Behavioural Finance Solutions GmbH

Axpo Cui Bono?

Solving the Accounting and other Puzzles in the Market for Electricity

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Abstract

This paper analyses to whom Axpo, one of the largest electricity providers in Switzerland, is a benefit. It resolves some puzzles that have recently been published about Axpo's operations, its trading, and its accounting. We find that Axpo not only secures a vital infrastructure of Switzerland but is economically sound and accurately reports its activities in its financial statements. Moreover, its trading contributes to the efficiency of the electricity market. The latter is important to steer the necessary investments for the future of Switzerland's energy supply.

Acknowledgments

The paper could not have been written without the proprietary data and financial support provided by Axpo. Axpo asked us for an independent third-party opinion on different issues about their valuations, trading and accounting that were raised in public discussions.

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1 Executive Summary

1.1 Introduction

Ever since the beginning of the last century, electricity has become a crucial infrastructure in all countries around the globe. We use electricity everywhere: to heat, to cook, to see and read, to organize traffic, to run life-saving machines in hospitals, to drive, to communicate, and to wash our clothes, brush our teeth or dry our hair. Popular books like “Black Out” (cf. Elsberg 2012) highlight how dependent we are on electricity.

In Switzerland, electricity is produced by companies such as Axpo, Alpiq, and BKW, which are mainly owned by the cantons. These companies have been accused of not serving the general public, but of having a life on their own. A life in which speculation on the electricity market is more important than the production of electricity itself! Moreover, this speculation has been claimed to create excessive liquidity risk as well as heavy losses, making it a burden on the companies, the cantons, and ultimately on the Swiss population. Finally, it has been claimed that the losses incurred by speculation are hidden by companies’ untransparent accounting.

We found these claims puzzling and investigated whether they are correct in the case of Axpo. Our results show that when relying only on public information, such claims can be made up. Indeed, as we show in Chapter 2, claims that only rely on public information will be biased by specific assumptions on Axpo’s costs and trading activities, about which information is not publicly available. However, using in-depth data from the company itself, the claims fizzle away. Axpo not only secures a vital infrastructure of Switzerland but is economically sound and reports its activities appropriately. Its trading is profitable and contributes to the efficiency of the electricity market, which is important to steer the necessary investments for the future. Furthermore, Axpo's financial accounting and reporting of trading activities are consistent with the requirements of IFRS (International Financial Reporting Standards) and present a true and fair picture of the company's business model and performance.

The paper is structured as follows. We first describe the electricity market in Switzerland: who produces how, who consumes electricity, and how electricity trading connects the two sides of the market. We then provide an overview of the market for trading electricity. How is the market structured and who participates in it? What types of trades can be distinguished and how efficient is the market? This general part of the paper is followed by a preview of the main results of the next three chapters, each of which considers a key aspect of the current debate: Axpo’s economics, the profitability of its trading activities, and its accounting.

The analysis of the economics of Axpo as an electricity company considers production quantities and costs, the revenues from sales, and how and why Axpo trades electricity. It also shows how all these activities add up to the company’s overall profits and losses. This is followed by an in-depth analysis of Axpo’s electricity trading covering its profitability, whether that profitability has declined over time, including an assessment of the sources of the trading profits. Finally, we provide a summary of the main findings of our investigation of whether Axpo`s accounting accurately reports these economic and financial activities.

This preview of the results in Chapter 2 through 4 is followed by a short conclusion and a reference list. Appendix A clarifies some common confusion on arbitrage and the efficiency of financial markets and Appendix B lists the main criticisms of Frauendorfer and Gutsche considered in our work and explains why they are not warranted.

1.2 Demand and Supply of Electricity in Switzerland

Approximately 600 companies produce electricity in Switzerland. According to the Federal Statistical Office, the largest producers are Axpo, Alpiq, and BKW with a production share of 34%, 19.58%, and 12.37%, respectively[1]. As Figure 1 shows, the main production sources are water (storage and running), nuclear, and renewables. The latter comprise both wind and solar energy and only accounts for 6% of overall production, but this share is expected to increase in the future.[2]

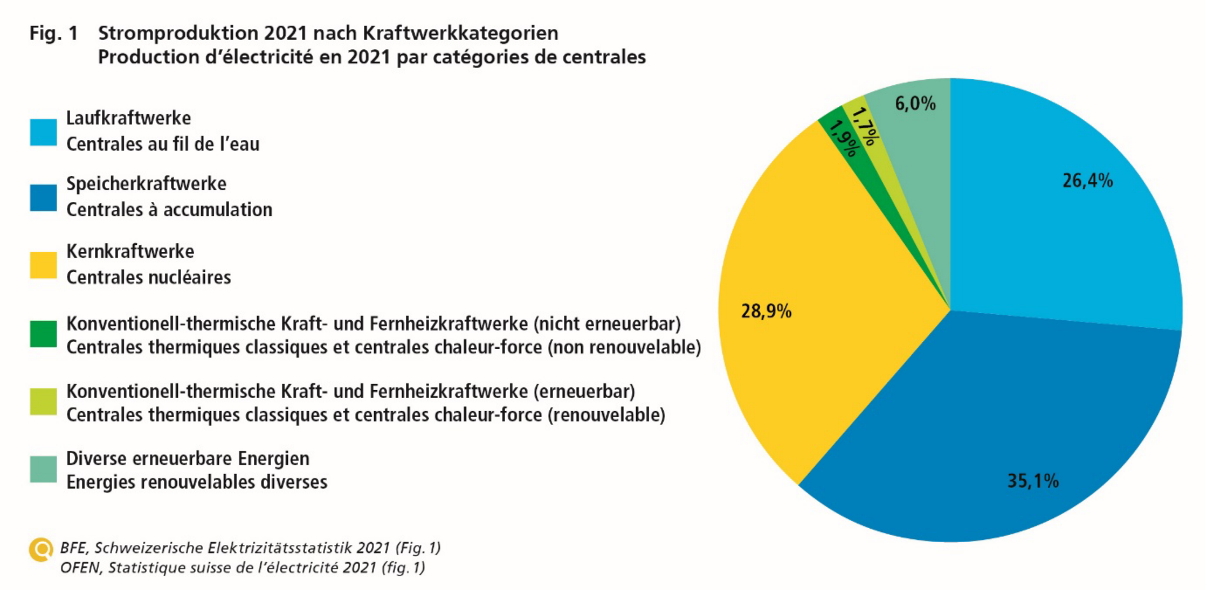


Figure 1. Electricity production by source.

The production facilities have different flexibility. Nuclear power plants, for example, produce a steady flow of electricity but cannot be stopped in the short-term[3]. Production from running water is quite inflexible as well. Production from storing water and burning gas or oil are the most flexible and are therefore used to balance demand and supply. Accordingly, their output fluctuates much more over time than production from nuclear power and running water, as Figure 2 shows.

[1] https://www.bfs.admin.ch/bfs/en/home/statistics/energy.assetdetail.23104752.html
[2] Energiezukunft 2050, Verband Schweizerischer Elektrizitätsunternehmen.
[3] However, nuclear power plants can be taken off-grid in case of emergency.

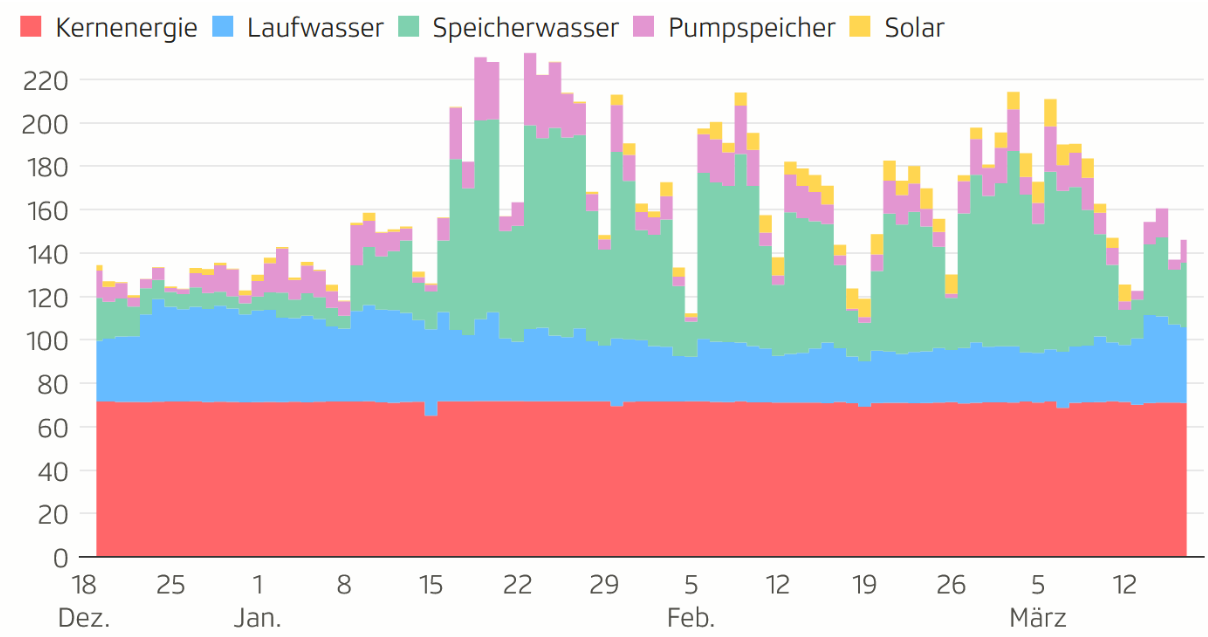


Figure 2. Daily net electricity production by source in GWh between December 2022 and March 2023. Source ENTSO-E.

On the demand side we have households, industry, services and transport, as Figure 3 shows.

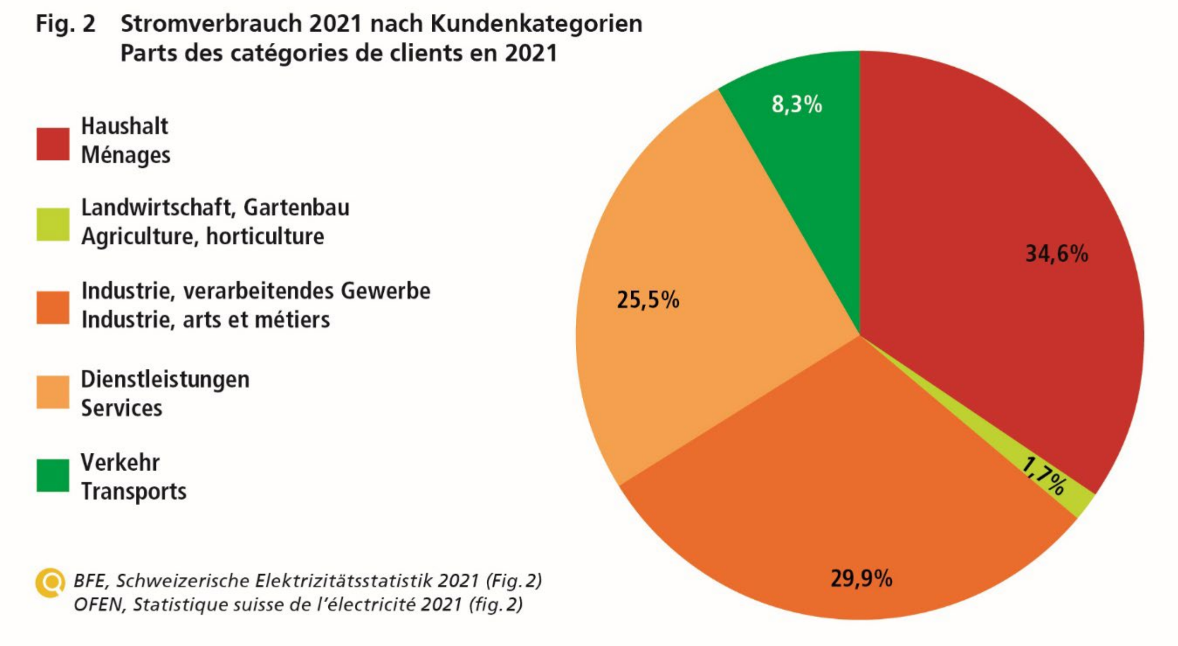


Figure 3. Demand for electricity by type of customer.

The demand and supply side are connected by Swissgrid (Figure 4), which has 6,700 kilometers of wires, 12,000 posts, and 147 transformers. Moreover, it has 41 wires connecting Switzerland to the surrounding countries, enabling import and export of electricity.

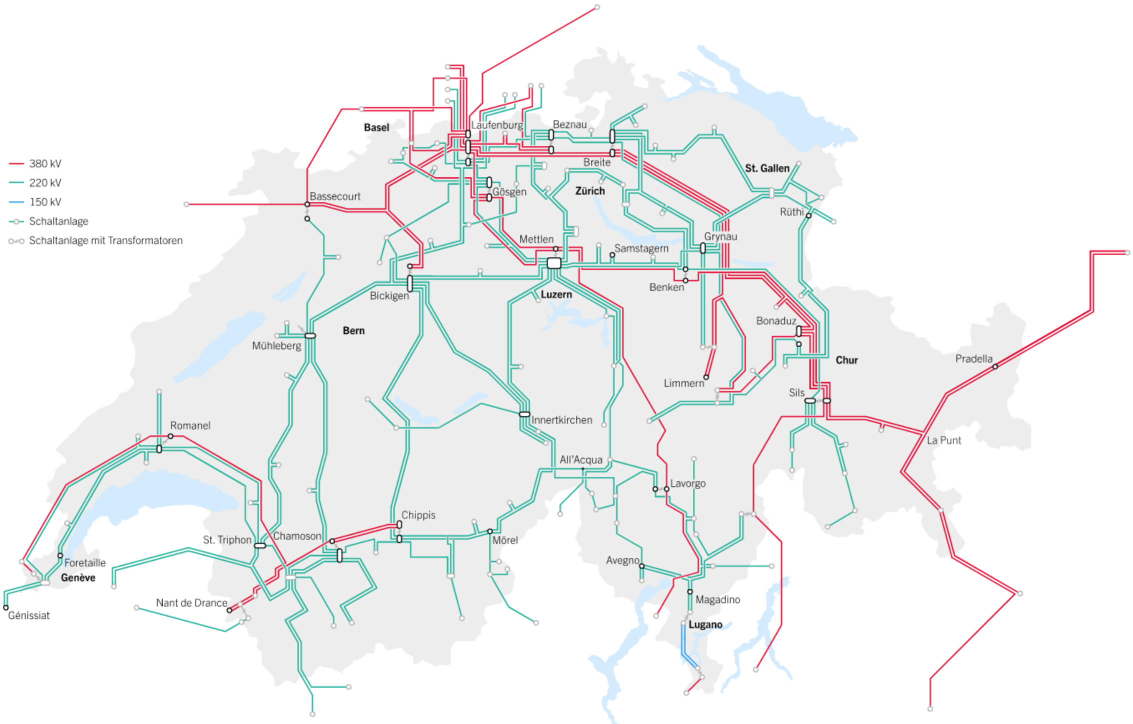


Figure 4: Overview of Swissgrid (https://www.swissgrid.ch/de/home/operation/power-grid/swiss-power-grid.html)

Both production and consumption are affected by seasonal factors. Switzerland is typically a net importer of electricity during the winter months (Figure 5, left panel) and a net exporter in summer. As can be seen in the right panel of Figure 5, the overall balance varies by year. It is therefore advantageous that Switzerland is connected to the European electricity market.

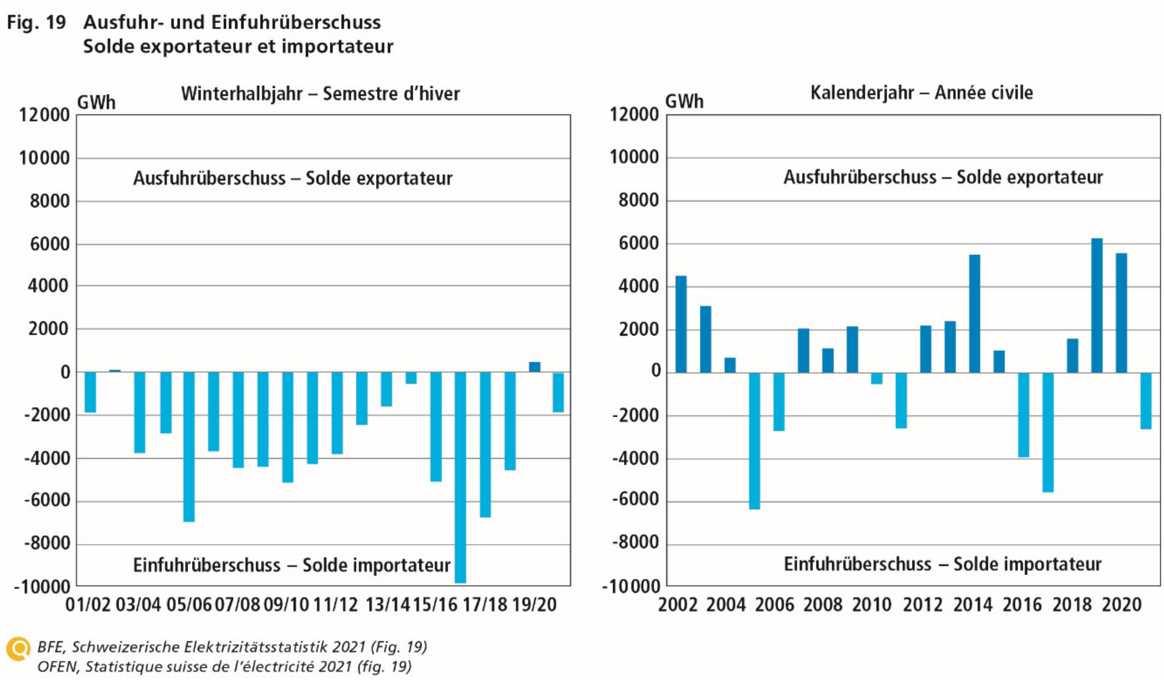


Figure 5: Import and export of electricity in Switzerland.

Demand for electricity in Switzerland is volatile not just across years (Figure 6) but also within a year and within a day. In particular, within a day there are off-peak (8 pm to 8 am) and peak-load (8 am to 8 pm) times. Moreover, due to the increased use of wind and solar energy in Europe, the supply of electricity in Europe is very volatile, as Figure 7 shows.

