

VERENA HAGSPIEL – CURRICULUM VITAE

Professor of Investment and Finance
Department of Industrial Economics and Technology Management
Norwegian University of Science and Technology
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7491 Trondheim, Norway

Civil status: Married, 2 children (2017, 2020) *Nationality:* Austrian

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EMPLOYMENT

- 2018 – current Professor, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology;
2013 – 2018 Associate Professor, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology;
2012 – 2013 Postdoctoral Research Fellow, Department of Operations, HEC, Université de Lausanne;
2011 – 2012 Postdoctoral Research Fellow, Department of Mathematics, Instituto Superior Técnico and CEMAT, University of Lisbon.

OTHER SERVICES

- 2021 – current Head of Research Group: Managerial Economics, Finance and Operations Research, Norwegian University of Science and Technology;
2021 – 2022 Expert committee member (Ekspertutvalget), Norwegian government appointed expert committee to assess the current framework conditions and market for climate-friendly investments;

EDUCATION

- 2008 – 2011 PhD Economics, Tilburg University, The Netherlands;
2003 – 2008 Dipl.-Ing. (5-year degree) Technical Mathematics, Technische Universität Graz, Austria;
2006 – 2007 MSc Quantitative Finance and Actuarial Sciences, Tilburg University, The Netherlands.

PUBLICATIONS

Risk and benefit sharing schemes in oil exploration and production, S. Fedorov, V. Hagspiel, M. Lavrutich, T. Lerdahl, accepted at *Energy Economics*, 2022

Price stress testing in offshore oil field development planning, G. Lei, V. Hagspiel, M. Stanko, accepted at *Energy*, 2022

Sequential Production of Two Oil Fields with an Option to Switch, S. Fedorov, M. N. Amar, V. Hagspiel and T. Lerdahl, 2022, accepted at *Journal of Petroleum Science and Engineering*

Transmission investment under uncertainty: Reconciling private and public incentives, M. Lavrutich, V. Hagspiel, A. S. Siddiqui, *European Journal of Operational Research*, In Press, 2022

The Impact of Retractable Subsidies on European Renewable Energy Investments, L. H. Sendstad, V. Hagspiel, W. J. Mikkelsen, R. Ravndal, and M. Tveitstøl, *Energy Policy*, Volume 160, 2022

- Stepwise Investment in Circular Plastics under the Presence of Policy Uncertainty, L. De Weerd, T. Compernelle, V. Hagspiel, P. M. Kort, C. Oliveira, *Environmental and Resource Economics*, 2021
- Policy uncertainty in Scandinavian countries, E. J. V. Ifwarsson, L. E. Kleiven, L. H. Sendstad, V. Hagspiel, *Economics Letters*, Volume 209, 2021
- Mothballing in a Duopoly: Evidence from a (Shale) Oil Market, N. Comincioli, V. Hagspiel, Peter M. Kort, F. Menoncin, R. Miniaci and S. Vergalli, *Energy Economics*, Volume 104, 2021
- Real options approach for a staged field development with optional wells, S. Fedorov, V. Hagspiel and T. Lerdahl, *Journal of Petroleum Science and Engineering*, Volume 205, 2021
- Green Capacity Investment under Subsidy Withdrawal Risk, R. L. G. Nagy, V. Hagspiel, and P. M. Kort, *Energy Economics*, Volume 98, 2021
- Optimal Risk Adoption and Capacity Investment in Technological Innovations, Lars H. Sendstad, Michail Chronopoulos and Verena Hagspiel, *Transactions on Engineering Management*, 2021
- Capacity Optimization for Innovating Firms, V. Hagspiel, P. M. Kort, C. Nunes, R. Pimentel and K. Støre, *International Journal of Production Economics*, Volume 233, 2021
- Green investment under time-dependent subsidy retraction risk, V. Hagspiel, C. Nunes, C. Oliveira, M. Portela, *Journal of Economic Dynamics and Control*, Volume 126, 2021
- Optimal timing and capacity choice under the rate-of-return renewable energy support, M. Kozlova, S.-E. Fleten, V. Hagspiel, *MethodsX*, Volume 7, 2020
- Technology adoption in a declining market, V. Hagspiel, K. J.M. Huisman, P. M. Kort, M. N. Lavrutich, C. Nunes, R. Pimentel, *European Journal of Operational Research*, Volume 285, Issue 1, 2020, Pages 380-392
- Green Electricity Investments: Environmental Target and the Optimal Subsidy, S. Bigerna, X. Wen, V. Hagspiel, P.M. Kort, *European Journal of Operational Research*, Volume 279, Issue 2, 2019, Pages 635-644
- Optimal timing and capacity choice under the rate-of-return renewable energy support, M. Kozolova, S.-E. Fleten and V. Hagspiel, *Energy*, Volume 174, 2019, Pages 591-601
- Optimal investment decisions in lice-fighting technologies: A case study in Norway, O. M. Brakstad, V. Hagspiel, M. Lavrutich and D. Matanovic, *Aquaculture*, Volume 504, 2019, Pages 300-313
- The impact of the Norwegian-Swedish green certificate scheme on the investment behavior: A wind energy case study, F. Finjord, V. Hagspiel, M. Lavrutich and M. Tangen, 2018, *Energy Policy*, Volume 123, 2018, Pages 373-389.
- Green Investment under Policy Uncertainty and Bayesian Learning, P. A. O. Dalby, G. R. Gillerhaugen, V. Hagspiel, T. Leth-Olsen and J. J.J. Thijssen, 2018, *Energy*, Volume 161, 2018, Pages 1262-1281.
- Valuing Supply-Chain Responsiveness under Demand Jumps, I. Biçer, V. Hagspiel, S. de Treville, *Journal of Operations Management*, Volume 61, 2018, Pages 46-67.
- Switching from oil to gas production in a depleting field, K. Støre, S.-E. Fleten, V. Hagspiel, C. Nunes, *European Journal of Operational Research*, Volume 271, Issue 2, 2018, Pages 710-79.

