) replication algorithms, link between the speed of placing orders on the market and the arrival of information, liquidity trade-offs, maximum trading capacity are areas of research in which QMI is regularly investing.

Serge Darolles, Gaëlle Le Fol, and Beatrice Sagna with another co-author are working on basket VWAP strategies. They first have papers of the volume forecasting methodology and now use this approach to filter from the realized volume the connections between stocks belonging to a same market.

The current research, with Ophélie Couperier, with Jean-Michel Zakoian and another co-author, aims at introducing functional covariates that considers the influence of intraday price variations in the volatility.

Marius Zoican and his co-authors find in their paper "Speed and learning in high-frequency auctions" that on discrete-time markets, faster trading enhances arbitrageur competition. In contrast to continuous-time markets, lower latencies can improve liquidity on batch auction markets.

Marius Zoican with another co-author propose an experimental trading platform where participants face speed bumps and invest in low-latency trading technology. They find that asymmetric speed bumps reduce investment in low-latency technology by 20%, and a one standard deviation larger speed bump further reduces low-latency

investment by 8.33%. These two papers are published in Journal of Financial Markets, see Published papers page 17.

1.3. The QMI's organization

1.3.1. The steering committee

The steering committee reviews, monitors and prioritizes major QMI projects.

Scientifique Director

Gaëlle Le Fol, Professor, Université Paris-Dauphine and CREST

General Secretary

Fabrice Riva, Professor, Université Paris - Dauphine

Researchers from l'ENSAE and Université Paris-Dauphine

Serge Darolles, Professor, Université Paris -Dauphine

Jean-Michel Zakoïan, Professeur, CREST-ENSAE ParisTech

Other Members

Gouriéroux G., Professor, Université de Toronto

1.3.2. The Advisory Board

The Advisory board assists the Steering Committee in its supervising tasks over the activities of the project. The advisory Board members are:

Representing LFIS Capital : Sofiène Haj-Taieb

Representing l'ENSAE ParisTech : Director of the GENES or his/her representative

Representing the Université Paris-Dauphine : Bruno Bouchard

Representing the Risk Foundation: Jean-Michel Beacco

Qualified Person: Charles-Albert Lehalles (CFM)

International Experts: Michel Crouhy (Natixis), René Garcia (Univ. Montreal & TSE), Michael Rockinger (University of Lausanne), and Ronnie Sadka (Boston College)

1.3.3. The secretariat

Pauline de Saint Quentin, the secretary of QMI can be contacted at Pauline.desaintquentin@dauphine.psl.eu or by telephone: +33 1 41 16 76 19.

1.3.4. The QMI's researchers
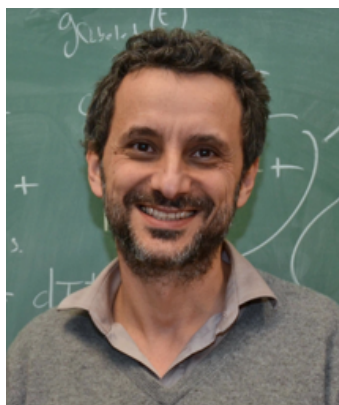
E. Bacry, CNRS and Ecole Polytechnique

C. Gouriéroux, Toronto University

S. Darolles, Université Paris - Dauphine

E. Jouini, Université Paris - Dauphine

M. Lambert, HEC Liège (Liège Université)

G. Le Fol, Université Paris - Dauphine

G. Mero, Université de Cergy-Pontoise

T. Nefedova, Université Paris - Dauphine

F. Riva, Université Paris – Dauphine

J.-M. Zakoïan, CREST and University Lille 3.

M. Zoican, Toronto University

E. Benhamou, PhD Student, Université Paris-Dauphine

H. Chan, PhD Student, Université Paris - Dauphine

O. Couperier, PhD student, CREST-ENSAE, ATER Université Paris – Dauphine

J.-G. Mémin, PhD Student, Université Paris-Dauphine

B. Sagna, PhD Student, Université Paris-Dauphine

J. Royer, PhD Student, CREST-ENSAE

Arthur Stalla-Bourdillon, PhD Student, Université Paris- Dauphine

1.3.5. The QMI's associate researchers

Paul Ehling, Professor, Norwegian Business School, Norway.

Hugues Langlois, Assistant Professor, HEC Paris

Costas Xiouros, Associate Professor, Norwegian Business School, Norway.