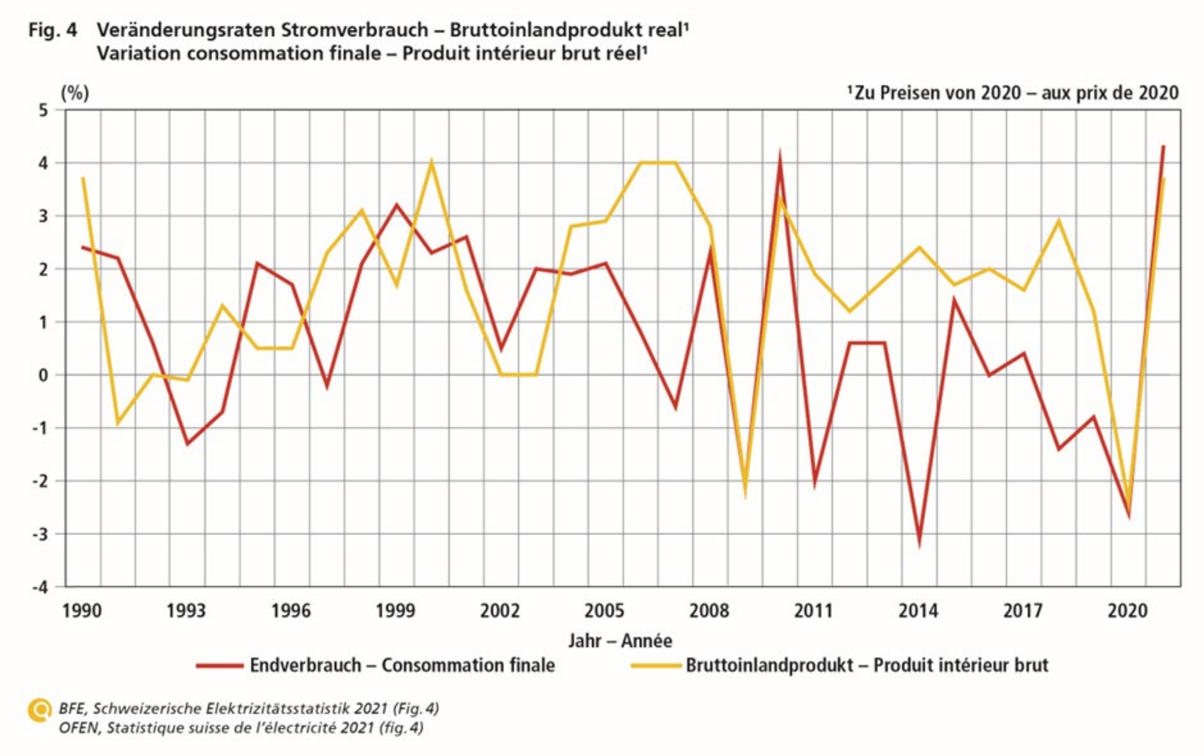


Figure 6: Volatility of electricity demand across years.

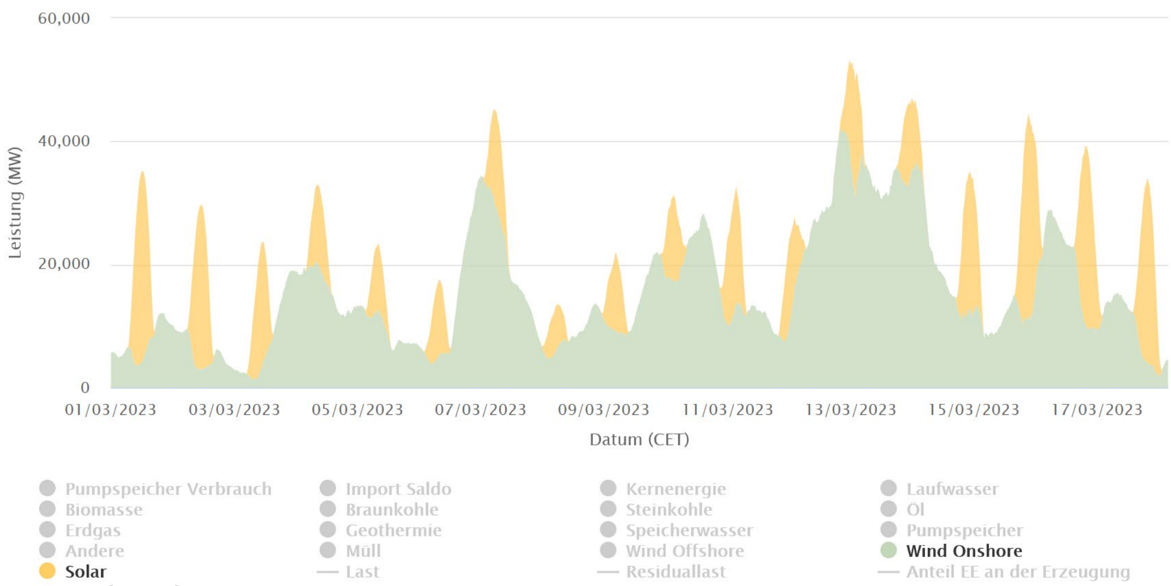


Figure 7: Net electricity production from wind and solar in Germany in March 2023. Source: https://www.energy-charts.info.

Since Switzerland is integrated in the market for electricity in Europe, the volatility of both sides of the market is a challenge for the safety of its electricity supply. The purpose of the market for electricity is to master this challenge. Market prices are quite volatile in the short run because of the low price elasticity of demand and the cost structure of the supply side. Since the more flexible production facilities are used to balance demand and supply on the market, short-term electricity prices reflect their marginal production cost. For thermal power plants, these costs include not just fuel costs (coal, oil, or natural gas), but also the price of CO_2 emission certificates. This is the reason that in the summer and fall of 2022, electricity prices rose in tandem with natural gas prices.

1.3 The Market for Electricity in Switzerland

In this section, we describe the market for electricity, covering such diverse aspects as its structure, the types of instruments that are traded, and the main participants.

Segmentation

The market for electricity is highly segmented by region and by time. Germany is the largest electricity market in Europe. Many Swiss electricity traders trade on the German market because of its higher liquidity, i.e., it is possible to trade large quantities without adversely affecting the market price. However, this so-called cross-hedging of Swiss production or delivery using German contracts gives exposure to basis risk, which can result in gains or losses to the extent that German and Swiss power prices do not move perfectly in sync.

Usually, the difference between the prices for electricity in Germany, France and Switzerland, the so-called spreads, are small. However, during some periods in 2022, the spreads became large (see Figure 8). This led to large, unexpected gains and losses for some electricity companies. For example, BKW had sold part of its production on the German market at a time when the country spread between Switzerland and Germany was narrow and bought it back at lower prices when the spread widened and thus the German prices were much below the Swiss prices. Ultimately, BKW will deliver electricity in Switzerland, but this round trip meant that the firm sold the electricity at high prices and bought it back at lower prices, generating substantial gains.

Electricity markets are also segmented between base load (delivery 24/7) and peak load (delivery Monday through Friday between 8 a.m. and 8 p.m.). The finest granularity at which one can trade electricity is by a quarter of an hour. There is no spot market in which electricity at this very instant is traded; rather, Swissgrid balances demand with supply using reserve capacity purchased in advance.

Concerning the time dimension, one first must distinguish spot and forward/futures markets. In the spot market, electricity for the day ahead is traded, while in the forward and futures markets, the delivery period can lie a few months and even years ahead. The further away the maturity of the contracts, the lower the liquidity.

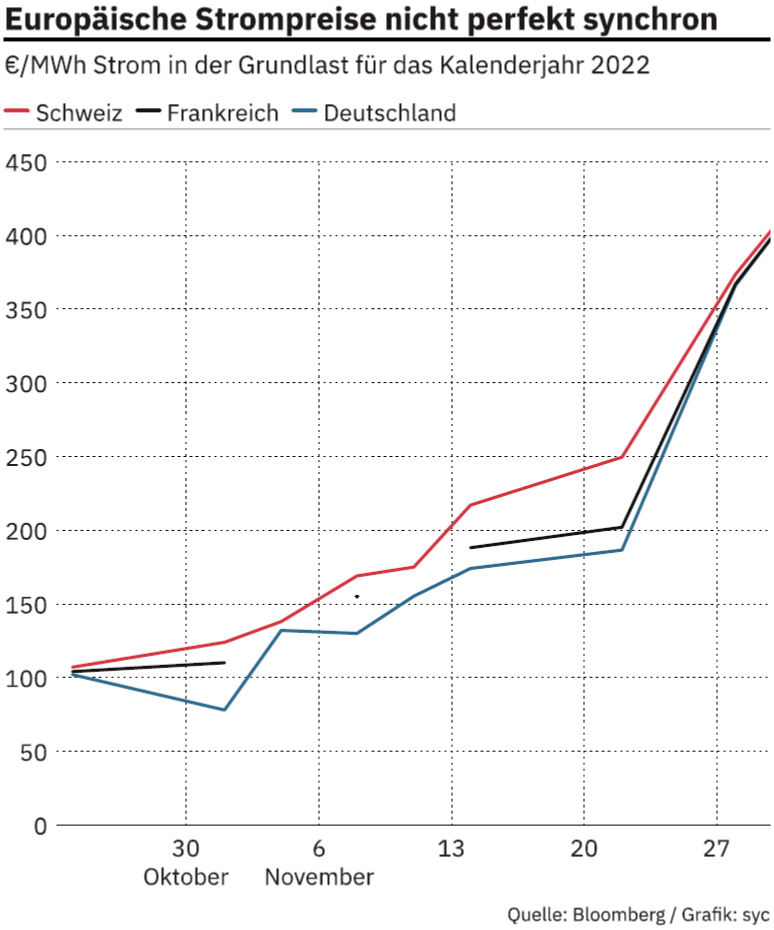


Figure 8: Base-load electricity prices in Germany, France, and Switzerland in October and November 2022.

The spot-market mechanism

Seen from an economic perspective, electricity prices signal scarcity of electricity, and give the right incentives to resolve it. The logic of the electricity market is as follows: When electricity prices are high, consumers have an incentive to reduce their demand and producers have an incentive to increase production. It is known from many other areas that this price mechanism works better than a centrally planned allocation. Otherwise, the equilibrium between demand and supply would have to be established by rationing one side of the market. For example, in many African countries, regular black outs are used to balance demand and supply. However, although trading allows reducing the probability of shortages, the volatility of demand and supply and the structure of production costs result in price volatility, as can be seen in Figure 9.

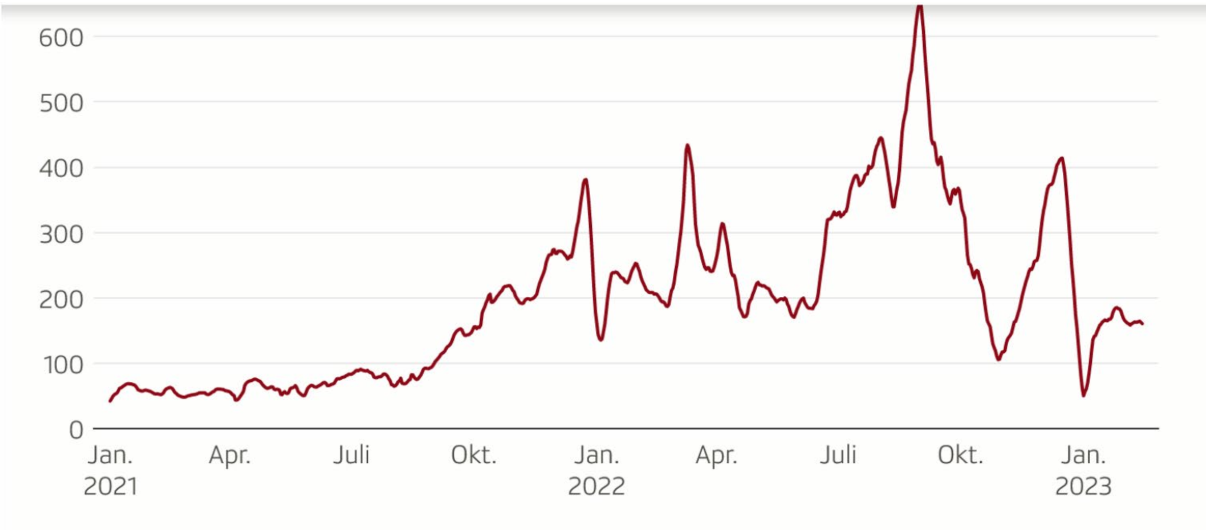


Figure 9. Electricity prices in Switzerland during the last two years. Source: energy-charts.info

The markets for future electricity

In spot markets the electricity of the next day is traded. However, to plan capacity and the production of electricity ahead of time, one needs to know the price of electricity further in the future. Forward and futures trading achieve this purpose. Both are contracts specifying the delivery of electricity in the future. While futures are traded on an exchange, such as the European Energy futures market (EEX), forwards are traded "over-the-counter" (OTC), i.e. by bilateral agreements with a counterparty. Futures markets are preferred because of their liquidity. However, OTC provide more flexibility in terms of the time and type of delivery.

The market participants

The participants in the market for electricity are electricity producers (Axpo, Alpiq, BKW,…) as well as traders without production or consumption facilities, e.g. Hedge Funds. The extent to which electricity distributors (e.g., EWZ) or end-users actively participate in the market depends on the degree of liberalization of the electricity market. In Switzerland the market is partially liberalized. Large consumers (more than 100 MWh p.a.) can purchase electricity from suppliers other than the local utility. The price specified in these contracts may be based on market prices, causing a demand for hedging.[4] While electricity producers trade to optimize their supply of electricity, Hedge Funds trade for speculation, i.e., they trade to exploit market inefficiencies.
Note that electricity producers have a competitive advantage over speculators since they can change their production depending on spot prices. For example, if electricity prices in some periods are known to be higher than in other periods (e.g., due to seasonal patterns), then a producer can benefit from this by refraining from producing or even storing electricity when it is cheap and selling it when it is expensive. A speculator cannot store electricity and has to forecast price changes in the futures market to turn a profit. But since seasonal patterns are well known the futures market most likely anticipates them so that no profit can be expected by

[4] In some countries, such as Norway, every household pays the instantaneous electricity price. Many of my colleagues at NHH in Bergen monitor electricity prices during the day to decide when to refill the battery of their car or when to start their washing machine.

trying to exploit seasonal patterns on the futures market. So, one might wonder what the role of speculative trading is.

1.4 Trading at Axpo

Axpo has the following trading model related to its own production. It sells its production capacity three years ahead on the electricity market. When these contracts mature, it has to buy it back at the spot market price if Axpo cannot produce as much as planned. This part of the business model is called asset-backed trading.

Axpo also utilizes its partnership with energy producers worldwide to provide tailor-made solutions for their customers. Axpo helps these customers meet their specific business demands by taking advantage of various opportunities arising through its own sources of energy and the wholesale market in a risk-optimized manner. This part of the business model is called origination.

Finally, depending on its expectation of future electricity prices, Axpo does proprietary trading (prop-trading). If Axpo has some view on which direction future electricity prices or the prices related to electricity (gas, oil, coal and CO2 certificates) will move, it trades accordingly. This part of the business model is prop-trading.

1.5 Valuation of OTC Contracts

The limited liquidity is a challenge for the correct pricing of OTC contracts because there might not be traded futures contracts that deliver the same payoff as the OTC contract. Axpo has been accused by Frauendorfer and Gutsche (2020) of using this discretion in valuing OTC contracts in an inappropriate way.

We found that this claim is not warranted. Standard and Poor`s, one of the most famous providers of market indices and ratings, provides a mechanism to ensure that the valuation of OTC contracts is consistent across market participants. They collect the individual pricing rules applied by market participants and aggregate them to an average price. As a result, market participants get feedback on how far their prices deviate from the consensus. In particular, Axpo never prices OTC contracts far away from the consensus.

1.6 Market Efficiency

As described above, the role of spot markets is to balance the demand and supply of electricity. Spot markets are said to be efficient if they can do so at any time. Futures markets also balance demand and supply. But some of the demand and supply might be speculative, i.e., not backed by planned production or consumption, but by expectations of price changes. Furthermore, future demand and supply are not precisely known in advance but must be estimated. As a result, what is actually traded in futures markets are *expectations* of future spot prices, plus a risk premium.

Futures markets are called efficient if prices reflect all available information. Since one never knows who has which information at what time, the concept of information efficiency is quite hypothetical – that is why it is called the efficient market *hypothesis*, which goes back to Fama

(1970).[5] A clever theoretical argument against the efficient market hypothesis was put forward by Grossman and Stiglitz (1980). They show that if prices did reflect all information, no trader would have an incentive to incur the costs for getting informed. He could simply free-ride on the information provided by others. But in this case, market prices will not reflect information since nobody bothers to inform himself. Thus, one would expect markets to be neither fully efficient nor fully inefficient.

Our analysis of the prop-trading of Axpo, which is summarized in Chapter 3, gives an indication of how efficient the futures market for electricity in Europe is. We find that Axpo's prop-trading is profitable, refuting the claim of Fraundorfer and Gutsche (2018). Thus, there is some market inefficiency and Axpo is able to exploit it. However, compared to the profits from origination and asset-backed trading, the statistical significance of profits from prop-trading is lower, reflecting the comparative advantage of asset-backed trading and origination described above.

1.7 The Indirect Approach to the Profitability of Axpo's Proprietary Trading

Financial reports aggregate financial data from different sources within a company into financial statements that are structured according to specific principles and rules. This process is bottom-up, i.e., detailed financial information is aggregated into business areas to properly describe the company's business activities. The indirect approach proposed by Frauendorfer and Gutsche (2021) aims at using Axpo's financial reports and publicly available market data to analyse the profitability of one of Axpo's trading activity, i.e., proprietary trading, which is located within the business area "Trading&Sales". The challenge of the indirect approach is to properly disentangle the contributions of single business activities to the reported, aggregated earnings available from the financial reports.

We analyse the robustness of the indirect approach of Frauendorfer and Gutsche (2021) with respect to their specific assumptions concerning Axpo's trading activities, production costs, and earnings from regulated distribution systems. We show that the reported estimated profits and losses from Axpo's proprietary trading are very sensitive to the specific assumptions made. Moreover, we also provide empirical evidence that the assumptions of Frauendorfer and Gutsche (2021) do not properly describe Axpo's trading activities, production costs, and earnings from regulated distribution systems. As a result, Frauendorfer and Gutsche (2021) overestimate the market value of Axpo's production, and the earnings generated from hedging and asset-backed trading activities, as well as the earnings generated from regulated distribution systems. Consequently, the profits and losses from proprietary trading, being estimated as the difference to the reported aggregated earnings, are significantly underestimated.

Specifically, Frauendorfer and Gutsche (2021) report estimated 6,400 million Swiss francs losses from Axpo's proprietary trading over the ten-year period from fiscal years 2008/2009 to 2017/2018. We show that, depending on the assumptions about Axpo's trading activities, production costs, and earnings from regulated distribution systems, estimated profits and losses

[5] Frauendorfer and Gustche (2020) believe in the efficient market hypothesis because they are confused by mathematics. We elaborate on this in Appendix A.

from Axpo's proprietary trading range from -1,039 million and 360 million [6]. The lower bound holds when one uses the assumptions of Frauendorfer and Gutsche (2021) concerning asset-backed trading. By contrast, with a direct assessment of the profitability of asset-backed trading based on existing trading data, the upper bound holds. This range must be seen as a robust estimation of the profitability of Axpo's proprietary trading. A precise assessment of the profitability of Axpo's proprietary trading is beyond the scope of this chapter and will be addresses in Chapter 3.

The difference to Frauendorfer and Gutsche's (2021) estimation can in large part be explained as follows:

(1) Until mid of 2013 around two third of Axpo's production (approximately 15 TWh annually) were delivered to Cantons at cost plus ("Kantonswerktarif"), so the earnings generated were significantly lower than those that could have been achieved on the market (market prices are used by Frauendorfer and Gutsche's (2021) to determine the so called "internal" value of production);

(2) Until mid of 2013 around two third of Axpo's production (approximately 15 TWh annually) was delivered to Cantons and thus neither hedged nor asset-backed traded. Consequently, earning from hedging or asset-backed trading these volumes are purely of theoretical nature.