Real options under technological uncertainty: A case study of investment in a post-smolt facility in Norway, V. Hagspiel, J. Hannevik, M. Lavrutich, M. Naustdal, H. Struksnæs, *Marine Policy*, Volume 88, February 2018, Pages 158-166.

Stepwise Investment and Capacity Sizing under Uncertainty, M. Chronopolous, V. Hagspiel, S.-E. Fleten, *OR Spectrum*, Volume 39, Issue 2, March 2017, pp 447-472.

Investment in mutually exclusive transmission projects under policy uncertainty, I. Bakke, S.-E. Fleten, L. I. Hagfors, V. Hagspiel, B. Norheim, *Journal of Commodity Markets*, Volume 3, Issue 1, September 2016, Pages 54-69.

Valuing quantity flexibility under supply-chain disintermediation risk, I. Bicer, V. Hagspiel, *International Journal of Production Economics*, Volume 180, October 2016, Pages 1-15.

How to Escape a Declining Market: Capacity Investment or Exit?, V. Hagspiel, K.J.M. Huisman, P.M. Kort, C. Nunes, *European Journal of Operational Research*, Volume 254, Issue 1, 1 October 2016, Pages 40-50.

Volume Flexibility and Capacity Investment under Demand Uncertainty, V. Hagspiel, K.J.M. Huisman, P. M. Kort, *International Journal of Production Economics*, Volume 178, August 2016, Pages 95-108.

Investment in Electric Energy Storage under Uncertainty: A Real Options Approach, I. Bakke, S.-E. Fleten, L. I. Hagfors, V. Hagspiel, B. Norheim, S. Wogrin, *Computational Management Science*, July 2016, Volume 13, Issue 3, pp 483-500.

Stepwise Green Investment under Policy Uncertainty, M. Chronopoulos, V. Hagspiel, S.-E. Fleten, *The Energy Journal*, Volume 37 (4), 2016.

Dedicated vs product flexible production technology: Strategic capacity investment choice, H.J. Boonman, V. Hagspiel, P.M. Kort, *European Journal of Operational Research*, Volume 244, Issue 1, 1 July 2015, Pages 141-152.

Optimal technology adoption when the arrival rate of new technologies changes, V. Hagspiel, K. J.M. Huisman, C. Nunes, *European Journal of Operational Research*, Volume 243, Issue 3, 16 June 2015, Pages 897-911.