2. RESEARCH ACTIVITIES

This research initiative aims to be a means of exchange and reflexion where research themes emerge naturally, and become the starting point of research articles in the best international journals. The QMI must also be able to create a research community around themes of interest to management companies by calling for research projects nationally and internationally and by reinforcing the QMI member teams by recruiting research assistants and publishing doctoral contracts.

2.1. Research Publications

- Date: 2021
- Themes: Quantitative Management

2.1.1. Working papers

Allen, D.E., McAleer, M. and Singh A.K., An entropy-based analysis of the relationship between the DOW JONES Index and the TRNA Sentiment series. Working paper.

Allen, D.E., McAleer, M. and Singh A.K., Daily Market News Sentiment and Stock Prices. Working Paper.

Atif, J., A. Auger, E. Benhamou, and R. Laraki, A new approach to learning in Dynamic Bayesian Networks (DBNs). Working Paper.

Atif, J., A. Auger, E. Benhamou, and R. Laraki, A discrete version of CMA-ES. Working Paper.

Atif, J., A. Auger, E. Benhamou, and R. Laraki, Operator norm upper bound for sub-Gaussian tailed random matrices, Working Paper.

Belly G., L. Boeckelmann, C. M. Caicedo Graciano, A. Di Iorio, V. Siakoulis, and A. Stalla-Bourdillon, Forecasting Sovereign Risk in the Euro Area via Machine Learning, Working paper.

Benhamou É., A few properties of sample variance, Working paper.

Benhamou É., Variance Reduction in Actor Critic Methods (ACM), Working Paper and SSRN 3424668.

Benhamou É., Similarities between policy gradient methods (PGM) in reinforcement learning (RL) and supervised learning (SL), Working Paper and SSRN 3391216.

Benhamou É., B. Guez, and N. Paris, Omega and Sharpe Ratio, Working Paper and SSRN 3469888.

Benhamou É., D Saltiel, B. Guez, N. Paris, Testing Sharpe ratio: luck or skill?, Working Paper and SSRN 3391214

Benhamou É., D. Saltiel, S. Ungari, A. Mukhopadhyay, J Atif, Augmented Asset Management with Deep Reinforcement Learning, arXiv preprint arXiv:2010.08497

Benhamou É., D. Saltiel, S. Ungari, A. Mukhopadhyay, Bridging the gap between Markowitz planning and deep reinforcement learning, arXiv preprint arXiv:2010.09108 1 2020

Benhamou É., D. Saltiel, S. Ungari, A. Mukhopadhyay, Time your hedge with Deep Reinforcement Learning, arXiv preprint arXiv:2009.14136 2020

Benhamou É., D Saltiel, JJ Ohana, J Atif. Detecting and adapting to crisis pattern with context based Deep Reinforcement Learning, arXiv preprint arXiv:2009.07200 2 2020

Benhamou É., Ohana J., Saltiel D., Guez B. (2021), Detecting crisis event with Gradient Boosting Decision Trees, Paris, Working Paper.

Benhamou É., Ohana J., Saltiel D., Guez B. (2021), Regime change detection with GBDT and Shapley values, Paris, Working Paper.

Benhamou É., Saltiel D., Tabachnik S., Wong S., Chareyron F. (2021), Distinguish the indistinguishable: a Deep Reinforcement Learning approach for volatility targeting models, Paris, Working Paper.

Benhamou É. (2021), Distribution and statistics of the Sharpe Ratio, Paris, Working Paper.

Benoit S., O. Couperier, J. Leymarie, and O. Scaillet, " Elicitability of Market-Based Systemic-Risk Measures", Working Paper.

Boeckelmann L, and A. Stalla-Bourdillon, Structural Estimation of Time-varying Spillovers: an Application to International Credit Risk Transmission in the Euro Area, Working paper Banque de France.

Briere, M., C.-A. Lehalle, T. Nefedova, Tamara and A. Raboun, Stock Market Liquidity and the Trading Costs of Asset Pricing Anomalies. Université Paris-Dauphine Research Paper, SSRN No. 3380239.

Brolley M. and M. Zoican, Liquid Speed: On-Demand Fast Trading at Distributed Exchanges, Working Paper and SSRN 3377346, Federation of European Exchanges (FESE) 2021. Annual award for outstanding research on securities markets in Europe.