(3) The earnings from distribution systems are significantly overestimated assuming the simple accounting rule multiplying the Net Asset Value of distributions systems with the regulatory weighted average cost of capital, and with a not well-motivated multiplicator of 2.83.

Our analysis shows that the indirect approach of Frauendorfer and Gutsche (2021) is generally not able to deliver robust estimates of the profitability of Axpo's proprietary trading without detailed information about Axpo's cost structure, production volumes, and trading strategies. In particular we find that Axpo`s prob trading is actually profitable.

1.8 Analysis of the Profitability of Axpo's Proprietary Trading

In light of the public debate about the profitability of Axpo's proprietary trading business, we conducted a detailed analysis of the profitability of Axpo's trading activities for the period from October 1, 2010 through December 31, 2022. The goal was to assess the magnitude and riskiness of historical profitability, the extent to which this profitability has evolved over time, and the sources of the trading profits.

The details of the analysis appear in Chapter 3. Our key findings are that the three types of trading – asset-backed trading, origination, and proprietary trading – all generate sizable profits over the period. The largest profits are earned in asset-backed trading, followed by origination, and proprietary trading. There is no indication that profitability in any of these areas has been declining over time.

[6] If we restrict the analysis to the period from 2010/2011 to 2017/2018, the relevant range for the indirectly estimated profitability of Axpo's proprietary trading is from -557 million to 515 million. By contrast, a direct estimation of the profitability of Axpo's proprietary trading leads to an overall profit of 241 million for the same period, and thus in the upper part of the indirectly estimated range.

Looking at the different business areas within proprietary trading, we find that although there is some statistical dependence between the profits in the different business areas, the relation is fairly weak. This indicates that proprietary trading's profitability is driven by more than a handful of strategies. Diversification across business areas weakens in crisis periods, but remains substantial.

Turning to the sources of the trading profits, we find that trading profits are statistically significant (i.e., unlikely to have occurred by chance) for asset-backed trading and origination, but not for proprietary trading. Thus, the data do not allow ruling out that the overall profits in proprietary trading have occurred by chance.

Finally, using estimates of the cost of capital that are available for the period 2020-2023, we find that after accounting for the cost of capital, asset-backed trading and origination both remain highly profitable. However, proprietary trading exhibits a moderate loss due to the combination of the missing gas deliveries from Russia and the large margin requirements in force during the volatile year 2022.

1.9 The Accounting of Axpo

Accounting for energy companies is often challenging due to their complex and unique business models. Among other issues such as revenue recognition, asset impairment, and environmental liabilities, the accounting and reporting for financial instruments arising from energy trading is especially difficult. Frauendorfer and Gutsche (2018, 2020, 2021, 2022) repeatedly criticized energy companies in Switzerland, including Axpo, for using accounting to facilitate and hide their excessive speculative trading, which in their opinion resulted in substantial loss and high liquidity risk.

Axpo Group follows the International Financial Reporting Standards (IFRS thereafter) in preparing its consolidated financial statements, which is appropriate and consistent with the industry norm both in Switzerland and internationally. The reporting standard most relevant for the accounting of financial instruments and hedging in energy trading is IFRS 9. The central question for Axpo's accounting for financial instruments is whether a derivative contract should be classified as "own use" or "trading", meaning whether its replacement value should be reported on the balance sheet (line item "Derivative Financial Instruments" in Axpo's annual reports) or kept off the balance sheet.

Due to the strict requirement of IFRS 9, only the first sale of asset-backed trading in Axpo is reported as "own use", since the subsequent trading transactions take longer time to close than allowed to qualify for "own use" and must be reported as "trading". Most of the origination business is also reported as "trading" as it contains transactions that do not qualify for "own use". As a result, the energy derivatives reported on Axpo's balance sheet include primarily asset-backed and origination business, instead of just prop trading as people may naively think. Further, the significant increase in energy derivatives during the past two years is mainly caused by the increased energy price due to the war in Ukraine, rather than more prop trading as Frauendorfer and Gutsche conjectured. Similarly, the sharp decline in reported hedging in Axpo financial statements is simply due to the first sale being reported as "own use" since 2017, not because Axpo is hedging less than before.

As we show in more details in Chapter 4, most of the accusations against Axpo by Frauendorfer and Gutsche from accounting perspective are a result of misunderstanding or lack of accounting knowledge. In addition to their confusion about energy derivatives and prop trading, they mistakenly assumed that IFRS allows too much discretion so that Axpo could report accounting information opportunistically. For example, they criticize Axpo for offsetting the derivative assets and liabilities on balance sheet in order to reduce the reported replacement values. In reality, IFRS 9 has clear and strict requirements on how netting can be applied, and Axpo follows these rules quite conservatively (e.g., only allowed on individual contracts, cross-country netting is very rarely allowed). In addition, Axpo reports replacement values both before and after netting in details in the footnote, which provides full transparency for financial statement readers. The lack of knowledge in IFRS also caused similar misunderstanding such as Axpo could switch between "own use" and "trading" books,[7] or shift profit from production to trading in their segment reporting. In reality, IFRS has stringent guidance on all of these issues which Axpo follows in compliance with auditor's inspection.

While Axpo's accounting and trading concept are both valid and appropriate, we provide a few suggestions on how the company could improve its disclosure strategy. For example, one possibility is to restructure the trading activities so that asset-backed and origination business could qualify for "own use". Certain annual report sections and footnote disclosures could be expanded to include more details so that readers obtain a clearer picture of Axpo's trading activities.

Energy industry faces significant public scrutiny in almost every country. Due to the high level of regulatory requirement and government involvement, energy companies that are not publicly traded often behave as if they are. Axpo is a highly visible company in Switzerland, and it is not surprising that Axpo as well as other big energy companies are constantly being scrutinized by the public. In our opinion, many of these misunderstanding could be eliminated through better disclosure and investor/public communication if done properly and proactively by the company.

1.10 Summary and Recommendations

This paper has analyzed to whom Axpo, one of the largest electricity providers in Switzerland, is a benefit.

It resolved some puzzles that have recently been published about Axpo's operations, its trading, and its accounting. These puzzles arise from many misunderstandings of the economics, the trading, and the accounting of Axpo – see Appendix B. They were published in a series of papers by Karl Frauendorfer and Robert Gutsche. Those papers drew public attention and are a threat to the reputation of Axpo.

In contrast to those papers, we find that Axpo not only secures a vital infrastructure of Switzerland but is economically sound and accurately reports its activities in its financial statements. Moreover, its trading contributes to the efficiency of the electricity market. The latter is important to steer the necessary investments for the future of Switzerland's energy supply. One might argue, however, that prop-trading should be done outside of electricity companies, e.g., in Hedge Funds. However, since prop-trading is profitable, doing so would not reduce the cost of electricity but only increase the bonuses of Hedge Fund managers.

[7] Note that the separation between the two is by trade types instead of by traders. That is, traders that work on asset-backed business can also trade by taking advantage of short-term market opportunities. However, these transactions will be recorded in different books.

We recommend to Axpo improving its disclosure policy so that those misunderstandings can be avoided in the future. In particular, a more transparent segment disclosure is needed.

1.11 Appendices

Appendix A: Market Efficiency, Attractive Returns, and the Martingale Property

Frauendorfer and Gutsche (2020) write on page 65: «Der Martingal Ansatz in der Finanzmathematik (cf. Björk, 2009) geht davon aus, dass Markteffizienz bzw. Preiseffizienz vorliegt, und damit die aktuellen Marktpreise handelbarer Produkte die besten Schätzungen für die Zukunft sind. Insbesondere nimmt man an, dass man zu keinem Zeitpunkt sowie auch über keinen Handelshorizont antizipieren kann, ob die Marktpreise fallen oder steigen. Dies bedeutet, dass man mit einem spekulativen Eigenhandel keinen nachhaltigen Erfolg erwarten darf. Aufgrund der inhärenten Transaktionskosten schliessen wir, dass der Erfolg im spekulativen Eigenhandel nachhaltig negativ ausfällt.»

By this argument, they conclude that prop-trading cannot be profitable – giving theoretical support for the facts that they claim to have found by analyzing the financial reports of Axpo – see Chapter 2.

Since this a common confusion, we need to clarify what the martingale concept really means. A martingale is a sequence of random variables in which at any point in time the current value is equal to the expected future value. For example, when one tosses a fair coin which delivers a payoff of +1 if tails and 0 if heads then the sequence of a current value of x = 0.5 and a future value of x (if heads) =1 and x (if tails) =0 is such a martingale.

The notion of a martingale is related to the notion of arbitrage from trading. An arbitrage is a trading strategy that delivers some gain without incurring any cost. For example, if one could buy electricity futures for the peak load and the off-peak load at prices which in sum are less than the base-load price, one would do so and sell the base-load contract. Today one gains the difference in prices and tomorrow no costs are incurred since a day consists of the sum of the 12 hours from 8 am to 8 pm and the 12 hours from 8 pm to 8 am.

It is reasonable to assume that arbitrage opportunities do not exist since traders could easily write programs to exploit them instantaneously. By the fundamental theorem of asset pricing (cf. Björk 2009), the absence of arbitrage opportunities is equivalent to the existence of *some* probability measure such that asset prices are martingales. However, this probability measure does not need to coincide with the physical probabilities that drive asset prices in the future.

In our example, with an artificial probability of 0.1 for tails the gamble would also be a martingale if the current value were x = 0.1. But if one buys the random variable at 0.1, one can expect a net payoff of 0.4 = 0.5 – 0.1 according to the true physical probability of p=0.5. The trading strategy of buying at 0.1 is arbitrage-free but not riskless. Indeed, if tails come up, one has lost 0.1. Nevertheless, buying at 0.1 is attractive if one considers risk-adjusted returns, where risk is measured by the standard deviation, which is 0.5 for our example. The standard adjustment for risk is to take the ratio of the expected return to the standard deviation, which is called the Sharpe ratio. In our example this is 0.8, a sizable value.

To make our argument a bit more realistic, we refer to an equity market index. There the expected return is about 7% p.a. with a standard deviation of 21%. Surely, investing in the equity market is risky and one can find a probability measure such that we get a martingale, i.e. such that the expected return under *that* measure is 0. However, what matters for the well-being of the investor are the physical probabilities and with those the expected return is 7% and the Sharpe ratio is 0.3. So, one should not confuse the mathematics of martingales and conclude that «Dies bedeutet, dass man mit einem spekulativen Eigenhandel keinen nachhaltigen Erfolg erwarten darf.».

Appendix B: Misunderstandings of Frauendorfer and Gutsche

Misunderstanding	Reference	Truth
One can estimate the P&L of prop-trading reliably by calculating it as the residual from Axpo's EBIT based on public information.	Frauendorfer and Gutsche (2021)	This indirect approach is very sensitive to assumptions and the true P&L of Axpo's prop-trading is underestimated.
Axpo generates a huge loss on prop-trading.	Frauendorfer and Gutsche (2021)	Axpo generates a profit from prop trading.
Axpo hides losses from prop-trading through accounting discretions.	Frauendorfer and Gutsche (2018)	Axpo's accounting treatment of its trading is compliant with IFRS and appropriate.
Axpo reports high energy derivatives on its balance sheet because of prop trading.	Frauendorfer and Gutsche (2018, 2022)	Axpo's energy derivatives on its balance sheet include all "first sales" in asset-backed trading and most of the customer solutions (origination) business. Prop trading is only a small portion.
In 2020, 2021, and 2022, Axpo's balance sheet expanded because of prop-trading.	Frauendorfer and Gutsche (2018, 2022)	In 2020, 2021, and 2022, Axpo's balance sheet mostly expanded because of energy price increase.
Futures markets are efficient because prices follow martingales.	Frauendorfer and Gutsche (2020)	There are some inefficiencies in the futures markets that Axpo is able to exploit.
Axpo can always sell its flexible electricity at peak prices.	Frauendorfer and Gutsche (2021)	Axpo cannot sell its entire electricity at peak prices because it mainly faces physical but also some contractual restrictions.
Axpo values its power plants too low.	Frauendorfer and Gutsche (2021)	The valuation of Axpo power plants is in line with IFRS standards and considers Axpo's restrictions.
Axpo moves value from the power plants to the trading division through inappropriately low transfer prices.	Frauendorfer and Gutsche (2018)	Documented transfer prices closely follow forward prices. Therefore, there is no evidence of artificially set low transfer prices that help hide losses from prop trading.
Axpo uses the valuation discretion due to the incompleteness of the futures markets to reduce profits from asset-backed trading.	Frauendorfer and Gutsche (2020)	Axpo's valuation of OTC contracts follows market consensus coordinated by Standard and Poor's Market Solutions.
Axpo offsets the positive and negative replacement values (netting) to reduce the derivative assets and liabilities on the balance sheet.	Frauendorfer and Gutsche (2018, 2022)	Axpo's netting follows standard IFRS 9 rules.
Axpo is hedging less than adequate, because they focus more on prop trading.	Frauendorfer and Gutsche (2022)	Axpo has implemented a new trading concept in 2017 in which hedging using forward contracts is now reported as own use.

Axpo can switch between trading and own-use books with discretion.	Frauendorfer and Gutsche (2021)	Axpo does not switch between the own-use and the trading books as this is not permitted.
Axpo shifts profit to the segment of trading (T&S) from other segments such as production and distribution (G&D).	Frauendorfer and Gustche (2021)	Axpo follows IFRS 8 for segment reporting which enables users of financial statements to see an entity's operations through the eyes of management.

2 The Indirect Approach to the Profitability of Axpo's Proprietary Trading

2.1 Introduction

This chapter investigates the *indirect approach* proposed by Frauendorfer and Gutsche (2021) to analyse the performance of Axpo's proprietary trading business. This approach consists in using publicly available financial data of Axpo Group to assess the profitability of its proprietary trading activities. Specifically, since the earnings from Axpo's properietary trading activities were not explicitly reported in Axpo's financial reports from 2008 to 2019, Frauendorfer and Gutsche (2021) gauge the profitability of Axpo's proprietary trading business from publicly available data under *specific* assumptions about how the trading activities at Axpo are performed and Axpo's cost structure, e.g., production costs.

This chapter focuses on the robustness of the *indirect approach*, and, more specifically, on Frauendorfer and Gutsche (2021)'s conclusions concerning Axpo's proprietary trading activities. They estimated a total loss of 6,400 million from proprietary trading activities over the 10-year period from 2008/2009 to 2017/2018. Our study also provides some insights into how specific assumptions affect the reported results.

The indirect approach starts from the internal organisational and management structure of Axpo and its three business areas: (1) Assets, (2) Trading & Sales, and (3) CKW, which are defined as follows:

> "The **Assets** business area operates and expands the Axpo power plant portfolio (hydraulic power plants, nuclear power plants, gas-fired combined-cycle power plants, power plants using new renewable energies) in Switzerland and abroad, as well as infrastructure such as grids and substations. This business area is also responsible for optimising the power plant portfolio and developing new power plant projects.
>
> The **Trading & Sales** business area encompasses the areas of energy trading, risk and portfolio management, customer service, and the optimal deployment of the power plant portfolio from an economic and supply perspective.
>
> With its production portfolio, investments in power plants as well as long-term contracts and grid infrastructure, the **CKW** business area supplies energy to Central Switzerland and ensures optimum use of hydro power in this region through existing exchange agreements."

An additional segment, "Reconcilation," includes non-operating segments and consolidation effects. The financial reports of Axpo Group contains a segment income statement that allows analysing the earnings in each segment.

We emphasize here that CKW delivers part of their production to end customers, and a sizeable portion of their infrastructure is devoted to this. Energy delivered to end client is regulated and this will be considered in our analysis. By contrast, the rest of Axpo Group does not deliver to end clients and the production is now traded on the market, but until mid of 2013 around two third of the production volumes were delivered to Cantons at cost plus (the notion of cost plus refers to productions costs plus a margin).

The indirect approach considers the segment income statement as found in Axpo's financial reports. However, the assumption of Frauendorfer and Gutsche (2021) is that the reported segmentation does not allow to properly identify the earnings generated from the different types of trading activities and production. Therefore, the suggested methodology consists in using public data (e.g., aggregated production data, market data, average production costs from Swiss energy suppliers) to independently derive the earnings generated from distribution systems, power plants, cross-hedge, and asset-backed trading, and indirectly obtain earnings from proprietary trading as the *differential* to the overall reported Earnings Before Interest and Taxes (EBIT).

Indeed, Frauendorfer and Gutsche (2021) argue that profits and losses from proprietary trading activities may have been transferred to other segments, e.g., "Assets" and "Consolidation," to limit their impact on the EBIT of "Trading&Sales" in order to avoid transparently disclosing how (un)successful prorietary trading was. Therefore, in their view, the segmentation of Axpo is not transparent and not sufficiently informative. The accounting perpective on this aspect will be provided in Chapter 4.

Table 1 shows the structure of the segment income statement of Axpo until fiscal year 2018/2019, i.e., during the period from 2008/2009 through 2018/2019 analysed by Frauendorfer and Gutsche (2021). The statement reports total income, as well as operating expenses, depreciation, amortisation, and impairments that lead to the resulting Earnings Before Interest and Taxes (EBIT) for all segments.

Earnings Before Interest and Taxes (EBIT)	**Total revenues minus operating expenses (=EBIT plus any depreciation, amortisation, impairments, provisions, and special effects)**
Assets (Generation and Distribution)	Assets (Generation and Distribtution)
Trading&Sales	Trading&Sales
CKW	CKW
Consolidation	Consolidation
	Provisions
	Depreciation
	Amortisation
	Impairments
	Special Effects

Table 1: Structure of the segment income statement of Axpo until fiscal year 2018/2019.

In Table 2, the overall EBIT plus any depreciation, amortisation, provisions, and special effects is broken down into positions that, according to Frauendorfer and Gutsche (2021), can be properly estimated using publicly available data. Frauendorfer and Gutsche (2021) consider the so-called internal value of production activities, that is, the EBIT that can be generated if production is sold on the day-ahead market. The internal value serves as the basis to derive the overall earnings from production, that also includes the earnings from cross-hedging (hedging production on the forward market) and asset-backed trading. The final goal is to indirectly derive the earnings from proprietary trading as the remaining. The structure in Table 2 clearly illustrates that provisions that are not related to nuclear production might also include losses from trading activities.

Total revenues minus operating expenses (=EBIT plus any depreciation, amortisation, impairments, provisions, and special effects) (see Section 2.2)	
Distribution (see Section 2.3)	Activities
	Depreciation and amortisation (related to distribution only)
Generation (Internal value of power plants and Long Term Contracts) (see Section 2.4)	Value of production in the spot market minus costs
	Depreciation and amortisation (excl. distribution)
	Provisions nuclear
Trading (see Section 2.5)	Cross-hedge
	Asset-backed trading
	Proprietary trading
Special effects	

Table 2: Structure of the income statement assumed in the indirect approach to quantify the profitability of proprietary trading activities.

In this chapter, we verify if the suggested indirect approach allows obtaining robust conclusions on the earnings from Axpo's proprietary trading. Specifically, the goal of this chapter is not to provide an alternative estimation of the profitability of Axpo's proprietary trading, but to verify if the stated assumptions in Frauendorfer and Gutsche (2021) allow deriving a robust assessment of the profitability of Axpo's proprietary trading. A detailed analysis of the profitability of Axpo's proprietary trading based on Axpo's internal data can be found in Chapter 3.