Valuing Lead Time, S. de Treville, I. Bicer, V. Chavez-Demoulin, V. Hagspiel, N. Schürhoff, C. Tasserit, S. Wagner. *Journal of Operations Management*, Volume 32, Issue 6, September 2014, Pages 337-346.

Flexibility in Technology Choice: A Real Options Approach, V. Hagspiel. *Dissertation series CentER*, Tilburg University, 2011

BOOK CHAPTERS

Marine minerals' role in future holistic mineral resource management, S. L. Ellefmo, N. Aberle, V. Hagspiel, M. Ingulstad and K. Aasly, Geological Society, London, Special Publications, Volume 526, SP526-2022-30, 2022

Product Innovation of an Incumbent Firm: A Dynamic Analysis, V. Hagspiel, K.J.M Huisman, P. M. Kort, C. Nunes, R. Pimentel, *conditionally accepted for publication as book chapter in forthcoming book Innovation: Flexibility, Organization and Strategy*, editor: Lenos Trigeorgis, MIT Press

CONFERENCE PROCEEDINGS

Fedorov, S., Hagspiel, V., Lerdahl, T., Idris, A., & Ghahfarokhi, A. J. (2020, October 21). Staged Development of a Marginal Oil Field Under Technical and Market Uncertainty: The Olympus Case. Society of Petroleum Engineers.

WORKING PAPERS

How damaging are environmental policy targets in terms of welfare?
(with S. Bigerna, P. M. Kort and X. Wen)

Risk and benefit sharing schemes in oil exploration and production
(with S. Fedorov, M. Lavrutich and T. Lerdahl)
Price Stress Testing in Offshore Oil Field Development Planning
(with G. Lei and M. Stanko)

A Multi-Layered Learning Approach for Sequential Decision Problems with Multiple Uncertainties
(with R. B. Bratvold, L. A. S. Eriksen, S. Fedorov and T. J. Olsen)

Evaluation of Tieback Developments for Marginal Oil Fields with Timing Flexibility
(with S. Fedorov, R. W. Hammerstad, S. Haseldonckx, J. H. Rogstad and A. H. Rønning)

Investment under uncertainty with costly Bayesian learning: The optimal choice of the learning rate
(with R. L. G. Nagy, S. Sund and J. J. J. Thijssen)

Revenue-Enhancing Pre-Investment Activities under Uncertainty
(with T. Olsen), Available at SSRN: <https://ssrn.com/abstract=3194617>

Optimal switching between projects with different profitability and uncertainty characteristics
(with T. Olsen)

Subsidized Capacity Investment under Uncertainty, CentER Discussion Paper Series No. 2017-043, X. Wen, V. Hagspiel and P. M. Kort, Nov 2017. Available at SSRN: <https://ssrn.com/abstract=3063942>

Boonman, H. J. and V. Hagspiel (2014): Sensitivity of Demand Function Choice in a Strategic Real Options Context. Working paper, Tilburg University
Available as Chapter 4 of Boonman's dissertation:
<https://pure.uvt.nl/portal/files/4594186/ThesisHettieBoonmanVersion27October2014.pdf>

Optimal Capacity Investment in Oligopoly: a Real Options Approach, Boonman, H. J., V. Hagspiel, and P. M. Kort (2014), working paper, Tilburg University.
Available as Chapter 4 of Boonman's dissertation:
<https://pure.uvt.nl/portal/files/4594186/ThesisHettieBoonmanVersion27October2014.pdf>

Optimal Investment Strategies for Product-Flexible and Dedicated Production Systems under Demand Uncertainty, working paper, Tilburg University.
Available as Chapter 4 of my dissertation:
<https://pure.uvt.nl/ws/files/1392447/dissertationHagspiel.pdf>

(INVITED) SEMINAR AND CONFERENCE PRESENTATIONS

2022: 15th Viennese Conference on Optimal Control, Dynamic Games and Nonlinear Dynamics;
2019: Annual International Conference on Real Options; Workshop on *Investment in Energy*,
Instituto Superior Técnico, University of Lisbon; Workshop on Investments, Energy, and