Brown D., S. Kovbasyuk and T. Nefedova, On the Origin of IPO Profits, Working Paper.

Brownlees C., Darolles S., Le Fol G., and B. Sagna, "Forecasting Intra-daily volume in large panels of assets for basket VWAP trading," working paper

Calvez L., V. Czellar, and C. Gouriéroux, "Structural Dynamic Analysis of Systematic risk", Working paper.

Chakpovski P., M. Khapo and M. Zoican, Does gamified trading stimulate risk taking?, Working paper.

Chan H., Market Impact Decay and Capacity, Working Paper.

Chan H., A. Landier and Y. Wang, Currency and Stock Returns: An Example of Market Inattention, Working Paper.

Chan H., and T. Tan, Crowding and Liquidity Shocks, Working Paper.

Chatelais N., M. Chinn, and A. Stalla-Bourdillon, Macroeconomic Forecasting using Filtered Signals from a Stock Market Cross Section, Working paper.

Chevalier C. and S. Darolles, Futures Market Liquidity and the Trading Cost of Trend Following Strategies, Working Paper.

Couperier O., C. Francq and J.-M. Zakoian, "Daily volatility forecasting using intraday returns and functional covariates", Working Paper R&R in International Journal of Forecasting.

Couperier O. and J. Leymarie, "Backtesting expected shortfall via multi-quantile regression", Working paper, R&R in Journal of banking and finance.

Dare W., Darolles S., Lambert M., and G. Monarcha: The Missing Link between Active and Passive Management, Working paper.

Darolles S., G. Le Fol and R. Sun, Liquidity Risk and Investor Behavior: Issues, Data and Models", Working paper.

Darolles S., and G. Roussellet, Managing hedge fund liquidity risks, working paper.

Eisele A., T. Nefedova, Tamara and G. Parise, Are Star Funds Really Shining? Cross-Trading and Performance Shifting in Mutual Fund Families, BIS Working Paper No. 577, Available at SSRN 2831690.

Eisele A., T. Nefedova, Tamara and G. Parise, Predation versus Cooperation in Mutual Fund Families. Working paper, SSRN 2082369.

Evans R., T. Nefedova and G. Parise, Front-trading and Information Environment in Mutual Fund Families. Working paper.

Fays, B., G. Hübner, and M. Lambert, Gamma Trading Skills in Hedge Funds. Working paper.

Fays, B., G. Hübner, and M. Lambert, The Seasons of the True Size Anomaly. Working paper.

Francq, C., and J.M. Zakoïan, Testing the existence of moments and estimating the tail index of augmented garch processes, MPRA Paper N° 110511.

Garriott C., V. van Kervel and M. Zoican, Does time priority prevent risk sharing?, Working paper.

Gourieroux, C., and J., Jasiak, A Stochastic Tree with Application to Bubble Modelling and Pricing, CREST-DP, Submitted International Journal of Theoreticla and Applied Finance.

Gourieroux,C., and J., Jasiak, Inference for Noisy Long Run Components, Working Paper.

Gourieroux,C., and J., Jasiak, Generalized Covariance Estimators, Working Paper, R&R Journal of Business and Economics Statistics.

Gourieroux, C., and J., Jasiak, Dynamic Deconvolution of Independent AR(1) Sources, Working paper, R&R, Journal of Time Series Analysis.

Gourieroux, C., and Y., Lu, Noncausal Affine Processes with Applications to Derivating Pricing, Working Paper, R&R Mathematical Finance.

Gourieroux, C., and A., Tiomo, The Evaluation of Model Risk for Probability of Default and Expected Loss.

Haas M. D. and M. A. Zoican, Beyond the Frequency Wall: Speed and Liquidity on Batch Auction Markets, Working paper. This paper received the Josseph de la Vega Prize 2016.

Khomyn M., T. J. Putniņš and M. Zoican, The Value of ETF Liquidity, Working Paper, Revise and Resubmit (round 2) at Journal of Finance, Best paper semifinalist (Microstructure), Financial Management Association 2021

Lambert M. and N. Moreno, The Earnings Announcement Day Puzzle in the Value Premium, Working paper.

Langlois H., Forecasting Portfolio Weights, Funded Project 2019, Webinar and Working Paper.

Lou D., and C. Polk, The Booms and Busts of Beta Arbitrage: Measuring the extent of the Low-Beta Crowd. Working paper and Funded Project 2018.

