Optimal ecological transition path of a credit portfolio distribution, based on Multidate Monge-Kantorovich formulation

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A need for quantitative tools to optimize portfolio alignment process

Context:

Perspectives of a low-carbon transition: need for a portfolio transition of financial institutions

- ➢ In the frame of alignment objectives, banks have made pledges to phase out from fossil fuel investments at given dates

Literature:

- Portfolio management under climate-related risks: *Cosemans (2021), Egli (2022)*
- Portfolio alignment: *The Alignment Cookbook (Institut Louis Bachelier et al., 2020)*

➢ Need for quantitative tools to help optimize the transitioning of large portfolios!

Question of the paper:

What is the optimal path to reach a target credit portfolio given the cost of changing the distribution of obligors, and given credit risk constraints ?

Main contributions of the paper

Question of the paper:

What is the optimal path to reach a target credit portfolio

- given the cost of changing the distribution of obligors
- and given credit risk constraints ?

Content of the paper:

a) This problem is modeled as a multi-date optimal transport problem, slightly modified to integrate the objective of minimising the credit risk of each intermediary portfolio.

b) They provide an ingenious solution to this problem on a discrete space in the following conditions:
   - The credit risk measure is strictly convex
   - Each obligor in the discrete space receives a non-null financing at the beginning and at the end of the period = no complete phase-out, and no completely new obligor categories.

c) They provide an efficient algorithm to estimate the solution

d) They provide an application of their framework on a fictitious portfolio of the biggest U.S. companies, with ESG scores to rank the obligors on their environmental performance.
   - They use the distance between ESG scores and credit ratings to define the transport cost.
   - They use a one-factor copula model with portfolio VaR to estimate the overall credit risk of each portfolio.

Discussion and going further (1)

On the optimal transport problem:

a. Diversification constraint: Portfolios must respect diversification constraints that are not simply accounted by a simple average of credit risk of the obligors.

→How do you think your model could include this diversification constraint ?

- Some of the intermediary portfolios seem to be quite concentrated in the application example.

b. Hypothesis of non-null financing in initial and target portfolios: For the model to have a solution, each obligor in the discrete space must receive a non-null financing in both initial and target portfolios

→This adds a big constraint on the transitioning process that could be investigated further, as it goes in contradiction with the phasing out objectives.

- Maybe very small portions of financing in an obligor could be approximated with zero financing, to allow for complete phase-outs, and completely new types of obligors that would be too risky at the beginning of the period ?

Discussion and going further (2)

About applications:

a. <u>Correlation between credit scores and exposure to transition risk</u>: If not already, credit scores will be correlated to environmental scores in the future (Bouchet, 2020)

→ Would be very interesting to use this model to see what happens when these two scores are correlated

- at the beginning, credit score of brown companies would be better than green ones, and it would become the contrary at the end

b. <u>On the cost of changing a portfolio distribution</u>: Would also be interesting to have more insights on the actual cost of changing a portfolio, for a bank for example.

→ Does a change in credit spread really increase the cost of a portfolio change ?

- I'd rather expect that the cost of a change of sector depends on the distance between the type of activities of the sector; for example if there is a change of group between primary, secondary and tertiary activities.

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Green investment and asset stranding under transition scenario uncertainty

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Uncertainty of climate mitigation and the role of agents expectations

Context:

- As Lage and Gobet (2021), this paper questions the financing of the transition, but with another perspective than transition planification:

→ The timing and modalities of mitigation pathway is highly uncertain, so agents have to make their investment decisions taking into account this uncertainty.

Objective of the paper:

Solves the problem of exercising real options at the optimal time in a context of uncertainty about the mitigation scenario that is being implemented.

Literature:

- On the role of uncertainty related to climate change in economic agents behaviour: *Dunz (2019), Annicchiarico (2021)*
- On real options: *Detemple and Kitapbayev (2020)*
- Bayesian learning literature: *Dalby (2018)*

Content of the paper

Theoretical contribution:

- The universe is modelled as a set of alternative mitigation scenarios described by trajectories of some risk factors and a signal (e.g. carbon tax, electricity and oil prices…)
- The agent estimates the probability that each scenario is being realised, and revises this estimation as the signal reveals more and more information in an active bayesian learning framework
- The agent values her real option based on these bayesian probabilities.

Two appplications:

- Optimal exit from a coal power plant
  - Risk factors: Electricity price, coal price and CO2 price
  - Signal: GHG emissions
- Optimal entry in a biomass power plant
  - Risk factors: Electricity and biofuel prices
  - Signal: Price of carbon allowances in the EU ETS system

Discussion and going further (1)

a) <u>Sensitivity to the set of scenarios</u>: Would be very interesting to see the sensitivity of the exercise to the number and the coverage of scenarios

- In particular, depending on the set of scenarios, for a given signal volatility the optimal exercise time could differ a lot, as scenarios would be more or less differentiated in each set

a) <u>Scenario dependency of the signal</u>: It is assumed that the signal is scenario-dependent. But the signal that an agent faces in reality is not scenario dependent, so it would be interesting to see how the model reacts when it is not.

→ The estimated probabilities could be very unstable and non robust as none of the considered scenarios is actually realised

Discussion and going further (2)

c) What about a multivariate signal ? Usually climate scenarios rely on combined assumptions on carbon tax and technology advances of green energy (e.g. NGFS scenarios)

→ A scenario is usually identified by at least bivariate trajectories

- Would be interesting to allow for the agent to use a multivariate signal
- The agent could even use all the risk factors as signals, as they provide more information
- This framework could therefore be used to discriminate between alternative models if the scenarios considered are made with different IAM models

d) Idea of alternative use of this framework: Extending it to other sets of scenarios would also help any scenario-maker to understand the consequences of its given set of scenarios on agents expectations

References

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