- Green Economy, University of Brescia; Workshop on *Real Options in Energy and Mining* (invited), The Fields Institute, Toronto; FIBE Conference
- 2018: Workshop on *Dynamic models of strategic investment under uncertainty* in Bielefeld (invited); INFORMS Annual Meetings; University of Brescia, Department of Economics (invited); Adam Smith Business School at the University of Glasgow (Applied Economics seminar series) (invited); Annual International Conference on Real Options; International Conference on Computational Management Science; PhD Winter School on Real Options and Commodity Markets.
- 2016 Annual International Conference on Real Options, Tilburg University (Operations Research Seminar Series).
- 2015 INFORMS Annual Meetings; Nordic Environmental Social Science Conference 2015; 11th Workshop on Optimal Control, Dynamic Games and Nonlinear Dynamics; Instituto Superior Técnico Lisboa (Probability and Statistics Seminar); FIBE Conference; Produksjonsteknisk konferanse 2015.
- 2014 INFORMS Annual Meetings; International Symposium on Dynamic Games and Applications; International Conference on Computational Management Science.
- 2013 INFORMS Annual Meetings; Instituto Superior Técnico Lisboa (Probability and Statistics Seminars); Norwegian School of Economics (Department of Business and Management); Aarhus University; Norwegian University of Science and Technology; International Conference on Computational Management Science.
- 2012 Carnegie Mellon University (Probability and Computational Finance Seminars); Winter School of Mathematical Finance, EPFL and University of Lausanne (IBF Brown Bag Seminar); Instituto Superior Técnico (Probability and Statistics Seminars); Viennese Workshop on Optimal Control, Dynamic Games and Nonlinear Dynamics.
- 2011 Tilburg University (Operations Research Seminars); INFORMS Annual Meeting; ISEG School of Economics and Management; Norwegian University of Science and Technology; Annual International Conference on Real Options; Tilburg University (GSS Multidisciplinary Workshops & Economics Workshop); Instituto Superior Técnico (Probability and Statistics Seminars).
- 2010 Finance Conference of Portuguese Finance Network; Tilburg University, (GSS Multidisciplinary Workshops); 11th Workshop on Optimal Control, Dynamic Games and Nonlinear Dynamics; Annual International Conference on Real Options.
- 2009 Annual International Conference on Real Options; Workshop on Operating Uncertainty using Real Options; Economics and Finance PhD Student Conference; EARIE Conference.

ADVISING

Post-doctoral Researchers

Semyon Fedorov, NTNU, 2022 -

Lars M. Sendstad, NTNU, 2018 – 2021

Maria Lavrutich, NTNU, 2016 – 2017

PhD Students

Farida Mustafina, *main supervisor*, NTNU (Jun 2022 -)

Project: The Economics of deep sea mining, TripleDeep – The Deep Dilemmas: Deep Sea Mining for the new Deep Transition, A project in the Interdisciplinary Sustainable Initiatives at NTNU

Olga Noshchenko, *main supervisor*, NTNU (Sep 2021 -)

Project: Multi-objective decision support for more environmentally friendly oil and gas production based on real options analysis, project within BRU21

Seok Ki Moon, *co-supervisor*, NTNU (Sep 2018 -)

Project: Improved planning methods for more energy efficient and environmentally friendly fields in the Barents Sea, project within BRU21, Industrial partner: AkerBP

Roel Nagy, *main supervisor*, NTNU (Feb 2018 -)

PhD candidate of the InvestExL project, Industrial partner: Hydro Energi AS
 Guowen Lei, *co-supervisor*, NTNU (graduated Jun 2022)
 Project: Automated methodologies for decision support in field development, project within BRU21, Industrial partner: Lundin
 Semyon Fedorov, *main supervisor*, NTNU (graduated Mar 2022)
 Project: Cost effective development of (small) discoveries on the Norwegian Continental Shelf, project within BRU21, Industrial partner: OKEA
 Lars Ivar Hagfors, *co-supervisor*, NTNU (graduated Oct 2018)
 Dissertation: “*Essays on Electricity Price Modelling*”
 Xingang Wen, *co-supervisor*, Tilburg University (graduated Nov 2017)
 Dissertation: “*Investment under Uncertainty: Timing and Capacity Optimization*”
 Hettie Boonman, *co-supervisor*, Tilburg University (graduated Dec 2014)
 Dissertation: “*Strategic Real Options: Capacity Optimization and Demand Structures*”