Marta T. and F. Riva, Do ETFs increase the co-movements of their underlying assets? Evidence from a switch in ETF replication technique, Working paper.

Martineau C. and M. Zoican, A machine learning measure of analyst report contribution, Working paper.

Martineau C. and M. Zoican, Investor Attention and the Cross-Section of Analyst Coverage. Working Paper and SSRN 3376162 won "Outstanding Paper in Investments" Award at Southern Finance Association 2020.

Menkveld A., E. Pagnotta, and M. Zoican, Does Central Clearing Affect Price Stability? Evidence from Nordic Equity Markets, Working paper, R&R at Journal of Financial Economics.

Nefedova T., G. Parise and M. Zoican, ETF fee competition and security lending, Working Paper.

Nefedova T., Tippers and tippees: Brokers' pre-release of price-sensitive information to their VIP clients, Working paper.

Ohana J., Benhamou É., Saltiel D., Guez B., Is the Covid equity bubble rational? A machine learning answer, Paris, Working Paper.

Ohana J., Ohana S., Benhamou É., Saltiel D., Guez B., Shapley values for Light GBM model applied to regime detection, Paris, Working Paper.

Sagna B., Learning From Heightened Equity Premium, Working Paper.

Sagna B., "Intra-daily trading volumes and VWAP strategy: evidence from a horse race, Working Paper.

Saltiel D., E Benhamou, Sélection efficace de variables par descente par coordonnée avec garanties théoriques. hal preprint 2020, https://hal.archives-ouvertes.fr/hal-02886506/document

Stalla-Bourdillon A., Stock Return Predictability: comparing Macro- and Micro-Approaches, Working paper.

Xiouros C., and P. Ehling, Asset Pricing with Endogenous beta, Funded Project 2019.

Zoican M., Asset management at the zero-fee bound, Working Paper.

Zoican and 341 co-authors, Non-standard errors, Working paper.

2.1.2. Published Papers

Benhamou É., Saltiel D., Ohana J-J., Atif J., Laraki R. (2021), Deep Reinforcement Learning (DRL) for portfolio allocation, in Yuxiao Dong, Georgiana Ifrim, Dunja Mladenić, ghent, Springer, p. 527-531.

Chevalier, C., and S. Darolles (2021), Diversifying Trends, Forthcoming in Econometrics and Statistics.

Darolles S., G. Le Fol, and G. Mero (2021), Timing the Size Risk Premia, Forthcoming in Finance.

Djogbenou A., C. Gourieroux and, J. Jasiak (2021), Testing for Endogeneity of Covid-19 Patient Assignments, Journal of Financial Econometrics,1-27.

Fays, B., M. Lambert, and N. Papageorgiou (2021), Risk optimizations on basis portfolios: The role of sorting. Journal of Empirical Finance, Volume 63, p. 136-163.

Francq, C., and J.M. Zakoïan (2021), Testing the existence of moments for GARCH processes, forthcoming in Journal of Econometrics, In Press.

Gourieroux, C., A. Hencic and J., Jasiak (2021), Forecast performance and bubble analysis in noncausal MAR(1,1) processes, Journal of Forecasting, vol. 40, n° 2, mars 2021, p. 301–326.

Gourieroux, C., and J., Jasiak (2021), Long Run Predictions, forthcoming Annals of Economics and Statistics.

Gourieroux, C., and J., Jasiak (2021), Time Varying Markov Process with Partially Observed Aggregate Data: An Application To Coronavirus, Journal of Econometrics, forthcoming.

Gouriéroux G., and A. Monfort (2021), Model Risk Management: Valuation and Governance of Pseudo Models, Econometrics and Statistics, vol. 17(C), 1-22.

Gourieroux, C., Monfort, A., S. Mouabbi, and J.P., Renne (2021), Disastrous Defaults, Review of Finance 25 (6), 1727-1772.

Haas M. D., M. Khapo and M. A. Zoican (2021), Speed and Learning in High-Frequency Auctions, Journal of Financial Markets, vol. 54, June.

Jourde and A. Stalla-Bourdillon (2021), Is there a Bubble in "Green" Equities?, Blog de la Banque de France, October 2021.

Karrer J., A. Louzier and J. Luca de Tena Gonzalez, La finance, une solution face aux enjeux environnementaux, Revue Banque, October 2021, 14-17.