The remainder of the chapter is organized as follows. Section 2.2 presents the publicly available earning data, including depreciation, amortisation, provisions, and special effects. Section 2.3 lists the main assumptions of Frauendorfer and Gutsche (2021) to estimate the profits from proprietary trading. Section 2.4 discusses the methodology to assess earnings from distributions systems. Section 2.5 addresses the so-called internal value of power plants and its estimation. Section 2.6 analyses cross-hedge and asset-backed trading. Section 2.7 reports the results on the estimated earnings from proprietary trading. Section 2.8 concludes.

2.2 Public Data from Axpo's Financial Reports

In this section we discuss the financial data as reported in Axpo's financial reports from fiscal year 2008/2009 through fiscal year 2018/2019. These data serve as the starting point of our analysis, as they are not based on any specific assumption. The goal is to obtain the so-called "clean-up" EBIT as in Frauendorfer and Gutsche (2021). We refer to Table 1 to describe the general structure of Axpo's segment income statement. The "clean-up" EBIT is defined as the resulting total revenue for any Axpo activity that is potentially related to trading. As mentioned above, the underlying assumption is that the segment "Trading&Sales" does not transparently disclose the profitability of Axpo's trading activities, as profit and losses might have been transferred to other segments.

Table 3 shows Axpo's reported financial data or fiscal years 2008/2009 through 2018/2019, which corresponds to the period analysed by Frauendorfer and Gutsche (2021). All positions that are assumed not to include any effect from trading activities are marked with stars (*). Specifically, in Frauendorfer and Gutsche (2021) all these positions are substracted to obtain the so-called "cleaned-up" EBIT, as reported in Table 4. This approach is to detect possible transfers of earnings generated by trading from one segment to another, as this is one of Frauendorfer and Gutsche (2021)'s hypothesis.

Total revenues minus OPEX	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**18/19**
EBIT										
Assets	384.6	221.6	84.0	243.9	-9.7	-635.1	-644.0	-916.1	96.8	82.9
Trading&Sales	329.8	168	53.3	-18.1	148.6	-204.9	-106.9	-246.1	-58.2	230.3
CKW	135.8	144.5	91.4	109.1	142.8	47.3	69.8	-81.0	78.4	102.6
*Consolidation**	*-2.1*	*3.9*	*-90.1*	*-5.7*	*30.2*	*-78.3*	*-247.7*	*17.0*	*152.1*	*-67.5*
Provisions										
*Nuclear**	*108*	*110.8*	*411.5*	*137.7*	*142.6*	*-28.5*	*106.3*	*19.7*	*106.9*	*120.4*
Energy contracts	244.6	-74.2	-36.7	-60.8	268.1	331	212.1	1021.2	54.5	46
Others	26	58.1	58.8	73.5	-8.2	95.5	17	87.4	32.3	94.2
Depreciation										
Assets	-217.1	82.9	380	269.3	626.2	1097.3	1155.5	558.4	57.7	-14
Trading&Sales	46.4	5.0	10.5	78.7	0	0.2	0	7.6	1.8	3.6
CKW	0.0	0.0	0	0	0.4	3.9	22	4.4	1.4	2.5
*Consolidation**	*36.1*	*0.4*	*82.3*	*13.2*	*0*	*87.1*	*133.2*	*44.8*	*-9.9*	*-19.7*
Amortisation										
Assets	231.7	316.4	238.7	221	275.7	238.2	137.2	173.4	168.1	215.1
Trading&Sales	66.4	72.9	70.5	60.6	9.2	6.5	5.5	6.9	5.0	5.9
CKW	59.9	60.2	64.1	62.7	61.1	56.6	56.6	55	54.7	56.9
*Consolidation**	*8.9*	*11.9*	*13.4*	*13.2*	*13.6*	*16.3*	*12.6*	*11.3*	*9.4*	*11.0*
Special Effects	*0*	*0*	*0*	*0*	*-192.1*	*0*	*0*	*0*	*-163.4*	*+5.2*
Total	**1459**	**1182.4**	**1431.7**	**1198.3**	**1508.5**	**1033.1**	**929.2**	**763.9**	**587.6**	**875.4**

Table 3: Axpo's reported financial data in millions CHF for fiscal years 2008/2009 through 2018/2019. The * indicates that the corresponding positions are excluded from the analysis, as they are assumed not to include any effect from Axpo's trading activities.

“Cleaned-up” EBIT (incl. distribution systems)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	18/19
EBIT without consolidation										
Assets	384.6	221.6	84.0	243.9	-9.7	-635.1	-644.0	-916.1	96.8	82.9
Trading&Sales	329.8	168	53.3	-18.1	148.6	-204.9	-106.9	-246.1	-58.2	230.3
CKW	135.8	144.5	91.4	109.1	142.8	47.3	69.8	-81.0	78.4	102.6
Provisions without nuclear										
Energy contracts	244.6	-74.2	-36.7	-60.8	268.1	331	212.1	1021.2	54.5	46.0
Others	26	58.1	58.8	73.5	-8.2	95.5	17	87.4	32.3	94.2
Depreciation without consolidation										
Assets	-217.1	82.9	380	269.3	626.2	1097.3	1155.5	558.4	57.7	-14.0
Trading&Sales	46.4	5.0	10.5	78.7	0	0.2	0	7.6	1.8	3.6
CKW	0.0	0.0	0	0	0.4	3.9	22	4.4	1.4	2.5
Amortisation without consolidation										
Assets	231.7	316.4	238.7	221	275.7	238.2	137.2	173.4	168.1	215.1
Trading&Sales	66.4	72.9	70.5	60.6	9.2	6.5	5.5	6.9	5.0	5.9
CKW	59.9	60.2	64.1	62.7	61.1	56.6	56.6	55	54.7	56.9
Special Effects	*0*	*0*	*0*	*0*	*192.1*	*0*	*0*	*0*	*163.4*	*-5.2*
Total	**1308.1**	**1055.4**	**1014.6**	**1039.9**	**1322.1**	**1036.5**	**924.8**	**671.1**	**329.1**	**831.2**

Table 4: The table reports the so-called “cleaned-up” EBIT where all (*) positions from Table 3 that are not affected by trading activities are excluded from the analysis, except distribution systems (that will be addressed in Section 2.3) and amortisation (that will be addressed in Section 2.4). The excluded positions are related to the segments “Consolidation,” provisions for nuclear, and to the reported special effects.

2.3 Main Assumptions of Frauendorfer and Gutsche (2021)

The indirect approach based on public data requires assumptions to determine the profits from proprietary trading. Indeed, relevant detailed information to calculate the profits from activities not explicitly covered by the financial statements is not publicly available, e.g., the production costs, the volumes effectively traded on the energy markets, and how hedging strategies have been implemented by Axpo.

In this section we list the main assumptions of Frauendorfer and Gutsche (2021). In the next sections we compare the stated assumptions with internal information provided by Axpo to analyse if the conclusions of Frauendorfer and Gutsche (2021) remains robust.

Assumption 1: Axpo’s profits from regulated systems can be approximated based on a *simple accounting rule* calibrated from BKW data.

Assumption 2: The *average* day-ahead prices over a total of 8760 hourly day-ahead prices during a fiscal year properly describe the day-ahead value of production.

Assumption 3: The *average* production costs estimated by the Federal Office of Energy in 2018 from a Survey that involved 21 companies operating in the water power plants properly describe Axpo's cost structure for all considered fiscal years.

Assumption 4: A part CKW-production delivered to end-clients at regulataed prices, the *full* production volumes are traded on the energy markets (including asset-backed trading and cross-hedging).

Assumption 5: Cross-hedge is done based on a 3-year rolling windows, i.e., Axpo hedges one third of the future production 3 years, 2 years, and 1 year in advance, respectively.

Assumption 6: Flexible production is hedged with PEAK futures contracts. Otherwise, hedging is done with BASE future contracts.

2.4 Distribution Systems

The segment "Assets" includes regulated distribution systems, whose earnings are separately estimated and subtracted from the "cleaned-up" EBIT of Table 4, as not related to any trading activities. Frauendorfer and Gutsche (2021) assume that earnings from distribution systems can be estimated from the Net Asset Value (NAV) of distribution systems (as reported in the financial statments) and the Weighted average cost of capital (WACC), as specified by the Federal Department of the Environment, Transport, Energy and Communications (DETEC) each year (Assumption 1).

Unfortunately, this simple rule does not even allow explaining the explicitly reported earnings from distribution systems of BKW. Indeed, between 2008 and 2018 these earnings are approximately between 1.2 to 3.7 times higher than the value obtained from the product of NAV and WACC, with an average "multiplier" of 2.83 (the standard deviation is 0.71, i.e., the multiplier fluctuates strongly over time during the 10-year period considered in the study). Frauendorfer and Gutsche (2021) assume that a similar multiplier also holds for Axpo. They finally apply the average multiplier of 2.83 to estimate the EBIT from distribution systems according to the following formula:

$$EBIT = NAV_t * WACC_t * 2.83$$

for each fiscal year $t = 2008/2009, \dots, 2017/2018$. The resulting EBITs are reported in the row "FG (2021)" of Table 5.

There is no clear motivation why Axpo and BKW should be comparable with respect to their activities related to regulated networks, and no specific justistication for the use of the multiplier, so the rule above is hard to understand. However, Frauendorfer and Gutsche (2021) emphasize that the resulting earnings should be seen as a conservative "over"- estimation of the realised earnings from distribution systems.

Following the guidelines of the Federal Electricity Commission (Elcom), Axpo and CKW deliver specific annual financial statements for regulated distribution systems. Therefore, we directly derive from these statements the earnings from regulated distribution systems. These are also reported in Table 5 and are generally significantly lower than the estimation provided by Frauendorfer and Gutsche (2021), confirming their conjucture that their estimation is likely to be a very conservative upper bound of the earnings.

EBIT regulated distribution systems	08/09*	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19
FG (2021)	233.01	230.49	215.83	159.63	150.05	148.98	147.81	153.39	158.68	159.59	157.72
Financial statements regulated networks	**81.458**	**81.458**	**53.949**	**61.934**	**112.247**	**79.192**	**93.894**	**84.502**	**81.323**	**91.897**	**69.448**

Table 5: The table reports the EBITs for regulated distribution systems as reported in the annual financial statements for regulated networks of Axpo (region Northeast Switzerland) and CKW. The figures for fiscal year 2008/2009 are missing, so we assumed the same EBITs as for fiscal year 2009/2010. The row FG (2021) indicated the estimates of Frauendorfer and Gutsche (2021).

2.5 Internal Value of Power Plants and Long-term Contracts

The next step consists in estimating the overall profitability of production. To perform this step, Frauendorfer and Gutsche (2021) initally consider the so-called "internal value" of hydropower plants and long-term contracts (LTC), that is, the overall EBIT that can be generated on the day-ahead market. The internal value of power plants and long-term contracts is only one component of the earnings generated from production. The additional components come from hedging activities and asset-backed activities, as we will discuss in Section 2.6.

Revenues on the day-ahead market

Frauendorfer and Gutsche (2021) estimate the interval value of power plants under the assumption (Assumption 2) that the revenue for every 1kWh of produced energy over a given fiscal year corresponds to the average day-ahead hourly price over the entire fiscal year (i.e., the average over a total of 8760 = 24*365 hourly day-ahead prices). Moreover, they differentiate between energy produced from (flexible) storage, which is priced at the average PEAK day-ahead price, and energy produced from nuclear plants or rivers, which is priced at the average hourly BASE day-ahead price.

To verify if this assumption properly describes the revenues from selling production on the day-ahead market, we analysed the hourly production profiles for all Axpo's power plants from 2008 through 2019 (and thus our comparison excludes the fiscal year 2008/2009). We use as input the hourly profile of the full power plants, thus including all shareholders, not only Axpo Group. Therefore, the hourly profiles may also be impacted by Axpo's competitors. To calculate the share of Axpo in every power plant we apply the same method as used for the consolidation in the balance sheet, to be more consistent with what reported in Axpo's annual reports, and thus to facilitate the comparison with Frauendorfer and Gutsche (2021).

We finally compare the average hourly day-ahead price over a fiscal year with the production-weighted hourly day-ahead price over the same fiscal year. The production-weighted hourly day-ahead price corresponds to the overall day-ahead market value of production divided by overall production.

For nuclear, long-term contracts, and river production, the two quantities are very close, as shown in Figure 10. Indeed, in this case production seems to be evenly distributed over time. The differences between average and production-weighted prices are negligible, supporting the assumption made by Frauendorfer and Gutsche (2021).

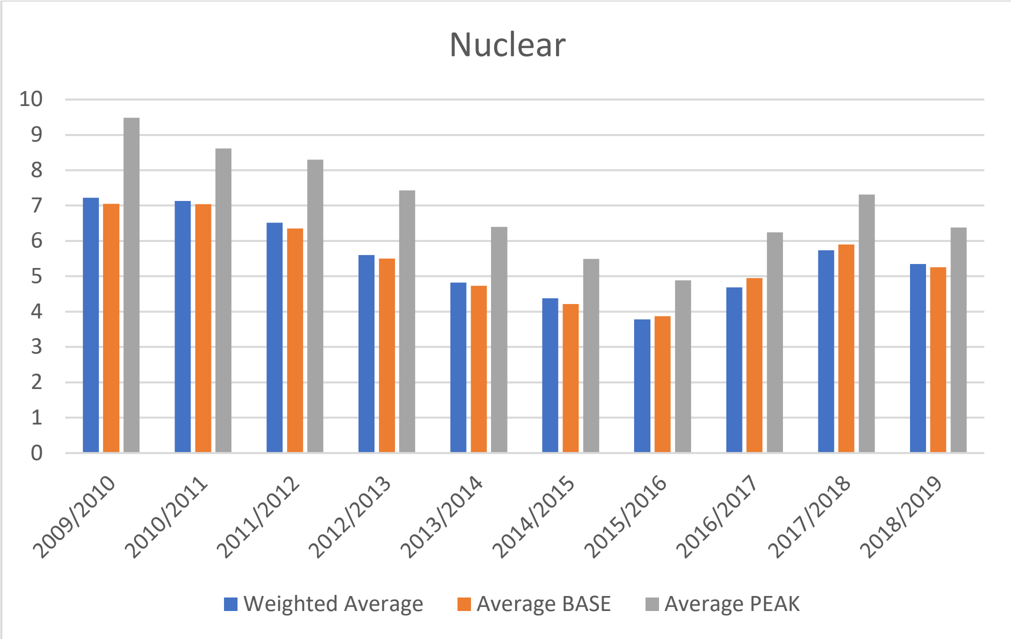


Figure 10: Weighted average of realised prices on the day-ahead market for nuclear production, based on hourly production profiles. We compare this quantity with the average BASE day-ahead prices over the fiscal year and the average PEAK day-ahead prices of the fiscal year.

By contrast, as shown in Figure 11, the production-weighted hourly day-ahead price for (flexible) storage production is generally lower than the average day-ahead PEAK price assumed to derive the internal value of (flexible) storage production. Overall, the average difference between the production-weighted day-ahead hourly price and the average day-ahead PEAK price over the period from fiscal years 2009/2010 through 2018/2019 is -1.04 cts/kWh.

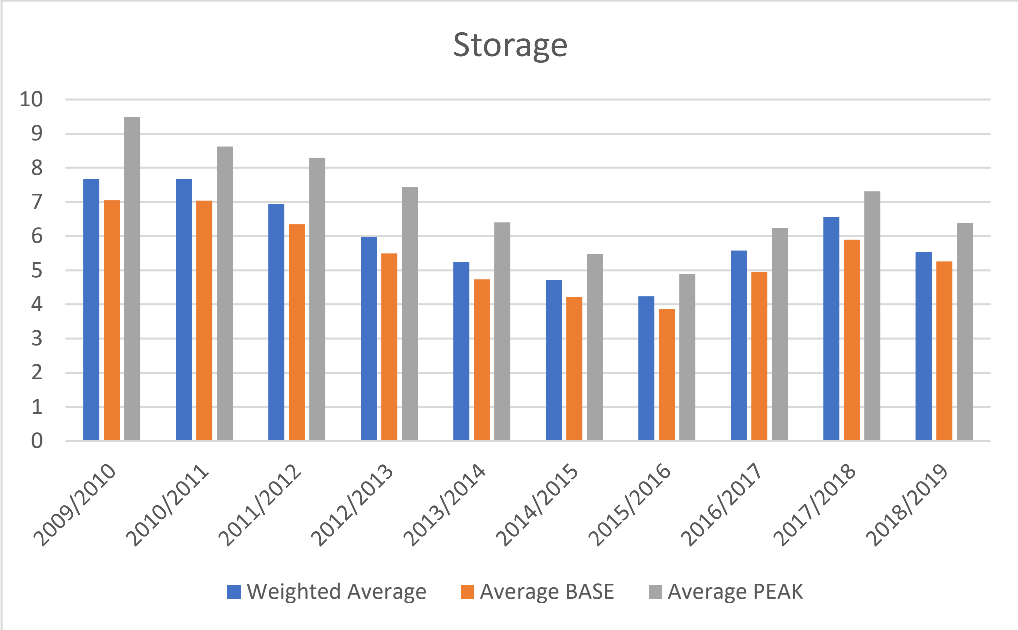


Figure 11: Weighted average of realised prices on the day-ahead market for storage production, based on hourly production profiles. We compare this quantity with the average BASE day-ahead prices over the fiscal year and the average PEAK day-ahead prices of the fiscal year.

If we take the difference between the production-weighted day-ahead hourly price and the average day-ahead PEAK price over the period from fiscal years 2009/2010 through 2018/2019 while keeping all other values unchanged, the overall internal value of power plants and long-term contracts decreases by around 285 mio. We emphasized that the interval value of power plants servers as the reference for estimating the overall earnings from production, including hedging and asset-backed trasing activities. As we will see in Section 2.5, this difference is partially transferred to the earnings from cross-hedging activities.

Cost structure

To determine the internal value of power plants and long-term contracts, the production costs must be substracted from the revenues on the day-ahead market as computed in the previous subsection. In Frauendorfer and Gutsche (2021), production costs are estimated from a survey conducted by the Federal Office for Energy (BEF) in 2018 (Assumption 3). The survey reports average production costs from 21 companies operating water power plants. Unfortunately, the survey does not provide any detailed information on how the cost structure varies among the participating companies, and thus it is not possible to verify if the average production costs represent a robust and valid assessment of the production costs for Axpo.

The cost structure has a significant impact on the interval value of power plants. For example, underestimating the cost by 0.1cts/kWh, while keeping all other assumptions unchanged, leads to an overall decrease of the internal value of power plants of 469 mio over the period from 2008/2009 through 2018/2019. Therefore, a correct estimation of production costs is crucial in order to derive a robust estimation of the internal values of power plants and long-term contracts.

The average production costs assumed by Frauendorfer and Gutsche (2021) do not properly capture the cost structure of Axpo. The costs are underestimated for some types of production and overestiamted for others.

Overall, if we adjust the cost structure assumed by Frauendorfer and Gutsche (2021) to reflect the production cost data reported by Axpo, while keeping all other assumptions unchanged, the internal value of power plants and long-term contracts over the period from 2008/2009 through 2017/2018 decreases from 3,100 mio to 2,245 mio, leading to an overall increase in the indirectly estimated profitability of proprietary trading.