Doctoral Committees

Loïc De Weerd, University of Antwerp, Belgium, 2021
 Francesca Andreolli, University of Padua, Italy, 2021
 Katarina Eriksson, Linnaeus University, Sweden, 2019 (main opponent)
 Luciana Salles Barbosa, Instituto Superior Técnico, University of Lisbon, Portugal, 2019
 Lars Hegnes Sendstad, NHH, Norway, 2018
 Xingang Wen, Tilburg University, The Netherlands, 2017 (co-promotor)
 Maria Lavrutich, Tilburg University, The Netherlands, 2016
 Hettie Boonman, Tilburg University, The Netherlands, 2014 (co-promotor)

RESEARCH GRANTS

TripleDeep – The Deep Dilemmas: Deep Sea Mining for the new Deep Transition, A project in the Interdisciplinary Sustainable Initiatives at NTNU, 2022-2025, The Economics of Deep Sea Mining (WP leader).

Investment under uncertainty in the future energy system: The role of expectations and learning (InvestExL), Competence building project with industry (ENERGIX-program of the Research Council of Norway), 2017-2022, (Project leader).

Cost effective development of (small) discoveries on the NCS, Industry funded PhD project, Part of the Field development and Economics research area of the BRU21 program at NTNU, 2018-2021, (Project leader).

WORK WITH INDUSTRY

2021 – current	Collaboration with OKEA ASA and the Norwegian Petroleum Directorate on the innovation project ProDecs;
2018 – 2022	Collaboration with OKEA ASA on the project <i>Cost effective development of (small) discoveries on the NCS</i> as part of the BRU21 program of NTNU;
2016 – 2022	Collaboration with HYDRO Energi AS as industry partner of the InvestExL project.
2013 – current	Collaboration on student and research projects with industrial partners from the Norwegian energy, automotive and aquaculture industry.
2015	Presentation “Real option analysis: Applications in a new energy field” at Produksjonsteknisk konferanse 2015.
2014	Recognition for contributing to the development of the CDF tool as a member of the OpLab team led by Prof. de Treville at the University of Lausanne.

- Description of the CDF tool: <http://acetool.commerce.gov/inventory>
 - The Cost-Differential Frontier has been made available since 2014 as part of the U.S. Department of Commerce toolbox to aid decision makers in valuing lead time (acetool.commerce.gov/inventory), and it has also been made available by the Swiss State Secretariat for Economic Affairs (<https://goo.gl/rjvQEO>).
 - Public release by the White House mentioning our efforts at the University of Lausanne: <http://www.whitehouse.gov/the-press-once/2014/10/03/fact-sheet-president-obama-announces-new-manufacturing-innovation-institute>
- 2012 – 2013 Collaboration on several industrial projects under the direction of Prof. de Treville with companies from food sector, automotive and pharmaceutical industry.

PROFESSIONAL SERVICE

Referee:

Journal of Economic Dynamics and Control, European Journal of Operational Research, Central European Journal of Operations Research, Journal of Banking and Finance, International Journal of Production Economics, Optimization Letters, North American Journal of Economics and Finance, Applied Energy, Journal of the Operational Research Society, Journal of Commodity Markets, Operational Research – An International Journal, The Engineering Economist, IEEE Transactions on Power Systems.

Conferences and Workshop Organization:

Organization and program committee member, Decision Quality Conference, September 2022, Oslo (Norway);

Co-organizer, Workshop on the *Hard Choices in the Energy Transition*, Energy transition conference, March 2021, digital, Trondheim (Norway);

Scientific committee member, Workshop on Investments, Energy, and Green Economy, University of Brescia, April 2019;

Main organizer, PhD Winter School on Real Options and Commodity Markets, March 2018, Tauplitz (Austria);

Conference organization committee member, 23rd European Operations Management Association (EurOMA 2016);

Scientific committee member, XV Conference on Computational Management Science, May 2018;

Scientific committee member, 1st YARO Workshop, March 2017;

Scientific committee member, 23rd EurOMA, June 2016;

Session organizer, EurOMA 2016, Special session *Interface of Operations Management & Finance*;

Session chair: Annual International Conference on Real Options 2018; EurOMA 2016 (*chairing 3 sessions on Interface of Operations Management & Finance*).