Khapo M. and M. A. Zoican (2021), Do speed bumps curb speed investment? Evidence from a laboratory market, Journal of Financial Markets, vol. 55, September.

Mhalla L., J. Hambuckers, and M. Lambert (2021), "Extremal Connectedness of Hedge Funds", Forthcoming in Journal of Applied Econometrics.

Royer J. (2021), Conditional asymmetry in ARCH(∞) models, forthcoming in Journal of Econometrics.

2.2. Call for projects

There was no call for project in 2021.

2.3. Completed projects

1. **beta**, Costas Xiouros, Associate Professor and Paul Ehling, Professor at BI Norwegian Business School, Norway.

   We study the cross-section of expected returns in a framework where the CAPM holds either conditionally or unconditionally and dividend dynamics determine market βs. Calibrating the discount factor and aggregate dividends allows matching standard features of aggregate stock market returns and the market price-to-dividend ratio. In the calibration, we see significant fluctuations in market βs due to both aggregate and individual shocks. These results explain, on the one hand, why stock characteristics contain considerable power in predicting returns. On the other hand, they are consistent with empirical failures of the unconditional CAPM, even in our framework when it holds conditionally.

2. **Forecasting Portfolio Weights**, Hugues Langlois, Associate Professor at HEC.

   We propose a new methodology to implement unconditionally optimal dynamic mean-variance portfolios. We model portfolio allocations using an auto-regressive process in which the shock to the portfolio allocation is the gradient of the investor's realized certainty equivalent with respect to the allocation. Our methodology can accommodate transaction costs, short-selling and leverage constraints, and a large number of assets. In out-of-sample tests using equity portfolios, long-short factors, government bonds, and commodities, we find that its risk-adjusted performance, net of transaction costs, is on average more than double that of other benchmark allocations.

2.4. Ongoing PhD thesis, PhD defense and placement

- Hector Chan (ongoing), under the supervision of Serge Darolles.
- Ophélie Couperier (ongoing), under the supervision of Christian Franck, Christophe Hurlin and Jean-Michel Zakoian. Ophélie is also teaching assistant (ATER) at Université Paris-Dauphine-PSL.
- Jean-Guillaume Mémin (ongoing), under the supervision of Serge Darolles.
- Julien Royer (ongoing), under the supervision of Christian Franck, Jean-Michel Zakoian.
- Béatrice Sagna (ongoing), under the supervision of Gaëlle Le Fol.
- Arthur Stalla-Bourdillon (ongoing), under the supervision of Gaëlle Le Fol.

3. RESEARCH EXPOSURE AND DIFFUSION

Over and above research production, the QMI aims to distribute quantitative management academic research throughout the scientific community but also towards quantitative management professionals (knowledge diffusion). To this end, the QMI's research will be presented in international conferences, within the framework of an annual conference addressed to academics and professionals. Furthermore, training (research applications) will be developed, and the website will propose research articles and webinars than put that research into practice.

3.1. Visibility & Diffusion of Research

3.1.1. 15th CSDA International Conference (CFE 2021)

Organization of one session at the Computational and Financial Econometrics, Virtual conference, December 2021
- Quantitative Finance, Session CO108.

G. Le Fol Organizer **and S. Darolles,** Chairman and organizer, Université Paris-Dauphine, Members of the QMI
- Forecasting portfolio weights, **Hugues Langlois**, HEC Paris
- Market impact decay and capacity, **Hector Chan**, Université Paris-Dauphine, Member of the QMI
- Dissecting beta, **Costas Xiouros**, BI Norwegian Business School with Paul Ehling
- Forecasting option returns with news, **Gang Li**, The Chinese University of Hong Kong, with Bing Han, Jay Cao, Ruijing Yang, Xinting Zhan

3.1.2. Seminar and conference participations

QMI's researchers have presented their work at several conferences and seminars:

"A multivariate ARCH(∞) model with exogenous variables and dynamic conditional betas", Francq, C., J. Royer and J.M. Zakoïan
- 15th International Conference on Computational and Financial Econometrics, London, December 18-20.

"Backtesting Expected Shortfall via Multi-Quantile Regression", Couperier O. and J. Leymarie,
- 37th International Conference of the French Finance Association, Audencia Paris, May 26-28.