Production delivered at cost plus

Until mid-2013, around 15 TWh (without accounting for CKW, that will be addressed separately), or two thirds of the production each year have been delivered to the Cantons at cost plus ("Kantonswerktarif"). These amounts have also not been hedged on the futures market as we will discuss in Section 2.6. To account for this in the estimation of the internal value of power plants, we implement a conservative adjustment for 2008/2009 through 2012/2013 by subtracting 40% of the internal value computed by Frauendorfer and Gutsche (2021) for these years. These adjuments assume that 50% of the production is delivered at an EBIT that is only 20% of the EBIT estimated under the assumption based on day-ahead market prices, on average around 1.2cts/kWh. We believe this assumption provides a conservative estimation of EBIT, because we only account for 50% of the production delivered to Cantons, while it was more close to 80%, and because the "Kantonswerktarif" was discountinued when the market price became more attractive, and thus when the internal value became lower.

Production delivered to end-clients by CKW

As in Frauendorfer and Gutsche (2021) we compute the correction for CKW delivery to end-clients. This correction accounts for the fact that energy delivered to end clients is regulated and thus its prices do not necessarily correspond to the day-ahead prices previously used in the computation of the day-ahead value of power plants. The correction of Frauendorfer and Gutsche (2021) assumes a total base-delivery of 6 TWh per year at a price of 6.4cts./kWh. This price is above the average BASE-day-price until 2010/2011, and thus in their analysis the correction is negative, while the opposite holds from 2011/2012 to 2017/2018, as reported in the first rows of Table 6. Over the 10-year period from 2008/2009 to 2017/2018 the correction accounts for a total of 570 million. In our analysis, we computed the correction for CKW base-delivery based on the exact delivery volumes, while we matained the the price of 6.4cts/kWh assumed by Frauendorfer and Gutsche (2021). In our computations we do not account for the volumes delivered to end clients by subsidiaries of CKW, a maximum of around 0.3-0.4 TWh per year. The results are shown in the last row of Table 6. Over the 10-year period, the correction is much lower and adds 38.8 millions (instead of 570 millions) to the internal value of power plants.

As a matter of comparison, CKW reports an EBIT for regulated energy of around 58 and 47.3 millions in 2018/2019 and 2019/2020, respectively. With a delivery volume of 1.13 TWh and 1.11 TWh in 2018/2019 and 2019/2020, respectively, this implies an EBIT of 5.2 cts./kWh and 4.2 cts./kWh in 2018/2019 and 2019/2020, respectively. These numbers imply an added value over average base day-head market prices of around 6.5 millions over the two fiscal years.

Adjustment CKW delivery	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Volumes (TWh) FG (2021)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Average prices (cts./kWh) FG (2021)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Total (mio CHF) FG (2021)	-52.2	-20.4	-26.4	29.4	74.4	115.80	143.40	169.20	112.20	25.20
Volumes (TWh) CKW data	2.55	2.80	2.93	2.31	2.27	1.54	1.23	1.23	1.17	1.17
Average prices (cts./kWh) CKW data	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Total	**-52.46**	**-18.07**	**-18.81**	**1.16**	**20.50**	**25.65**	**26.88**	**31.17**	**16.92**	**5.86**

Table 6: Correction of CKW delivery to end clients to account for regulated prices above or below the average day-ahead prices used in the computation of the day-ahead market value of power plants.

Summary

Table 7 summarises the main findings concerning the internal value of power plants and long-term contracts. We also add the correction for depreciation as in Frauendorfer and Gutsche (2021). They justify this adjustment because their estimated costs include an average depreciation of 1.25cts./kWh, as reported in the survey conducted by the Federal Office for Energy (BEF) in 2018. The average depreciation costs of 1.25cts./kWh clearly affect their estimated market value of production. However, Axpo reports lower depreciation values, ranging from 0.44cts./kWh to 0.79cts./kWh. Therefore, the difference between the average depreciation costs of 1.25cts./kWh and Axpo's depreciations cost are added back to the value of power plants to correct for the "excessive" deduction in the computation of the market value. In our analysis, we direcly apply the cost structure reported by Axpo. Therefore, we could avoid any correction. However, we keep the correction to address the hypothesis of Frauendorfer and Gutsche (2021) that low depreciation costs may hide other losses, e.g., losses from trading activities.

To summarize, the overall internal value of power plants and long-term contracts range from Frauendorfer and Gutsche (2021)'s estimation of 5,916 millions to 3,082.19 millions taking into account the adjustments previously discussed.

Estimated Internal value (mio CHF)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
FG (2021)	1007.34	641.82	599.34	407.62	177.47	36.89	-85.4	-208.99	54.68	470.21
Adjustment to account for Axpo's cost structure	-104.9	-97.47	-63.8	-97.7	-86.5	-91.65	-77.8	-68.35	-64.1	-103.8
Adjustment to account for production-weighted prices	0	-55.58	-29.42	-47.82	-47.93	-37.34	-26.26	-20.94	-20.03	-26.77
Correction CKW Base-delivery	-52.46	-18.07	-18.81	1.16	20.50	25.65	26.88	31.17	16.92	5.86
Correction for depreciation as in KF (2021)	222.85	175.42	179.5	212.1	149.3	190.5	333.4	274.83	259.26	246.85
Correction for production sold at cost plus	-402.94	-256.73	-239.74	-163.05	-70.99	0	0	0	0	0
Total Estimated Internal value	**669.89**	**389.39**	**427.07**	**312.31**	**141.85**	**124.05**	**170.82**	**7.72**	**246.73**	**592.35**

Table 7: Estimation of the internal value of power plants and long-term contracts accounting for Axpo's production costs and for production-weighted day-ahead market prices.

2.6 Trading Activities

This section quantifies the earnings generated by trading activities, including hedging and asset-backed trading.

Cross-hedge

Axpo's production is hedged on the futures market. As in Frauendorfer and Gutsche (2021), we assume that hedging activities take place in the German market that shows significantly higher liquity.

In this subsection we test the three main stated assumptions made by Frauendorfer and Gutsche (2021) to derive the earnings generated by heging activities. First of all, it is assumed that production is fully hedged (Assumption 4). Second, the hedging strategy is a "rolling" deterministic strategy that does not take price levels into account and hedge one third of the future production 3 years, 2 years, and 1 year in advance, respectively (Assumption 5). Finally, it is assumed that production is hedged with BASE futures products, except for flexible storage production that is hedged with PEAK future products (Assumption 6).

From Axpo's financial reports, we cannot determine if the above assumptions correctly reflect the implemented hedging strategies. As the goal of this chapter is not to analyse the performance of Axpo's hedging activities, but to investigate the robustness of the indirect approach, we analyse if the estimated revenues from cross-hedging are sensitive to alternative assumptions on how hedging is implemented.

Specifically, we compare the proposed 3-year rolling strategy with an alternative strategy where the full production is hedged 3 years in advance. On average this strategy was superior between 2009/2010 and 2016/2017 given the falling day-ahead prices and slightly inferior afterwards. In our computations, we also account for the fact that from fiscal years 2008/2009 through 2012/2013, part of the production was delivered at cost plus to the Cantons, and thus not hedged. Indeed, because these volumes were promised to the cantonal utilities (the shareholders of Axpo) it was not possible to also sell this production to the market.

We accordingly adjust the hedged quantities by deducting 15 TWh each fiscal year from the volumes of band-energy, making this way the conservative assumption that energy produced from flexible storage was fully sold on the market and that only 15 TWh (instead of around 20TWh) were delivered to the Cantons at cost plus.

Table 8 reports the results. We clearly see that accounting for the lower hedge volume significantly reduces the earnings from hedging activities. Therefore, properly taking into consideration the realized hedging volume is crucial to derive proper estimations of the earning from hedging. Second, the rolling 3-year strategy was generally performing worse in the considered period compared to the 3-year-in-advance hedging strategy. The proposed adjustment of the hedging index are based on realized day-ahead and futures prices. We see that hedging 3 years in advance delivered higher revenues until fiscal year 2013/2014, while the opposite holds for the following fiscal years. Our goal here is not to obtain an exact estimation of the revenues from hedging, which in our view can only be done from trading data, but to study how robust the conclusions are with respect to the stated assumptions. In general, the assumed 3-year rolling strategy underestimates the revenues from cross-hedging.

We also corrected our estimations to account for the different evaluation of the internal value of power plants, as discussed in the previous section. We also emphasize that this correction is done because of a possible misinterpretation of the hedge index in Frauendorfer and Gutsche (2021) to ensure that our computations do not understimate the profilt from hedging. However, if the hedge index in Frauendorfer and Gutsche (2021) is properly constructued, the correction is not necessary. In our computations, the reference value is not the average day-ahead price but the production-weighted day-ahead price. In the computation of the internal value of power plants this implied a lower estimation, that we now paratially adjust back for the quantities that are hedged. On average this leads to an increase in the revenues from hedging of around 60 mio Swiss francs each year, i.e., 60 mio out of 285mio reduction of the interval value are transfered to the EBIT from hedging.

We finally test how revenues from hedging activities are affected if only base products are used. Indeed, due to the low liquidity of peak products, we analyse how the profits from hedging would be affected if only base products were used. Inspecting data from EEX we observe that selling peak products 3 years in advance for the volumes required to hedge Axpo's production might not be feasible. We do not argue that Axpo only uses base products, but account for this possibility in the context of our robustness analysis.

Hedging with base products only lowers the perfomance of the hedging strategy. However, the difference declines over time to reach around 2 mio in 2018/2019, reflecting the diminishing gap between average day-ahead prices and peak prices.

Estimated cross hedge profits	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**
FG (2021) (mio CHF)	436.324	564.796	236.138	349.918	420.271	466.166	277.025	192.246	-80.172	-243.998
Flexible storage (TWh)	3.43	3.08	3.08	3.54	3.27	3.23	3.39	3.21	3.02	3.58
Band-energy (TWh)	18.7	18	20.3	19.3	18.4	19.4	18.4	16.5	15.4	17.3
Adjustement to account for lower hedging volumes (mio CHF)	-262.5	-358.5	-118.5	-204	-280.5	0	0	0	0	0
3-year ahead hedging Base: adjustment Hedge-Index (cts/kWh)	0.5	0.6	0.80	0.64	0.09	0.04	-0.04	-0.10	-0.05	-0.05
3-year ahead hedging Peak: adjustment Hedge-Index (cts/kWh)	0.25	0.35	0.40	0.40	0.10	0.02	0.00	-0.08	-0.04	-0.05
Adjustement 3-year ahead hedging Base (mio CHF)	9.25	10.5	21.2	17.2	3.4	3.88	0	-13.2	-6.16	-8.65
Adjustement 3-year ahead hedging Peak (mio CHF)	17.15	18.48	24.64	22.656	2.943	1.292	-1.356	-3.21	-1.51	-1.79
Adjustement to account production-weighted day-ahaed price[8] (mio CHF)	56.249	50.39	51.241	58.231	53.578	58.858	61.048	57.465	54.018	63.681
Adjustment if production is hedged with Base products only (mio CHF)	-57.624	-68.684	-63.756	-47.79	-14.715	-14.212	-9.831	-10.272	-2.416	1.79
Total Estimated Cross-Hedge profits (mio CHF)	**198.849**	**216.982**	**150.963**	**196.215**	**184.977**	**515.984**	**326.886**	**223.029**	**-36.24**	**-188.967**

Table 8. The table reports the robustness analysis for the estimation of the earnings from Axpo's hedging activities. We account for the alternative hedging strategy where the full production is hedged

[8] This adjustment addresses a conservative interpretation of the cross-hedge index of Frauendorfer and Gutsche (2021) that leads to an upper bound for the profits from cross-hedge.

3 years in advance, for lower hedged volumes, and for the possibility that only BASE products were used to hedge production.

Our analysis clearly illustrates that the assessment of hedging strategies based on publicly available data is very sensitive to the stated assumptions. Taking into account possible deviations from the stated assumptions leads to significantly different results concerning the revenues from cross-hedging. Specifically, our assessment shows that the earnings from hedging over the 10-year period from 2008/2009 through 2017/2018 are likely to be much lower than the 2,610 mio reported by Frauendorfer and Gutsche (2021) and lies around 1,790 mio instead.

Asset-backed trading

In this section we analyse the estimated profitability of asset-backed trading activities. By asset-backed trading activities we mean transactions in the spot and forward markets that are backed-up by production. Table 9 reports the estimated profits and losses from asset-backed trading for the fiscal years 2008/2009 to 2017/2018. We compare the estimated quantities of Frauendorfer and Gutsche (2021) with profit and losses directly computed using data of Axpo's trading portfolio. Overall, apart from fiscal year 2016/2017, Frauendorfer and Gutsche's estimates exceed the actual profits from asset-backed trading by a substantial margin. Overall, the difference corresponds to 1,437.18 million Swiss francs for the overlapping period from 2010/2011 through 2017/2018. Interestingly, around 949.49 million out of 1,437.18 million (almost 70% of the total difference) relates to fiscal years from 2010/2011 through 2012/2013.

Asset-backed trading	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**
FG (2021) (mio CHF)	340.905	284.38	381.318	306.358	222.107	169.653	150.118	144.6	148.364	208.874
Estimated based on trading data (mio CHF)	-	-	-103.15	-24.19	87.64	-76.14	118.99	30.82	161.61	98.65
Difference (mio CHF)	-	-	484.47	330.55	134.47	245.80	31.13	113.78	-13.25	110.23

Table 9: The table reports the profits and losses of Axpo's asset-backed trading activities. We compare the estimated profits and losses based on the calculation of Frauendorfer and Gutsche (2021) with the actual values based on Axpo's trading data.

We therefore evaluate if the difference could be partially explained by accounting for the 15TWh annually delivered to the Cantons from 2008/2009 to 2012/2013 at cost plus, i.e., the assumption is that these volumes are not traded. We otherwise apply the same metrics "Abt-Spot" and "Abt-Forward" as suggested by Frauendorfer and Gutsche (2021). Table 10 reports the results. Although the gap remains important, it decreases to 1,073 million, so around one third of the orginal gap could be related to the volumes delivered to the Cantons at cost plus.

Asset-backed trading (mio CHF)	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Without volumes to Cantons	228.405	171.88	223.818	178.858	142.607	169.653	150.118	144.6	148.364	208.874
Estimated based on trading data	-	-	-103.15	-24.19	87.64	-76.14	118.99	30.82	161.61	98.65
Difference	-	-	326.97	203.05	54.97	245.80	31.13	113.78	-13.25	110.23

Table 10: The table reports the profits and losses of Axpo's asset-backed trading activities considering that from 2008/2009 through 2012/2013, 15TWh annually were delivered to the Cantons at production cost. The assumption is that these volumes were not traded. We compare the estimated profits and losses based on the calculation of Frauendorfer and Gutsche (2021) with the actual values based on Axpo's profit and losses for the asset-backed trading books.

To better understand the gap between the estimation of profits and losses based on the metrics proposed by Frauendorfer and Gutsche (2021) and the realised quantities, we need to investigate the way asset-backed trading is implemented at Axpo and how it deviates from the suggested strategies. However, this is beyond the scope of this analysis, which focuses on the robustness of the conclusions related to proprietary trading.

2.7 Transfer Prices

To address the hypothesis that losses from trading might be transferred to other segments, we investigate the transfer price at which the "Assets" segment sells its production volumes to the "Trading&Sales" segment. This transfer is generally performed 3 years in advance. The transfer price closely follows the 3-year forward base price and does not include costs. The conversion from CHF to EUR and vice versa is done using FX-forward curves.

In Table 11, we compare the estimated profitability of production, which is the sum of the estimated internal value of assets and the estimated profits from cross-hedging and asset-backed trading, with the transfer values at which production is transferred from "Assets" to "Trading&Sales". Low transfer values would allow to transfer losses from proprietary trading activities to "Assets", as "Trading&Sales" would "buy" the production at a lower cost and generate this way extra revenues, which could limit the effects of losses from proprietary trading. We emphasise that transfer prices do not include costs and thus the comparison with our estimates of "profit&losses" should be made with some care. Moreover, we only have the observation from four business years overlapping with the sample of Frauendorfer and Gutsche (2021). We observe that transfer prices are on average 0.69cts/kWh higher than the sum of BASE day-ahead and BASE hedge-index in Frauendorfer and Gutsche (2021). This implies that there is no evidence for these years that transfer prices were too low.

Transfer prices and volumes	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18
Estimated internal value+profits from cross-hedge, asset-backed (mio CHF)	1059	746	755	676	500	883	748	497	437	607
BASE day-ahead in FG (2021) (cts/kWh)	7.27	6.74	6.84	5.91	5.16	4.47	4.01	3.58	4.53	5.98
Hedge-Index BASE FG (2021) (cts/kWh)	1.75	2.39	2.46	2.47	2.33	2.42	1.55	1.26	-0.36	-1.16
Transferred volume (TWh)	-	-	-	-	-	-	24.7	21.1	19.5	21.6
Transfer price (cts/kWh)	-	-	-	-	-	-	7.43	6.36	4.57	3.77
Total value	-	-	-	-	-	-	1835.21	1341.96	891.15	814.32

Table 11: The table compares the estimated total profitability of production (internal value+profits from cross-hedge, asset-backed) with the total transfer value.

2.8 Summary and Conclusions

Following the indirect approach suggested by Frauendorfer and Gutsche (2021), we now derive the profit and losses for proprietary trading. We apply the suggested adjustments to properly address the robustness of the methodology. Again, the goal is not to generate an alternative estimation of the profitability of Axpo's proprietary trading, but to indicate a range where the profitability is likely to be. The results are reported in Table 12.

We emphasize that differently from Frauendorfer and Gutsche (2021) in our computation of the clean-up EBIT (see Table 4) we also included the amortisation amounts. Therefore, we now subtract them, as amortisation amounts already enter the internal value of power plants.
If we deduct from our clean-up EBIT the amortisation amounts and the EBIT from regulated distribution systems, we obtain an overall value of 5,598 million for the considered 10-year period. This value should be compared with the "bereinigter EBIT" of 4,490 million reported by Frauendorfer and Gutsche (2021). Therefore, our analysis leads to a higher value (+1,108 million). The main reason for the gap relates to the different estimation of the EBIT from regulated system (1,760 million in Frauendorfer and Gutsche (2021) and 821 million according to our estimations, i.e., +939 million). Additionally, 175 million can be attributed to adjustments in the financial reports of Axpo referring to depreciations and provisions (next-year corrections).

According to our results, the implied range for the profitability of Axpo's proprietary trading is between -1,039 million and 360 million. The upper bound of 360 million is achieved when we use the historical data from Axpo's asset-backed trading, assuming that the profitability of Axpo's asset-backed trading in 2008/2009 and 2009/2010 (for which we didn't have trading data) corresponds to the average profitability in the following 8 fiscal years (36.78 million annually on average). By contrast, the lower bound is obtained when the profitability of Axpo's asset-backed trading is derived using the metrics proposed by Frauendorfer and Gutsche (2021), as discussed in Section 2.6.

We now compare the implicitly derived values for the profitability of Axpo's proprietary trading with the profit and losses directly obtained from trading data. If we limit our comparison to the overlapping period, our implied range is from -557 million to 515 million. By contrast, the realized profit as estimated from trading book data is 241.43 million and thus lies in the given range. If we focus on single years, the comparison is more difficult, despite the numbers are quite close apart from 2012/2013.

