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Aalto University
School of Science

MS-E2177

Seminar on Case Studies in Operations Research

Optimal currency hedging strategy in global pulp markets

INTERIM REPORT

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Client:
UPM

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1 Changes in objectives and scope

Initially, our objective was to develop a strategy that would use forwards for mitigating both upside and downside risk for smaller fluctuations and use options to mitigate the downside risk of larger fluctuations. This has been replaced by a forward-oriented approach, although the use of options is not entirely ruled out. The client's objective is to minimize the variance in the cash flows caused by changes in currency rates, and this is best achieved by using forwards.

We proposed to build a hedging tool that the client could use. The tool that we have built is well suited for our study, but not intended to be used by the client as it is. However, we hope it will provide a proof-of-concept of our method, which the client can afterward implement with their own tools. Our current focus is making observations on the dependency between pulp prices and currencies, and decide on how the currency hedge should be implemented.

2 Project status

During the research stage of the project, the main achievements can be described as follows.

Before the COVID-19 pandemic adjustment, the team had meetings with the client, UPM. Through the client meetings, the project related questions were solved well and the research direction of the hedging strategy was adapted correspondingly. In addition, the team meetings every Monday within the group also supported the suitable path of project improvement.

During the COVID-19 pandemic, the group switched to remote meetings through Zoom. This adjustment momentarily slowed down the progression of the project, as the remote working did not appear to be as effective. However, this problem was detected and the working methods were changed.

The hedging tool is ready and different strategies can be tested for different time periods and pulp types. The tool simulates through a selected time period and buys or sells forwards on each time step determined by a predefined rebalance function. The rebalance function contains the hedging strategy, which can be changed between simulations. The hedging strategies have been implemented so that they

can adapt dynamically to changes in markets. The hedging effectiveness is currently measured with means, variances, and communicated through visualizations. These are fairly simple methods to measure effectiveness, and they will be replaced with more effective ones.

Correlations have been studied with basic statistical methods including Pearson's correlation and autocorrelations as well as cross correlation with different lags. This has been done iteratively for different pulp indices and currency pairs with the aim of finding the best signal for an optimal lag. Although the margins between correlation with different lag levels have been rather low, indicating that the pulp price level does not have a rapid effect on price level or vice versa. Therefore correlation analysis was conducted for modified time-series as well. For example with moving averages, logarithmic scale and with rates of change. So far the greatest discovery has been that the correlation level between pulp price indices and individual currency pair varies significantly over time. This suggests that correlation levels are dynamic variables and should be updated or at least be reviewed from time to time.

The conclusions on correlation analysis are yet to be conducted. Then the hedging tool can be used on the more robust level without being affected by persistent changes with correlations values during the development phase.

The data which we have received contains pulp prices from early 2000 to the end of 2019. However, both qualitative and quantitative research indicate that the dynamics of the price have changed during this time. Our team asked for more specific market data from UPM, and they offered time series on interest rates with 3 months and 12 months maturities and extended time series by the current date.

The team also received new data sets related to volumes and supply of the pulp commodity. These were requested to evaluate which fluctuations in pulp prices are caused by changes in currencies. The received data contained worldwide information about the following:

- Pulp inventories
- Pulp shipments
- Pulp production
- Capacity changes

In addition, trade data on pulp commodity was also delivered including specific data on demand and supply levels on pulp.

3   Changes to project plan and schedule

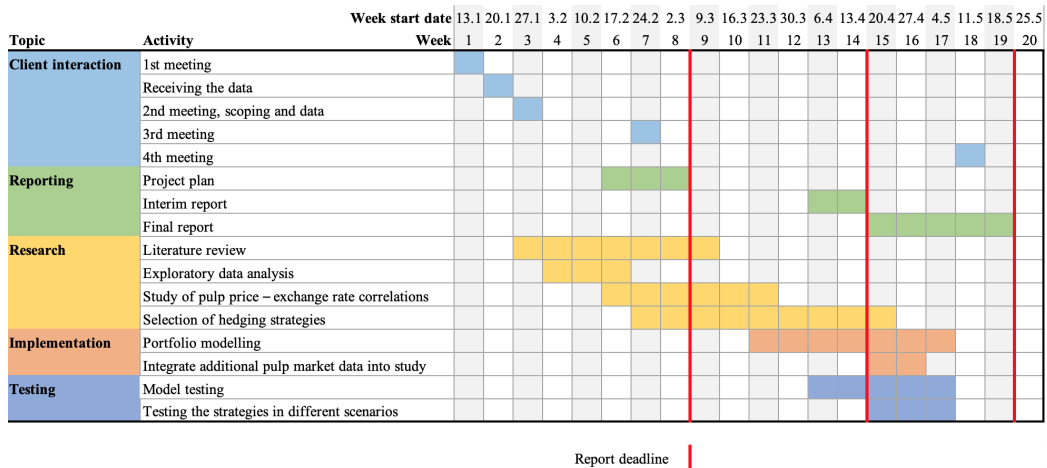| Week start date	13.1	20.1	27.1	3.2	10.2	17.2	24.2	2.3	9.3	16.3	23.3	30.3	6.4	13.4	20.4	27.4	4.5	11.5	18.5	25.5
Topic	**Activity**	Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Figure 1: Gantt chart of the project schedule. The week numbers correspond to weeks of the course.

Figure 1 shows the updated project schedule. A few changes have been made to the project schedule. The original plan included five meetings with the client, but the need for the fifth meeting is still uncertain. The project is approximately one week behind schedule, which can be compensated in a two weeks time horizon. The additional data received needs analyzing, which changed the schedule for the following two weeks.

4   Updated risk management plan

Risk	Probability	Impact	Effects	Mitigation measures
Team member inactivity or communication issues due to the COVID-19 epidemic	Medium	High	Imbalanced workload, more narrow scope, lower quality, tasks left until last minute	More collaboration, well-defined schedule, and regular meetings.
Model too complicated for the course	Medium	High	Problem too demanding to solve in the given time, or a complicated solution that is impossible for the client to implement.	Focus on the main task and keep it simple. Discuss new features of the model with the client in time. Prioritization.
Data-related issues	High	Low	Final model is based on a too small and specific data set.	Careful selection of data when modelling correlations between pulp price and exchange rate.
Communication issues with the client	Low	Medium	Deliverables are not what the client wanted	Frequent meetings with the client, effective communication via Slack and email

Table 1: Updated risk management table

In Table 1, an updated risk management table is presented. The probabilities and impacts of some risks have been changed, some risks were removed and some added. The previously included risk *Blindness to unexpected events* was removed, since predicting unexpected events is per definition impossible. Therefore our model will not account for rare, extreme events. The probability of the risk *Data-related issues* was changed to high since it is unlikely that our model will be completely unbiased based on the limited data. Therefore, the data will be selected carefully when modelling relationships between pulp price and exchange rate.

The risk *Not enough time to finish implementation* was merged with the risk *Solution too complicated*. They are both caused by setting the scope too wide, or by spending much effort on wrong things. The merged risk *Model too complicated for the course* has a high impact, since it means we are not able to finish the implementation in time. A new risk, *Team member inactivity or communication issues* was added. It has a high impact, since if some team member do not do their part at this stage, it would cause a much higher workload for the other team members, and a lot of work would need to be done in the last minute. The probability is medium since the team members also have other commitments that take up their time. All team members are present for the whole project since Elin's exchange studies were cancelled due to the corona pandemic.