"Conditional asymmetry in Power ARCH (∞) models", J. Royer
- Econometric Society European Meeting, Copenhagen, August 24-27.
- 9th Italian Congress of Econometrics and Empirical Economics, Cagliary, January 21-23.
- 14th Financial Risks International Forum, Paris, poster session, March 25-26.

"Elicitability of Market-Based Systemic-Risk Measures", Benoit S., O. Couperier, J. Leymarie, and O. Scaillet,
- 10th International Conference of the Financial Engineering and Banking Society (FEBS), online, Université de Lille, September 30 to October

"Environmental Scores and Stock Valuations", Jourde T. and A. Stalla-Bourdillon,
- ECB-Global Economy Meeting, December.

"Estimating conditional systemic risk measures in semi-parametric volatility models", L. Cantin, C. Francq, J.-M. Zakoïan
- 3rd IWEEE "High-dimensional and Multivariate Econometrics: Theory and Practice", Rimini Italy, January 20-21.

"Do ETFs increase the commonality of their underlying assets? Evidence from a switch in ETF replication technique", Marta T., and F. Riva
- " Investor Emotions and Asset Pricing", Lille, February 2.
- DRM Finance seminar, December 18.

"Macroeconomic Forecasting using Filtered Signals from a Stock Market Cross Section", Chatelais N., M. Chinn and A. Stalla-Bourdillon,
- 2nd International Macroeconomics Workshop PSE-BdF, Paris, October.

"Stock Return Predictability: comparing Macro- and Micro-Approaches", Stalla-Bourdillon A.
- PANORisk conference, November

"Testing the existence of moments for GARCH processes", J.-M. Zakoian
- Econometric Society European Meeting, Copenhagen, August 24-27.

"From Active and Passive Management", Dare W, Darolles S., Lambert, M., and G. Monarcha
- Conseil Scientifique de l'AMF, Paris France, October 19.

"Does Time Priority Prevent Risk Sharing? ", C. Garriott, V. van Kervel and M. Zoican
- Asia-Pacific Microstructure Online Seminars, Hong Kong China (Virtual Event)
- Tianjin University, Tianjin China.

"Investor Attention and the Cross-Section of Analyst Coverage", C. Martineau, and M. Zoican
- Asian Finance Association, July 2-4, Jinan China (Virtual Event).

"Knowledge discovery with Deep RL for selecting financial hedges", E. Benhamou, D. Saltiel, S. Ungari, A. Mukhopadhyay
- AAAI 2021: KDF workshop, https://aaai-kdf.github.io/kdf2021/accepted_papers

"Liquid Speed: A Congestion Fee for Low-Latency Exchanges", M. Brolley, and M. Zoican
- Northern Finance Association, Northern Finance Association, September 16-18, Waterloo Canada (Virtual Event).
- 5th SAFE Market Microstructure Conference, August 23-25, Frankfurt Germany (Virtual Event).
- Asian Finance Association, July 2-4, Jinan China (Virtual Event).
- Seminars: TMX Group

"The Value of ETF Liquidity", M. Khomyn, T. Putnins and M. Zoican
- Financial Management Association annual meeting, October 20-23, Denver USA.
- ERMAS—Romanian Academic Economist Diaspora, July 28-30 (Virtual Event), Sibiu Romania.

3.2. Webinars

Because of the pandemic, we were not able to organize our annual events (QuantVision Summit & Round table) and as a consequence, we could not have a presentation of the two projects that we funded and are now completed (see Completed Project page 18). However, the two papers have been presented in a "quantitative finance" session organized online at the 15th CSDA International Conference (CFE 2021) and we launched the Webinar series based on funded projects.

[Hugues Langlois](#), Associate Professor at HEC, is the first to present his research on "Forecasting Portfolio Weights" based on his paper "[A New Benchmark for Dynamic Mean-Variance Portfolio Allocations](#)". Follow the link below to get more information and watch the video.

3.3. Annual events

Every year, the QMI organizes some events. Intended for quantitative management experts – academics, professionals and journalists – it will aim to combine the research undertaken by members of the QMI, projects financed by the QMI and research by internationally renowned researchers, by organizing a guest session and presentation sessions for research articles. A roundtable has also been organized in which academics, journalists and professionals will be invited to take part in a debate.
However, this year we only had a roundtable.

3.3.1. Annual conference and annual round table

Unfortunately, there could not be any annual conference in 2021. However, we organized an online round table in March 2021.

Fighting for climate change and protecting nature – can sustainable finance be one of the solutions ?