In Millions of CHF	**2008-2018**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**14/15**	**15/16**	**16/17**	**17/18**
Clean-up EBIT (Table 4)	**9532.8**	**1308.1**	**1055.4**	**1014.6**	**1039.9**	**1322.1**	**1036.5**	**924.8**	**671.1**	**329.1**	**831.2**
Deductions:											
EBIT regulated distribution systems (Table 5)	821.854	81.458	81.458	53.949	61.934	112.247	79.192	93.894	84.502	81.323	91.897
Amortisation: Assets Trading&Sales CKW	 2215.5 309.4 587.8	 231.7 66.4 59.9	 316.4 72.9 60.2	 238.7 70.5 64.1	 221 60.6 62.7	 275.7 9.2 61.1	 238.2 6.5 56.6	 137.2 5.5 56.6	 173.4 6.9 55	 168.1 5 54.7	 215.1 5.9 56.9
Internal value power plants (Table 7)	3082.19	669.89	389.39	427.07	312.31	141.85	124.05	170.82	7.72	246.73	592.35
Cross-hedging activities (Table 8)	1788.678	198.849	216.982	150.963	196.215	184.977	515.984	326.886	223.029	-36.24	-188.967
Asset-backed trading (Table 10)	1767.18 *367.77*	228.405 *36.78**	171.88 *36.78**	223.818 *-103.15*	178.858 *-24.19*	142.607 *87.64*	169.653 *-76.14*	150.118 *118.99*	144.6 *30.82*	148.364 *161.61*	208.874 *98.65*
Total deductions	10572.59 *9173.18*	1536.60 *1344.97*	1309.21 *1174.11*	1229.10 *902.13*	1093.62 *890.57*	927.68 *872.71*	1190.18 *944.38*	941.02 *909.89*	695.15 *581.37*	667.98 *681.22*	982.05 *871.83*
Total differential	-1039.79 *(-557.48)* *359.62* *(515.20)*	-228.50 *-36.87*	-253.81 *-118.71*	-214.50 *112.47*	-53.72 *149.33*	394.42 *449.39*	-153.68 *92.12*	-16.22 *14.91*	-24.05 *89.73*	-338.88 *-352.12*	-150.85 *-40.63*
Profit and loss from proprietary trading based on trading data	241.43			166.74	-44.50	42.27	24.76	-31.88	50.88	11.14	22.02

Table 12: Summary of the results and estimation of the profits and losses from proprietary trading based on the indirect approach. In rows 9 and 10, we show in italics the estimated quantities for asset-backed trading using data from Axpo; we also assumed that in this case earnings for 2008/2009 and 2009/2010 correspond to average earnings in the following 8 years. For the total differential in row 10, in brackets we report the figures for 2010/11 to 2017/2018, that is the overlapping period with sample of trading data.

Overall, our analysis indicates that the indirect approach based on public data is extremely sensitive to the specific assumptions on how trading and hedging are performed and on the cost structure. Specific assumptions on how cross-hedge and asset-backed trading is performed clearly impact the assessment of proprietary trading. We suggested possible, plausible deviations from the given assumptions made by Frauendorfer and Gutsche (2021).

Specifically, we conservatively accounted for the volumes delivered at cost plus to Cantons and also included possible deviations from the average cost structures that can be inferred from the 2018 survey of the Federal office for energy. These deviations significantly affect the evaluation of proprietary trading strategies. Our investigation shows that the reported losses of 6,400 million over the 10-year from 2008/2009 to 2017/2018 in large part result from significantly overestimating the earnings from regulated distribution systems (1,760 million vs 821 million), the internal value of power plants and long-term contracts (5,920 million vs 3,082.19 million) and the profits from cross-hedging (2,610 million vs. 1,788 million) and asset-backed trading (2,360 million vs. 1,767 million). Taken together, these four factors account for almost 5,000 million of the estimated losses.

3 Analysis of the Profitability of Axpo's Proprietary Trading

3.1 Introduction

In light of the public debate about the profitability of Axpo's trading business, Axpo Solutions Ltd. has asked us to conduct an independent analysis of the profitability of its trading activities. Axpo Solutions' financial reports contain information on the gross margin earned in trading both overall and broken down into the different types of trading activity conducted at Axpo, namely asset-backed trading, origination, and proprietary trading. Table 13 summarizes this information, which is available from fiscal year 2015/2016 onwards. The years shown in the left column correspond to the end of the fiscal year (e.g., 2016 corresponds to the fiscal year from October 1, 2015 through September 30, 2016). One observes that all three types of trading earned significant profits each year during the period.

	Trading Type			Total
Year	**Asset-Backed Trading**	**Origination**	**Proprietary Trading**	
2016	134.1	129.8	78.2	335.2
2017	133.9	166.7	76.4	375.4
2018	119.4	127.9	95.9	345.0
2019	119.9	246.5	174.9	543.9
2020	230.8	202.6	264.7	699.9
2021	324.5	476.5	79.1	880.4
2022	1,275.9	859.4	87.0	2,236.7
2023*	380.9	785.8	377.5	1,544.3
Total	**2,719.4**	**2,995.2**	**1,233.7**	**6,960.8**

The years shown in the left column refer to the end of the fiscal year.
* The data for FY 2023 only cover the first quarter and were provided by Axpo's risk management department.

Table 13: Annual trading P&L (gross margin) in million euros by trading type for the period 01.10.2015-31.12.2022.

This chapter investigates the profitability of Axpo's trading operations in more detail and for a longer sample period ranging from October 1, 2010 (the start of Axpo's 2010/11 fiscal year) through December 31, 2022. The goal of the analysis is to assess the magnitude and riskiness of historical profitability, the extent to which this profitability has evolved over time, and the sources of the trading profits. The analysis focuses on the businesses that share the same central ETRM system, for which granular data with a consistent structure are available. Since the only reason for omitting the other businesses is data availability and these businesses in aggregate consistently earned a positive P&L every year, there is no reason to believe that including them would materially affect our main conclusions.

The chapter is organized as follows. Section 3.2 describes the data used in the analysis. Section 3.3 analyzes trading performance by type of trading activity both for the entire period and on an annual basis. It also assesses whether this performance has declined in recent years. Section 3.4 investigates statistically the extent to which the profits generated in the different business areas within proprietary trading are genuinely different or are driven by exposure to similar sources of risk. Section 3.5 investigates the sources of Axpo's trading profits. Section 3.6 analyzes whether trading performance both at the aggregate level and by trading type covers the estimated cost of capital. Section 3.7 summarizes our main findings.

3.2 Data

The data used in our analysis were provided by the risk management department. The dataset comprises the trading type (asset-backed trading, origination, or proprietary trading) and daily P&L information on all trading books. The Italian, Spanish, Scandinavian, and U.S. divisions were not included due to lack of sufficiently granular historical data.

The P&L information available for each book consists of its gains and losses (both realized and unrealized) for each business day for the period from October 1, 2010 through December 31, 2022. Inspection of the data revealed a number of instances of large values that were reversed during the following days. In these cases, the profit or loss on both days involved was replaced with its average value over those same days. This data cleaning approach removes the upward bias on risk estimates resulting from such reversals without impacting the overall profitability assessment in any way.

It is worth noting that internal transactions between books can take place. However, according to the risk management department, they are performed in the form of position transfers at market prices and therefore would not affect our profitability assessment.

3.3 Trading Performance by Type of Trading

The first step in our analysis considers the profitability and riskiness of trading by type of trading and its evolution over time.

Profitability

Figure 13 reports the cumulative P&L by trading type over time in billion euros for the period from October 1, 2010 through December 31, 2022. All three trading types generate sizable profits over the period. The largest profits are earned in asset-backed trading, followed by origination, and proprietary trading.

Table 14 reports the total P&L as well as its breakdown by trading type for each fiscal year. For completeness, the penultimate column in the table shows the combined P&L of the foreign subsidiaries not analyzed in this chapter and centralized foreign exchange and interest rate hedging, and the last column the grand total including the omitted subsidiaries and centralized hedging. Again, the years shown in the left column correspond to the end of the fiscal year. Over the sample period spanning over 12 years, proprietary trading made moderate losses in three fiscal years, namely 2012, 2015, and 2021. Fiscal year 2022 recorded a large loss related to missing natural gas deliveries from Russia. This loss was offset by the profit in the first quarter of fiscal year 2023, which is the largest during the sample period.

Comparing the values for the divisions analyzed in detail in this chapter (Table 14) with those for the overall firm (Table 13) reveals that profitability at the level of the overall firm is more consistent across years. This reflects the presence of diversification effects between the businesses analyzed in this chapter and the omitted divisions.

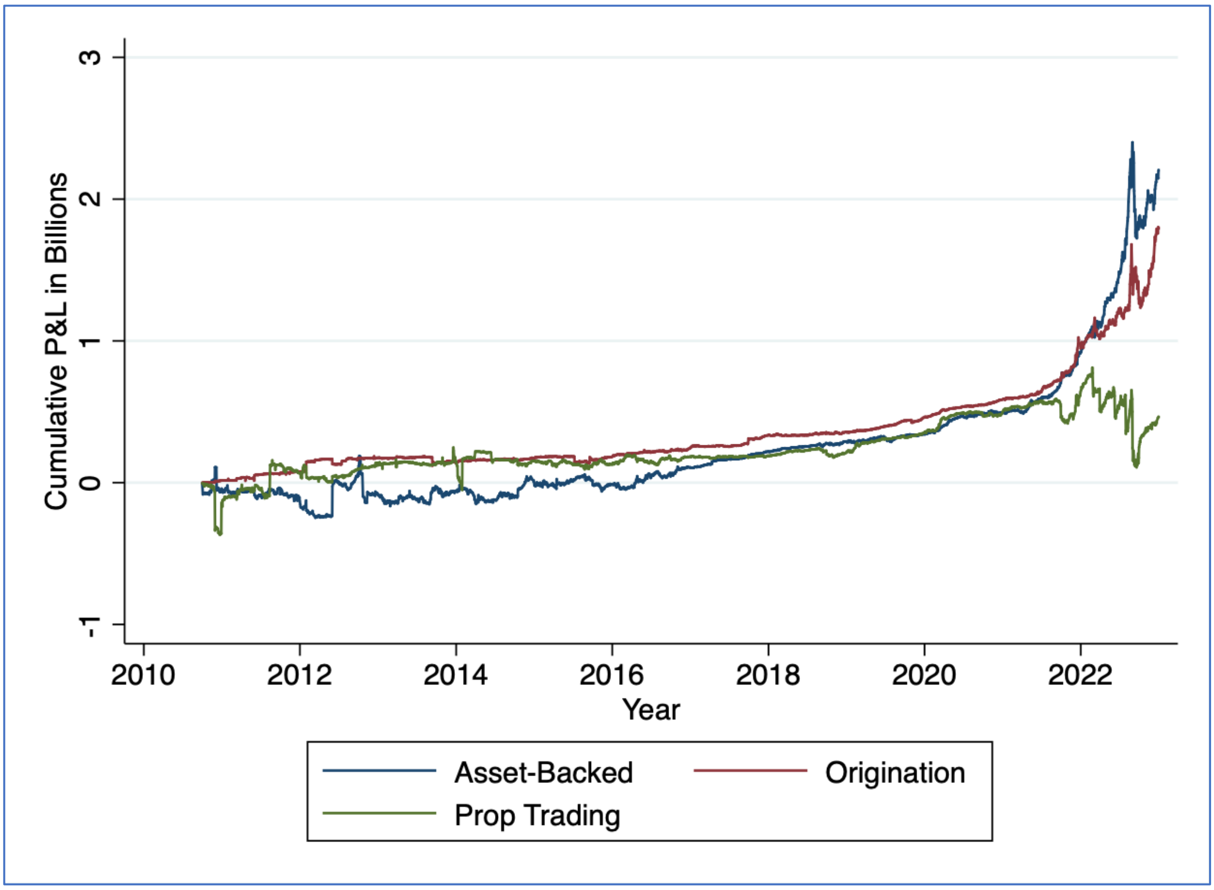


Figure 13: Cumulative P&L by trading type for the period 01.10.2010-31.12.2022 in billion euros.

Year	Trading Type			Total	Divisions not included in dataset and centralized hedging	Grand Total
	Asset-Backed Trading	Origination	Proprietary Trading			
2011	-82	68	133	118	121	239
2012	-20	106	-37	49	153	202
2013	72	-33	34	73	203	276
2014	-62	26	20	-16	150	134
2015	108	-4	-29	75	172	248
2016	28	66	47	141	194	335
2017	148	79	10	237	138	375
2018	85	40	19	144	201	345
2019	51	89	120	260	284	544
2020	158	109	151	419	281	700
2021	220	196	-9	408	472	880
2022	1,163	521	-211	1,473	764	2,237
2023	337	533	216	1,085	459	1,544
Total	**2,206**	**1,796**	**465**	**4,467**	**3,592**	**8,059**

The years shown in the left column refer to the end of the fiscal year. The data for FY 2023 only cover the first quarter.

Table 14: Annual trading P&L in million euros by trading type for the period 01.10.2010-31.12.2022. For completeness, the penultimate column shows the P&L of the foreign subsidiaries and centralized hedging not analyzed in this chapter, and the last column the grand total including the omitted subsidiaries and centralized hedging.

Risk-adjusted performance

The above analysis considered profitability without adjusting for risk. In order to put the two in perspective, Figure 14 reports the ratio of annualized profitability to annualized P&L volatility, a measure that is similar in spirit to the Sharpe ratio commonly used in the finance literature. We shall refer to our ratios as Sharpe ratios, bearing in mind that we use euro amounts rather than percentage returns. It is worth noting that since the P&L mostly arises from positions in derivatives that do not need to be funded, there is no need to subtract the riskless asset return in these computations. We address the question of the cost of capital in Section 3.6 below.

The results reveal that asset-backed trading and origination achieve the highest Sharpe ratios, with values of about 0.8 and 1, respectively, while the Sharpe ratio of proprietary trading is about 0.2. Taken as a whole, Axpo's trading activities generate a Sharpe ratio exceeding one, which is quite large compared to the values typically achieved on traditional financial markets.

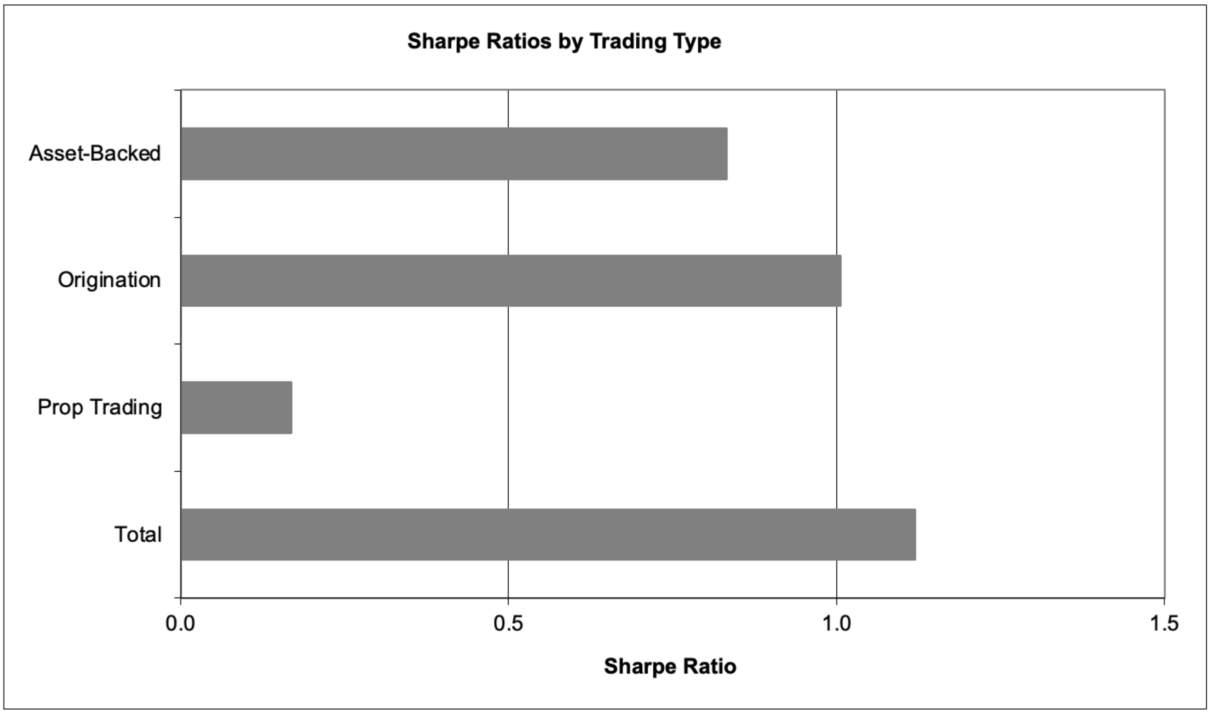


Figure 14: Sharpe ratios by trading type for the period 01.10.2010-31.12.2022.

Evolution of risk-adjusted performance over time

Trading profits vary substantially over time and may erode due to competitive pressures and the associated increase in market efficiency. It is therefore instructive to analyze the extent to which the Sharpe ratios achieved have declined over time. Figure 15 reports the results of this analysis. To improve readability, the different years are coded using colors as follows: the first four fiscal years in the sample are shown in increasingly dark shades of blue, the next four in increasingly dark shades of yellow/orange, and the last five in increasingly dark shades of grey. As before, the years shown in the legend correspond to the end of the fiscal year.

Considering total firm profits first (right of the figure), no decline in Sharpe ratios can be observed over time. If anything, the Sharpe ratios towards the end of the sample period tend to be higher than average. The highest value is observed for the 2023 fiscal year, but this finding should be treated with caution, as it is based on a single quarter of data.

Considering the individual trading types, there is no indication that the Sharpe ratios achieved in asset-backed trading and origination decline over time. For asset-backed trading, they average close to zero in the first third of the sample period, but are consistently positive thereafter. For origination, the Sharpe ratios are on average positive at the beginning of the sample, but also tend to be higher in later years. For proprietary trading, the Sharpe ratios are on average close to zero during the first two thirds of the sample, and positive in the later part of the sample, with large positive values in 2019, 2020 and the first quarter of fiscal year 2023 more than offsetting small negative values in 2021 and 2022.