Committees:

Chair of the ENRE Early Career Award committee, INFORMS, 2022

Fagekspert, Assessment of project proposal to Regional Forskningsfond Rogaland, 2022

Member of ENRE Best Publication Award committee in Energy, INFORMS, 2021

Scientific assessment committee member for Professor position in Computational Engineering, Department of Energy Resources, University of Stavanger, 2020;

Scientific assessment committee member for Associate professor position in Financial Economics, Business School in Trondheim (HHiT) of Sør-Trøndelag University College (HiSt), 2015;

Administrator of PhD assessment committee for Steinar S. Veka, 2015.

Department Service:

Member of the MTIØT Study Program Committee (*Studieprogramråd*) at IØT, 2016 – 2021;

Member of the Academic Affairs Committee (*Studieutvalget*) at IØT, 2016 – 2021;

Organization and coordination of PhD Course *Winter School – Planning under Uncertainty*, 2018;

Organization and coordination of PhD Course *Dynamic Capital Investment*, 2016.

TEACHING EXPERIENCE

Instructor (Graduate), Project Evaluation and Financing (Derivative Markets), NTNU,
Spring 2014 – 2016, 2019-2022;
Instructor (PhD) and course coordinator, Winter School – Planning under Uncertainty, Spring 2018;
Instructor (Graduate) and course coordinator, Corporate Finance, NTNU, Fall 2013 – 2016, 2021;
Instructor (Graduate), Energy markets, NTNU, Fall 2016;
Instructor (Graduate), Production and Network Economics, NTNU, Spring 2014;
Teaching assistant, Introduction to Finance, Tilburg University, Spring 2010 & 2011;
Teaching assistant, Mathematics 1, Tilburg University, Fall 2008;
Teaching assistant, Analysis for Engineers 2, TU Graz, Spring 2006;
Teaching assistant, Analysis for Engineers 1, TU Graz, Fall 2005.

RESEARCH VISITS

March 2012 Carnegie Mellon University, Department of Mathematical Sciences,
Pittsburgh, United States, *Host*: Dmitry Kramkov;
May 2011 Instituto Superior Técnico, Department of Mathematics, Lisbon, Portugal;
January 2010 Instituto Superior Técnico, Department of Mathematics, Lisbon, Portugal;
Sep-Dec 2009 Anderson School of Management, University of California, Los Angeles
Sponsoring Professor: Prof. Eduardo S. Schwartz.

Short visits (2 days to 2 weeks)

University of Glasgow, Adam Smith Business School: August 2018;
Instituto Superior Técnico, Department of Mathematics, Lisbon, Portugal: October 2016, June 2015,
January 2015, October 2014, May 2014;
Tilburg University, Department of Econometrics and Operations Research: November 2019, June
2016, January 2016, February 2015, August 2014;
Department of Mathematical Sciences, University of Copenhagen: Nov 2013.

GRANTS

Gender equality starter kit, NTNU, 2013;
Postdoctoral research grant, 2011;
CentER oversea research grant, 2009;

ADDITIONAL EXPERIENCE

NTNU Mentorprogram (adept), 2018/2019;
NTNU's Educational Program for New Academic Staff (PEDUP), 2014-2015;
UT-Austin Portugal Summer School and Workshop in Mathematics, 2012;
Organization of Real Options Workshop, Tilburg University, 2011;
Presentation Skills Training, Tilburg University, 2010;
Teacher Training Course for PhD-Students and Junior Lecturers, Tilburg University, 2009;
Winter school on Mathematical Finance, Lunteren, Netherlands, Jan 2009, 2011 & 2012;
Internship, Raiffeisen Bank Raaba, July 2005.

ADDITIONAL INFORMATION

Languages: German (native), English (fluent), Dutch (fluent)
Norwegian (NTNU exam Trinn 3, European level C1)
French, Italian (intermediate)