Université Paris-Dauphine, (virtual) March 11, 2021

Climate change, biodiversity loss, natural resources depletion, pollutions of all kinds and origins, Covid-19 crisis.

We are facing real and urgent environmental challenges. All the financial sector largely communicates about its awareness on these issues and the sustainable finance sector is growing at an unprecedented pace.

During this conference, we would like to raise some questions regarding the ability of the financial sector to bring real solutions to these complex challenges. Sustainable Finance, what are we talking about? Is/can Finance an adequate answer to these long-term issues? What are the impacts of Green Investments? Are we able to measure them? Is the classical risk/return model still appropriate to this kind of investments? How to introduce the idea of utility? Should we move towards more binding regulations? Faster?

To try to answer to these complex questions, we will gather some cutting-edge experts coming from various horizons: bankers, economists, asset-managers, investors, regulators all having a long-term involvement on these subjects.

Chairman: **Juliette Karrer** (Founder of JKR - Financial Markets & Sustainable Finance Advisor)
- **Bertrand Badré**, Founder and CEO, BlueOrange Capital, Former CEO, World Bank Group.
- **Andrea Blackman**, Global Head of ESG Solutions Group, Moody's
- **Georg Kell**, Chairman, Arabesque Partners, Founding Director, UN Global Impact.
- **Lucie Pinson**, Founder & Executive Director, Reclaim Finance.
- **Elree Winnett Seelig**, Head of ESG and Securities Services, Citi

A paper based on the conference was published in Revue Banque in October 2021.

3.3.2. Hackathon

We organized on February 5-6, 2021, the third Hackathon - Intelligence Artificielle & Machine Learning and for the first time, it was online.

This event was organized by QMI, led by research teams of Université Paris Dauphine, ENSAE and the support of LFIS and SESAMm.

96 candidates/41 teams composed of students, young graduates, researchers and engineers, from Centrale Lyon, Centrale Supelec, ENS Paris Saclay, ENSAE, ENSAI, ESSEC, HEC Liège, IA School, IMT Atlantique, ISUP, Polytech Paris Saclay, Université Aix-Marseille, Université de Nantes, Université Paris Dauphine-PSL, Université Paris Diderot, Sorbone Université, Technical University of Munich and from Télecom ParisTech, have been working for 24 hours to explore the fields of artificial intelligence and machine learning in the asset management industry. The results of the competition are below.

NOM	PRENOM	PROGRAMME	ECOLE/UNIV.	EQUIPE	SCORE
Batardiere	Bastien	Mathématiques-Vision-Apprentissage	ENS PARIS-SACLAY	FJLA	0,004584
Boulet	Lucien	MSc 203	UNIVERSITE PARIS - DAUPHINE		
Demoly	Juliette	MSc 203	UNIVERSITE PARIS - DAUPHINE		
Périgné	Florian	MSc 203	UNIVERSITE PARIS - DAUPHINE		
Hrittane	Meriem	MSc 203	UNIVERSITE PARIS - DAUPHINE	VEGA	0,004698
Klimaschka	Simon	Technical University of Munich	TECHNICAL UNIV. OF MUNICH		
Lund	Maximilian	Technical University of Munich	TECHNICAL UNIV. OF MUNICH		
Shawareb	Mickaël	MSc 203	UNIVERSITE PARIS - DAUPHINE		
La Spada	Enzo	MSc 203	UNIVERSITE PARIS - DAUPHINE	CHAR	0,004706
Lai	Olivier	MSc 203	UNIVERSITE PARIS - DAUPHINE		
Luca de Tena	Jimena	MSc 203	UNIVERSITE PARIS - DAUPHINE		
Metral	Benjamin	MSc 203	UNIVERSITE PARIS - DAUPHINE		
Hacheme	Gilles	Doctorat	UNIV. AIX-MARSEILLE	AMSE	0,004738
Sessinou	Rosnel	AMSE	UNIV. AIX-MARSEILLE		