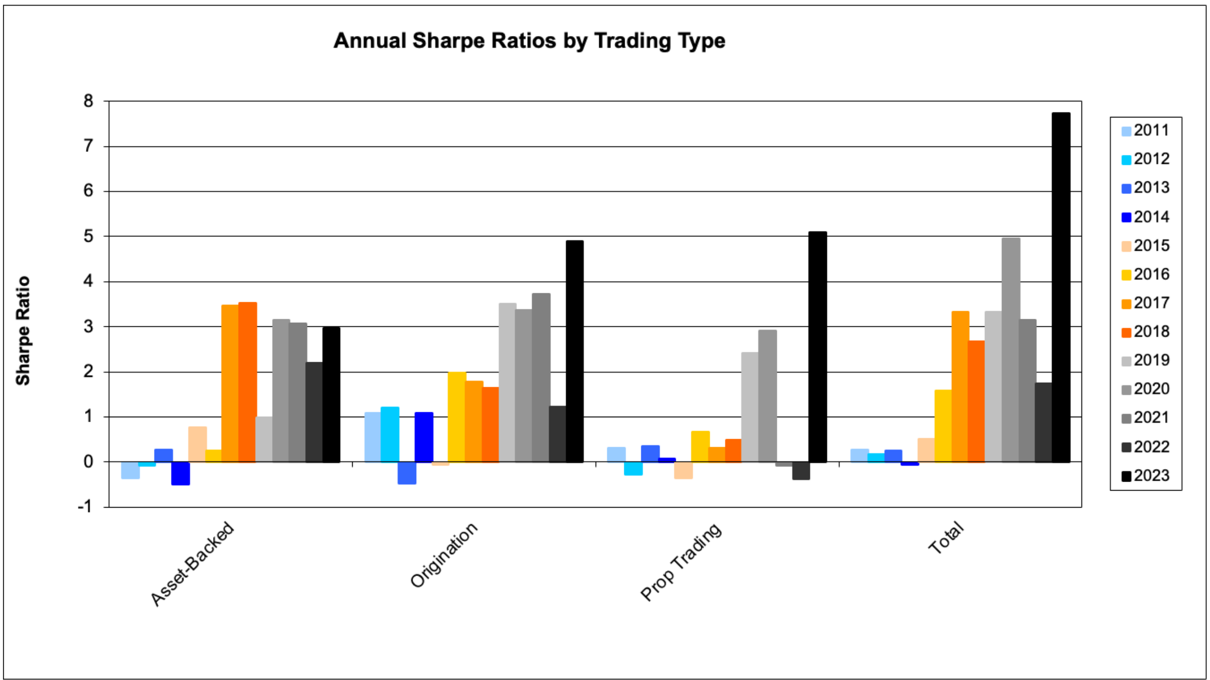


Figure 15: Sharpe ratios by trading type for each year in the sample.

3.4 Degree of Heterogeneity in Trading Strategies

This section investigates whether the different trading strategies used in proprietary trading are similar or genuinely different. To do so, we conduct a principal component analysis (PCA) of the correlation matrix of the historical P&L of the different business areas within proprietary trading. There are 39 such areas; their P&L was computed as the sum of the P&Ls of all trading books that are part of that area.

PCA is a statistical method used to reduce the dimensionality of a dataset. It does so by constructing factors, called principal components, that explain as much as possible of the observed variability of the original data. Appendix C provides a short description of the method.

The results of PCA reveal the extent to which the original data are driven by common sources of variation. In our case, it can be used to assess whether the returns generated in the different business areas are genuinely different or exposed to similar sources of risk. Using the correlation matrix in the analysis ensures that the results are not distorted by the fact that some business areas are larger than others.

Figure 16 presents the results. The grey bars report the magnitude of the eigenvalues, which show how much of the variation in profits can be explained by each principal component extracted from the return history. If the profits in the 39 business areas were completely unrelated to each other, all eigenvalues would be equal to one. The blue bars show the fraction of the overall variation in the return history of the 39 business areas that can cumulatively be explained by the number of principal components reported on the x-axis. If the profits of the different areas were completely unrelated to each other, the bars would lie on a straight line.

While it is apparent that the results for Axpo differ from this extreme benchmark case, indicating that there is some dependence in profits across business areas, the relation is fairly weak. As a basis of comparison, for stock portfolios, the first eigenvalue is very prominent, and the first principal component (representing overall movements in the stock market) generally explains about 50% of the variation.[9] By contrast, in the case at hand, 13 principal components (i.e., one third of the number of business areas) are needed to explain half of the variation in business area profitability. This indicates that the profitability of Axpo's proprietary trading business is driven by more than a handful of strategies.

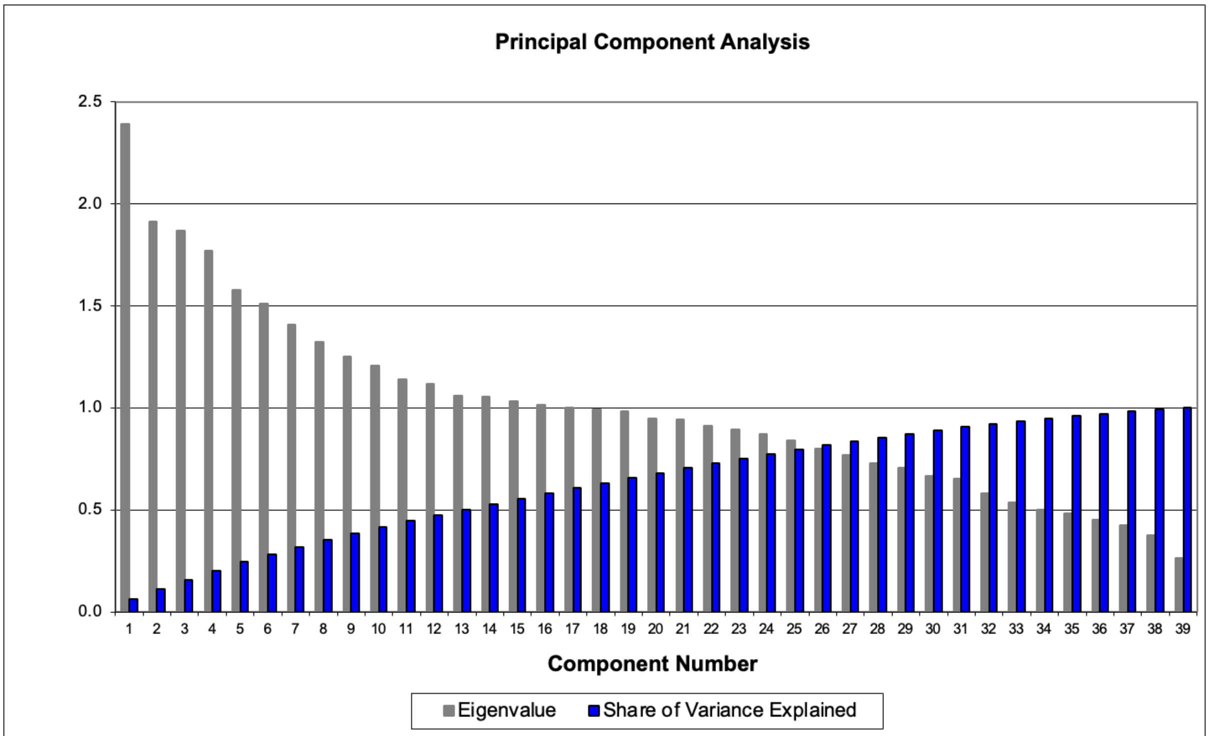


Figure 16: Principal component analysis of business area trading profits for the period 01.10.2010-31.12.2022.

Correlations between financial instruments are known to increase in periods of high macroeconomic or geopolitical uncertainty. It is therefore instructive to consider whether this causes the diversification in business area profitability to break down in periods of market

[9] Appendix C reports the results for the Swiss Market Index constituents.

stress. Figure 17 reports the PCA results year by year for the last six fiscal years in the sample. The number of principal components appearing on the x-axis varies by year in line with the number of active business areas that year. The y-axis is formatted consistently across panels to make the differences across years easier to assess.

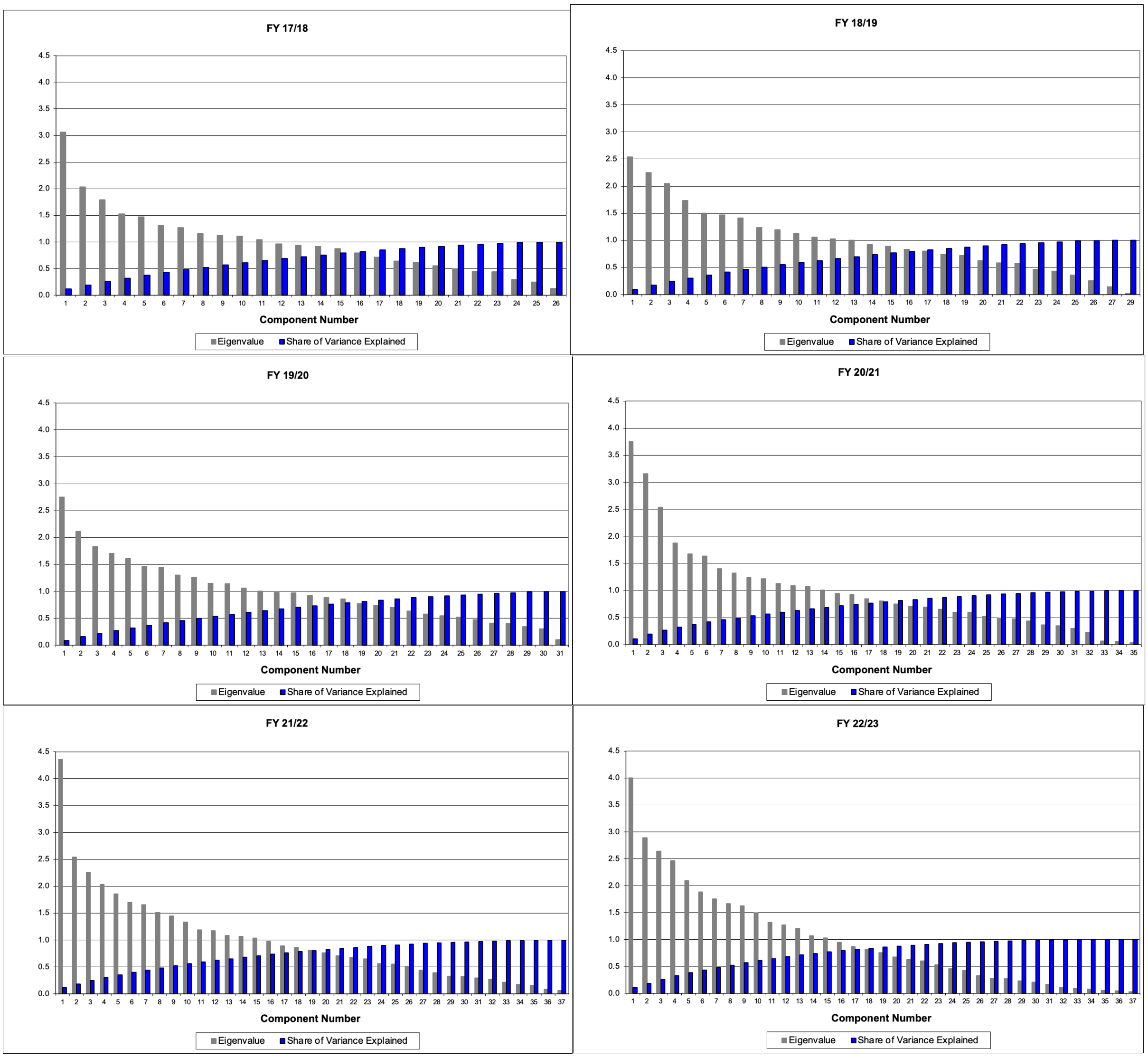


Figure 17: Principal component analysis of business area trading profits for the last six fiscal years in the sample.

Comparing the results for fiscal years 2018, 2019, and 2020 with those for fiscal years 2021, 2022, and 2023 reveals that co-movement in business area profits indeed increases in periods of market stress. During the first three years considered, the largest eigenvalue ranges from around 2.5 to around 3; it rises to almost 3.8 in fiscal year 2021 and reaches almost 4.4 in 2022. Fiscal year 2023 lies somewhere in-between, with the largest eigenvalue at 4. Substantial increases between the first and the last three years can also be observed for the second eigenvalue, and moderate increases occur for the third. Nevertheless, even in fiscal years 2021 through 2023, the first principal component only explains between 10 and 12% of the overall variation in business area profitability, and eight or nine principal components are required to account for half of the variation. Thus, although diversification does not function as well in crisis periods, it remains substantial compared to what one observes for stock portfolios.

3.5 Sources of Returns

This section investigates the sources of Axpo's trading profits. The goal is to determine the extent to which these profits arise from taking relatively stable exposures to a number of benchmark energy prices or from more sophisticated strategies. Section 3.5.1 briefly describes the methodology and the additional data used in this analysis. Section 3.5.2 presents the results for the different trading types.

Methodology

The empirical approach used to assess the source of the trading profits is to regress the daily P&L of each trading type on the changes in the prices of the main instruments used in Axpo's trading. These prices are the year-ahead prices for (i) base- and peak-load power in Switzerland, France, Germany, Italy, and the United Kingdom, (ii) EU CO_2 emission certificates, and (iii) UK and Dutch (TTF) natural gas. The regression equation is

$$P\&L_t = \alpha + \sum_{n=1}^{13} \beta_n \Delta P_{n,t} + \varepsilon_t \ ,$$

where $P\&L_t$ denotes the P&L of the trading type on trading day t, $\Delta P_{n,t}$ the changes in the prices of the 13 key instruments listed above compared to the previous trading day, and ε_t a zero-mean error term.

The coefficient estimates β_n are the sensitivities of the P&L to changes in the different prices. They can be thought of as reflecting the average exposure of each trading type to that instrument. The coefficient α represents the average daily profit or loss after accounting for the (average) exposure of the P&L to the instruments included in the regression. If α is significantly positive, one concludes that the trading profits are due to successful strategies that are more complex than just taking (constant) exposure to changes in (one or several of) the key prices. Conversely, a significantly negative α indicates that trading profits are lower than one would expect them to be based on the risks taken.

Since power prices are highly correlated across countries and UK and Dutch natural gas prices are highly correlated as well, in addition to the full specification with all 13 price changes, we also estimate the regression equation using only Swiss and German base- and peak-load power, EU CO_2 emissions, and TTF natural gas prices.

Daily historical price data for this analysis were provided by the risk management department and cover the period from October 1, 2018 through December 31, 2022. For each trading day, year-ahead prices were computed as the simple average of the 12 monthly prices maturing in the next calendar year (e.g., the year-ahead price for September 15, 2022 is the average of the prices for the monthly maturities from January through December 2023). For the first trading day of each year, the price change was computed as the year-ahead price on that day minus the two-year-ahead price on the last trading day of the previous year. Doing so ensures that prices for power with the same delivery period are being compared.

For Italy, power prices were only available for a few maturities (sometimes even for a single month in the case of peak-load prices), especially in the early part of the sample. Instead of year-ahead prices, we therefore used the average of the prices of all maturities between the current trading day and December of the following calendar year. Prices for the UK instruments are quoted in pounds; they were converted to euros for the analysis.

Results for the different trading types

Table 15 presents the estimated values of the coefficient α for each trading type. Three cases are considered. The "raw" value represents the average daily profit in million euros without accounting for any of the price exposures. The "main prices" value represents the average daily profit achieved after accounting for exposure to Swiss and German base- and peak-load power, EU CO_2 emissions, and TTF natural gas prices. The "all exposures" value is the average daily profit achieved when accounting for the exposures to all 13 prices.

As can be seen in the last row of the table, total trading profits during the period exceed three million euros per day and are statistically significant at the 1% level. This implies that it is unlikely that they merely occurred by chance. Accounting for the exposures to the main prices or to all prices only leads to a small reduction in α, whose value remains strongly significant. This indicates that trading profits are not generated by Axpo's merely taking a constant exposure to changes in (one or several of) the key prices either. Rather, the profits appear to be driven by more complex, successful strategies.

	Average profit per trading day α		
Trading Type	**Raw**	**Accounting for exposure to main prices**	**Accounting for all exposures**
Asset-Backed Trading	1.822 ***	1.719 ***	1.707 ***
Origination	1.368 ***	1.257 ***	1.287 ***
Proprietary Trading	0.253	0.060	0.060
Total	3.442 ***	3.036 ***	3.054 ***

Statistical significance based on robust t-statistics: *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 15: Average daily profit in million euros for the different trading types for the period 01.10.2018-31.12.2022.

The results at the trading type level reveal that trading profits are statistically significant for asset-backed trading and origination, but not for proprietary trading. This statement holds both for raw profits and when accounting for the exposures to changes in the key prices.

A question that often arises in the context of such analyses is whether raw or adjusted profits constitute the right measure to assess performance. The answer depends on the constraints under which traders operate. If traders can choose their exposures to key prices relatively freely, as is likely to be the case for proprietary trading, then they should get credit for taking exposure to the right prices, and raw profits are the appropriate measure. By contrast, if traders have little leeway in selecting exposures, as appears likely for asset-backed trading and origination, exposure-adjusted profits are preferred. The definite answer is not essential in our case, however, since the conclusions that can be drawn from Table 14 are the same for raw and adjusted measures.

3.6 Profitability Accounting for the Cost of Capital

The results so far show that over the sample period, Axpo's trading generated substantial profits. However, they do not account for the cost of capital. Doing so requires an estimate of the amount of capital necessary for trading and of the percentage cost of capital.

As mentioned in Section 3.3, trading is mostly conducted using positions in derivatives that do not need to be funded. However, entering and maintaining these positions requires margin to be posted with exchanges or over-the-counter counterparties. Such margin will usually earn interest at a rate close to that on high-quality government bills. As a result, the capital cost can be estimated as the product of the amount of margin and the difference between Axpo's weighted average cost of capital (WACC) and the yield on short-term high-quality government bills.

Axpo provided an estimate of its WACC, which was 5.6% until fiscal year 2013, 5.2% for fiscal years 2014 through 2020, and 4.9% thereafter. Since a large part of the trading occurs in euro-denominated instruments, we use the yield on one-month German government bills as a measure of the interest that could be earned on margin. This rate was negative during most of the sample period, so our estimates of the cost of capital are higher than they would be if interest on margin were zero.

To estimate the amount of margin, we use net operating assets (NOA), which were provided by the risk management department and are available monthly from the end of August 2019.[10] Since this lies just one month before the start of fiscal year 2020, we run the cost of capital computations from the beginning of fiscal year 2020 onwards. For each month, we compute the capital cost as the product of NOA at the end of the previous month (converted to euros at the spot exchange rate) and the interest rate differential. We then aggregate the monthly values across all months in a given fiscal year to obtain annual estimates of the total capital cost. The results are shown in the "Total" column in Table 16. For the period 2020-2023, the total capital cost exceeds 500 million euros, reflecting the large amounts of margin that had to be posted during fiscal year 2022, which accounts for almost 60% of the total.

Apportioning these costs to the different trading types would require knowledge of the positions they held over time. Since these data are not available, we use the fact that margin requirements are typically roughly proportional to volatility, and therefore apportion capital costs using the ratio of a trading type's volatility to its sum across trading types.

Table 16 reports the results of these computations. Over the period, the capital cost is almost uniformly distributed across trading types, with values between 155 million for origination and 193 million for asset-backed trading.

[10] Values for the months of April and October are not available. For these months, we therefore use the average of the values of adjacent months.

Year	Trading Type			Total
	Asset-Backed Trading	Origination	Proprietary Trading	
2020	25	16	26	68
2021	30	22	43	95
2022	107	87	111	305
2023	30	29	11	71
Total	**193**	**155**	**191**	**539**

The years shown in the left column refer to the end of the fiscal year. The data for FY 2023 only cover the first quarter.

Table 16: Estimated annual cost of capital in million euros for the different trading types for the period 01.10.2019-31.12.2022.

Table 17 shows the estimated annual P&L (gross margin) net of the cost of capital for the different trading types. The values shown in the table are obtained by subtracting the values in Table 16 from those in Table 14. They reveal that when accounting for the cost of capital, asset-backed trading and origination both remain highly profitable. However, over the shorter sample period for which data on NOA are available, proprietary trading exhibits a loss due to the combination of the missing gas deliveries from Russia and the large margin requirements in force during the volatile year 2022.