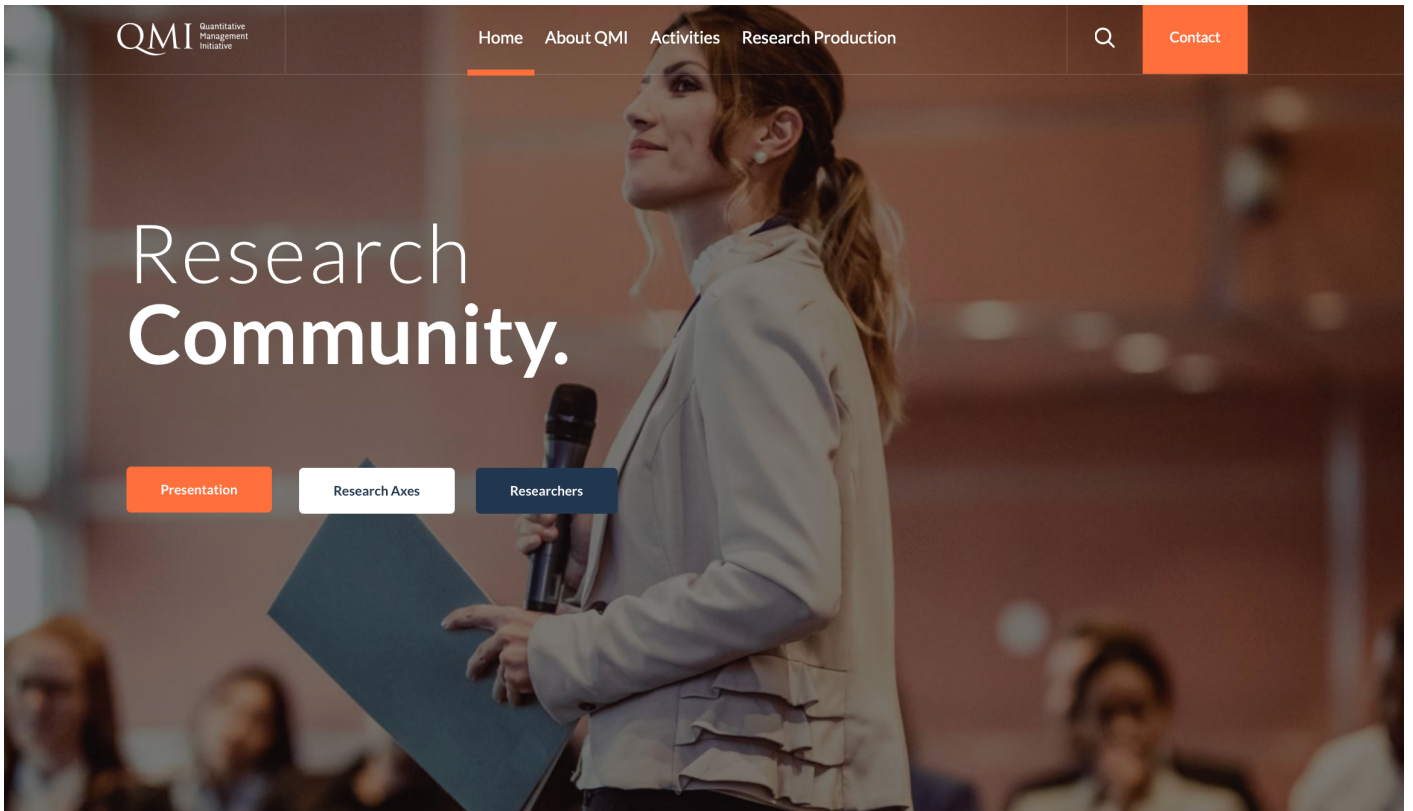Follow the link below to get more information and watch the video.

The next Hackathon will be organized online on March 10-11 2022. At the registration closure, we had 66 candidates from Aix Marseille Université, Centrale Supelec, Dauphine Tunis, Ecole Polytechnique, ENSAE, ENSAE-SENEGAL, ENSAI, ENSEEIHT –Toulouse INP, ESSEC, IAE Nice, IMT Atlantique, INRAe, ISCID-CO, Sorbonne Université, SUPCOM Tunisie, TEKUP Tunisie, Université de Lorraine, Université Paris 1 Panthéon – Sorbonne, Université Paris Dauphine – PSL, in 40 teams.

3.4. Website

The goal of the website is to become a showcase for the QMI and to encourage exchange between research and professionals by becoming for example a public library of research articles and computer code relating to quantitative management themes. Address: QMinitiative.org.

The website is a way to manage the annual conference and workshops registrations. Moreover, it is continuously updated.

After 9 years, we have decided to launch a completely new website. After 6 months of work, the new website was out at the beginning of June 2021.