Year	Trading Type			Total
	Asset-Backed Trading	Origination	Proprietary Trading	
2020	133	93	125	351
2021	190	174	-52	313
2022	1,056	434	-322	1,168
2023	306	504	204	1,014
Total	**1,685**	**1,205**	**-44**	**2,846**

The years shown in the left column refer to the end of the fiscal year. The data for FY 2023 only cover the first quarter.

Table 17: Estimated annual P&L (gross margin) net of capital cost in million euros for the different trading types for the period 01.10.2019-31.12.2022.

3.7 Summary

This chapter investigates the profitability of Axpo's trading activities for the period from October 1, 2010 through December 31, 2022 for the different type of trading, namely asset-backed trading, origination, and proprietary trading.

The goal is to assess the magnitude and riskiness of historical profitability, the extent to which this profitability has evolved over time, and the sources of the trading profits. With respect to these key questions, we come to the following conclusions:

1. All three trading types generate sizable profits over the period. The largest profits are earned in asset-backed trading, followed by origination, and proprietary trading.
2. There is no indication that profitability has been declining over time.
3. Although there is some statistical dependence between the profits in the different business areas within proprietary trading, the relation is fairly weak. This indicates that

proprietary trading's profitability is driven by more than a handful of strategies. Diversification weakens in crisis periods, but remains substantial.

4. Profits in asset-backed trading and origination are statistically significant, even after controlling for exposure to key European energy market prices. For proprietary trading, although profits are positive, they are not statistically significant. Thus, while the data indicate that the trading profits of asset-backed trading and origination are unlikely to have occurred by chance, they do not allow ruling this out for profits earned in proprietary trading.
5. The cost of capital can be estimated for the period 2020-2023. During that period, after accounting for the cost of capital, asset-backed trading and origination both remain highly profitable. However, proprietary trading exhibits a moderate loss due to the combination of the missing gas deliveries from Russia and the large margin requirements in force during the volatile year 2022.

3.8 Appendix

Appendix C: Introduction to principal component analysis

This appendix provides a short introduction to principal component analysis (PCA). As mentioned in the main text, PCA is a statistical method used to reduce the dimensionality of a data set. The objective is to find a linear combination of the data that explains as much as possible of the observed variability of the original data.

Consider demeaned data about N variables observed over T periods (such as the time series of returns for N stocks, or, in the case considered in the main text, the P&L for N business areas). The data are collected in a $T \times N$ matrix $\boldsymbol{Y}$. Let $\boldsymbol{\Sigma}$ denote the covariance matrix of $\boldsymbol{Y}$.

Each principal component will be a $T \times 1$ vector (i.e., a time-series variable obtained by combining the original variables) and be orthogonal to the other principal components.

The first principal component, denoted $\boldsymbol{f_1}$, is that linear combination of the original variables, $\boldsymbol{f_1} = \boldsymbol{a}_1'\boldsymbol{Y}$, whose sample variance $\boldsymbol{a}_1'\boldsymbol{\Sigma a_1}$ is greatest. Since the variance of $\boldsymbol{f_1}$ could be increased without limit by increasing the elements of $\boldsymbol{a_1}$, one imposes the constraint that $\boldsymbol{a}_1'\boldsymbol{a_1} = 1$. The optimization problem is:

$$\max_{\boldsymbol{a_1}} \boldsymbol{a}_1'\boldsymbol{\Sigma a_1} \quad \text{s.t.} \quad \boldsymbol{a}_1'\boldsymbol{a_1} = 1.$$

To solve such constrained problems, one uses so-called Lagrangian functions, in which the constraint, multiplied with some coefficient λ_1, is added to what one seeks to maximize. In this case, the Lagrangian is

$$L = \boldsymbol{a}_1'\boldsymbol{\Sigma a_1} + \lambda_1(1 - \boldsymbol{a}_1'\boldsymbol{a_1}).$$

To find the maximum, on then takes the derivatives of L with respect to the elements of $\boldsymbol{a_1}$ and sets them equal to zero. Doing so in our case, the solution satisfies the following conditions:

$$\boldsymbol{\Sigma a_1} = \lambda_1\boldsymbol{a_1}.$$

This is the equation for the eigenvector of $\boldsymbol{\Sigma}$ corresponding to eigenvalue λ_1. Noting that the variance of $\boldsymbol{f_1}$ is given by

$$\mathrm{var}(\boldsymbol{f_1}) = \boldsymbol{a}_1'\boldsymbol{\Sigma a_1} = \boldsymbol{a}_1'\lambda_1\boldsymbol{a_1} = \lambda_1$$

and remembering that we seek to maximize it, $\boldsymbol{a_1}$ is the eigenvector of $\boldsymbol{\Sigma}$ corresponding to its largest eigenvalue, λ_1.

Similarly, the second principal component, $\boldsymbol{f_2}$, is the linear combination of $\boldsymbol{Y}$ that has the greatest variance subject to the conditions that $\boldsymbol{a}_2'\boldsymbol{a_2} = 1$ and $\boldsymbol{f_2}$ be uncorrelated with $\boldsymbol{f_1}$. The optimization problem in this case is:

$$\max_{\boldsymbol{a_2}} \boldsymbol{a}_2'\boldsymbol{\Sigma a_2} \quad \text{s.t.} \quad \boldsymbol{a}_2'\boldsymbol{a_2} = 1, \qquad \boldsymbol{a}_2'\boldsymbol{a_1} = 0.$$

The second restriction, $\boldsymbol{a}_2'\boldsymbol{a_1} = 0$, ensures that both principal components are uncorrelated. The Lagrangian for this optimization problem is:

$$L = \boldsymbol{a}_2'\boldsymbol{\Sigma a_2} + \lambda_2\left(1 - \boldsymbol{a}_2'\boldsymbol{a_2}\right) - \mu\boldsymbol{a}_2'\boldsymbol{a_1}.$$

Taking the first-order derivatives with respect to the elements of $\boldsymbol{a_2}$ and equating them to zero, the solution satisfies the following condition:

$$\boldsymbol{\Sigma a_2} = \lambda_2\boldsymbol{a_2} + \frac{\mu}{2}\boldsymbol{a_1}.$$

Hence, the variance of $\boldsymbol{f_2}$ is given by:

$$\mathrm{var}(\boldsymbol{f_2}) = \boldsymbol{a_2'\Sigma a_2} = \boldsymbol{a_2'}\lambda_2\boldsymbol{a_2} + \frac{\mu}{2}\boldsymbol{a_2'a_1} = \lambda_2,$$

where the last equality follows from the fact that $\boldsymbol{a_2'a_1} = 0$. Thus, $\boldsymbol{a_2}$ is the eigenvector of $\boldsymbol{\Sigma}$ corresponding to its second-largest eigenvalue, λ_2. (Since distinct eigenvectors are always orthogonal to each other, condition $\boldsymbol{a_2'a_1} = 0$ will always be met.)

Proceeding analogously, the *n*th principal component is defined by the eigenvector associated with the *n*th largest eigenvalue of $\boldsymbol{\Sigma}$, λ_n, and by choosing $\boldsymbol{a_n'a_n} = 1$, its variance is λ_n.

In total, *N* principal components can be extracted from the data. Each additional principal component explains a smaller share of the variability in the data than the previous one. The total variance of all *N* principal components equals the variance of the original variables, i.e.

$$\sum_{n=1}^{N} \lambda_n = \mathrm{trace}(\boldsymbol{\Sigma}),$$

and the *n*th principal component accounts for a proportion

$$z_n = \frac{\lambda_n}{\mathrm{trace}(\boldsymbol{\Sigma})}$$

of the total variation in the original data.

The above description showed how to compute principal components based on the covariance matrix. When the *N* original variables have very different variances, which is the case in our setting since some business areas are much larger (and their P&L much more volatile) than others, it is preferable to perform the analysis using the correlation matrix rather than the covariance matrix. This is equivalent to normalizing all variables to have unit variance. In this case, the variance of the original variables is just *N*, and PCA provides information on the extent to which the original variables are correlated. In the extreme case where all variables are uncorrelated, all eigenvalues are equal to one, and the share of the total variance explained by the first *n* principal components is *n* / *N*. At the other extreme, if all variables are perfectly correlated, the first eigenvalue is equal to *N*, and the first principal component explains the entire variation in the data.

Real-world cases lie between these two extremes. The results for Axpo's business areas presented in Section 3.4 reveal a weak correlation between their P&Ls. For comparison, Figure C1 shows the results obtained when performing PCA on the return correlation matrix of the 20 current constituents of the Swiss Market Index over the same sample period (01.10.2010 – 31.12.2022). With a value approaching 10, the largest eigenvalue is dominant, and the first principal component explains almost half (= 10 / 20) of the variation in the returns of the 20 stocks. It essentially captures the average return of the stocks included in the index.

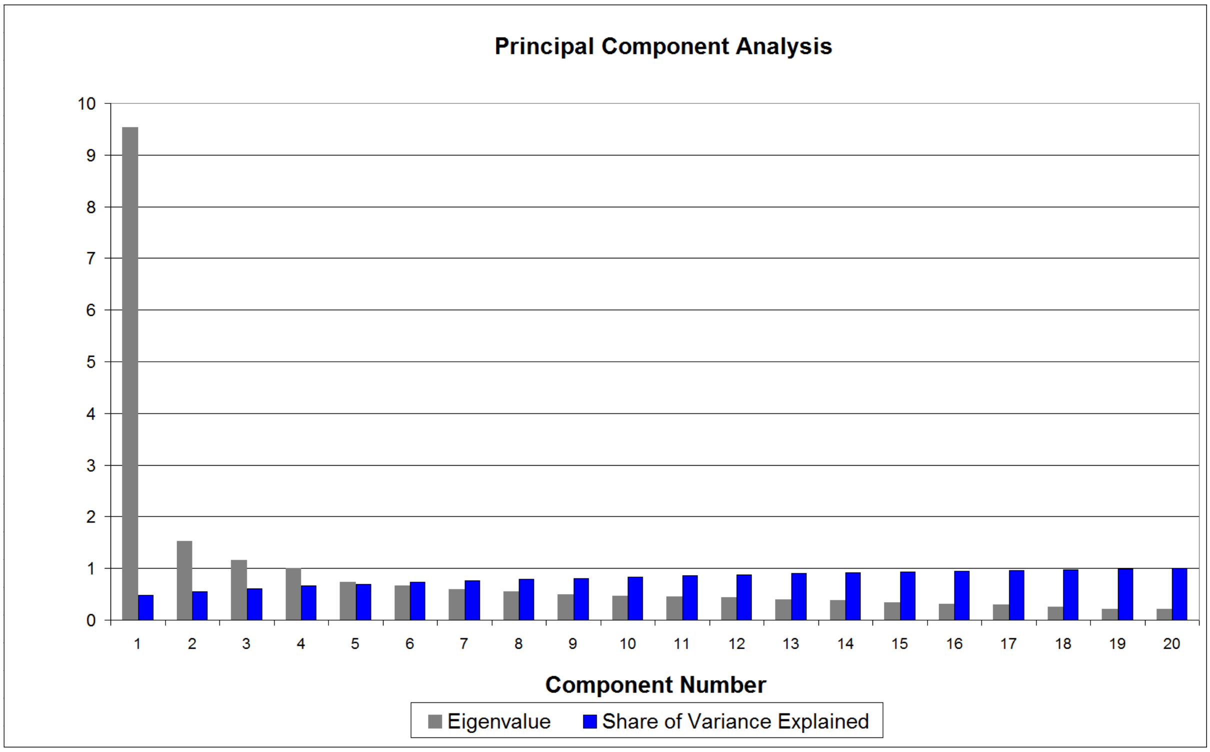


Figure C1: Principal component analysis of the returns of the SMI constituents for the period 01.10.2010-31.12.2022.

4 Accounting at Axpo

4.1 Introduction

In this chapter, we further analyse the opinions reflected in Frauendorfer and Gutsche (2018, 2020, 2021, 2022) (FG thereafter) with a focus on their criticism of Axpo Group from an accounting perspective. Our analysis contains three sections. First, we provide an overview of financial accounting and reporting at Axpo, including the reporting standard followed and the key accounting issues faced by the company. Second, we provide an evaluation of Axpo's accounting classification of trading activities, with a reconciliation of Axpo's own trading concept and financial reporting framework provided by IFRS 9. While both Axpo's trading concept and its accounting treatment are valid, the complexity and uniqueness may give rise to challenges in the company's financial disclosure and communication with outsiders. As we demonstrate in the analysis, a significant portion of FG's accusations against Axpo from accounting perspective is a result of misunderstanding or lack of accounting knowledge. Third, we provide some suggestions to Axpo 's reporting and disclosure practice, especially in the context of these common misunderstandings reflected in FG's papers. Accounting aims to provide a "true and fair" picture of a company's business model and performance, but the process is not easy or straightforward, especially for companies that face high public scrutiny and political cost. We comment on the current challenges faced by Axpo and give some suggestions in the disclosure strategy to improve the situation.

4.2 Overview of Axpo Accounting and Reporting

Accounting for energy companies is often challenging due to their complex and unique business models. Among other issues such as revenue recognition, asset impairment, and environmental liabilities (e.g., provision for decommissioning of nuclear plants), the accounting and reporting for financial instruments arising from energy trading can be especially difficult.

Reporting Standard

Axpo Group follows the International Financial Reporting Standards (IFRS thereafter) in preparing its consolidated financial statements. IFRS is a set of accounting standards developed by the IASB (International Accounting Standards Board) that provides a common framework for financial reporting across countries and industries. Currently, over 140 countries have either adopted IFRS or have converged their local accounting standards with IFRS, making it the most widely used accounting standards in the world.

The SCO (Swiss Code of Obligations) allows Swiss companies to choose from several reporting standards, such as IFRS, US GAAP (United States Generally Accepted Accounting Principles), and Swiss GAAP FER (Swiss Accounting and Reporting Recommendations). As a prominent energy company with complex business transactions, Axpo's choice of IFRS is appropriate and consistent with the industry norm, not only in Switzerland, but also internationally.[11] Table 18 presents a summary of financial reporting standards adopted by Swiss companies listed on the SIX stock exchange in 2019. Although Axpo is not a publicly

[11] For example, comparable companies such as Alpiq, BKW, E.On, and RWE, also follow IFRS in preparing their consolidated financial statements.

traded company, the expectation of its reporting quality and transparency is arguably as high as, if not higher, than some public companies due to its high visibility and public scrutiny.

Which GAAP?	Total companies	
IFRS Standards	133	56%
Swiss GAAP FER	78	33%
US GAAP	10	4%
Bank law	18	8%
Total	239	100%

Table 18: Financial reporting standards adopted by Swiss public companies traded on SIX Swiss Exchange. (Source: IFRS jurisdiction profile, Switzerland)

While FG have implied that IFRS provides too much discretion for the adopting companies[12], IFRS has by far stricter accounting requirements and higher reporting quality for complex financial transactions than any local GAAPs (Generally Accepted Accounting Principles) in Europe.[13] For example, Swiss GAAP FER has almost no guidance on the reporting of financial instruments or hedge accounting. Given the complexity of Axpo's trading business model, Swiss GAAP FER would not be sufficient in the guidance it provides for the company's financial accounting and reporting.

Key Accounting Issues

Due to a wide variety of regulatory requirements, energy companies have evolved into different business models. These models are often both unique and complex, dependent on the specific geographic and political environment the companies operate in. Accounting for energy companies is therefore often difficult and firm specific. The degree of government involvement and public scrutiny also impose additional challenge to the reporting and disclosure of energy companies' financial information.

KPMG, Axpo's auditor, has consistently identified three key audit issues in their reports to the investors. The first issue is the "valuation of property, plant and equipment (PPE), intangible assets, energy procurement contracts as well as investments in partner plants", especially involving the impairment of assets. The second issue is the "classification and valuation of energy derivatives", where the major challenges are the correct identification of energy derivative contracts for accounting purpose as well as the estimation of their replacement values. The third issue is the "completeness and accuracy of provisions for the decommissioning and nuclear waste disposal", where potential environment liabilities related to nuclear plants are identified. These are the three issues where the auditor pays special attention and conducts additional tests on, to ensure the reliability of the reported information. While these issues are equally important and challenging, we focus on the second issue in our analysis, due to the concentration of criticism raised by FG on Axpo trading. Before we move onto a detailed discussion on this issue, it is worthwhile to note the auditor's description of the

[12] For example, in "Das Accounting Puzzle der Schweizer Stromwirtschaft", they criticize that IFRS permitting the offsetting of financial assets and liabilities could be misleading.

[13] The only reporting standard that is considered as (arguably) more comprehensive is US GAAP, since it is more rules-based, meaning there are detailed guidelines that may be industry-specific. IFRS is more principles-based, meaning there are general principles to be followed, but the interpretation and application may differ depending on the specific circumstances.

audit matter and their response. As stated by the auditor, the classification and valuation of energy derivatives have important effects on the financial statements of the company and involve “considerable discretion”.[14]

Figure 18 provides an excerpt of the statutory auditor’s report by Axpo’s auditor KPMG highlighting the key audit matter of energy derivatives.

KPMG

Classification and valuation of energy derivatives

Key Audit Matter

Fair value of energy derivatives as at 30 September 2022 are disclosed in the line item “Derivative financial instruments” in non-current assets (CHF 17’013.2 million) and in current assets (CHF 22’672.7 million), as well as in the non-current liabilities (CHF 23’452.2 million) and current liabilities (CHF 24’819.9 million).

Fluctuations in the replacement values as well as the settlement of the relevant contracts affect the income statement, other comprehensive income and equity, depending on their classification as “own-use” contracts, as energy trading transactions or hedges. Moreover, the classification of derivative financial instruments influences the presentation and disclosure requirements of such contracts.

For subsequent valuation of the energy derivatives as at balance sheet date, models with observable input parameters are used. The definition of such input parameters and the use of suitable valuation models are subject to considerable discretion. Moreover, the assessment of an energy derivative’s purpose is decisive for its correct classification and is also subject to considerable discretion.

The valuation is based on the complete and correct recording of all contractual parameters. The recording of the contracts is subject to operational risk in the business workflows that stem from the organizational structure of Axpo Group and the numerous energy products traded.

Our response

We have performed the following audit procedures with regard to the reported energy derivatives, using both valuation specialists and data analysis techniques:

- Testing of controls implemented to ensure the complete and accurate recording of energy derivatives; we thereby focused on the segregation of duties and the reconciliation of internal contractual data with external confirmations as well as on the IT controls relevant to the business workflows for energy derivatives and interfaces between the IT solutions used in the information flow;
- We examined the calculation methods used in the models for consistency and appropriateness with the support from valuation specialists. Together with valuation specialists, we also reviewed whether appropriate energy price curves had been used;
- We also re-calculated the energy derivatives’ valuation for a substantial part of the portfolio using our own valuation methods and applying independently procured market data; the remaining derivatives were assessed on a sample basis to ensure they were correctly valued.

Figure 18: Excerpt from Axpo statutory auditor’s report (2022).

4.3 Axpo’s Trading Concept and Related Accounting Issue

Derivatives under IFRS

IFRS 9 was published by IASB in 2014 and became effective in 2018 to replace the previous standard, IAS 39, as the financial reporting standard for the recognition, measurement, presentation, and disclosure of financial instruments. The standard also sets the reporting guidance for hedge accounting. For derivative instruments in commodity trading, it is important to first determine whether the scope of IFRS 9 applies.

> “This Standard shall be applied to those contracts to buy or sell a non-financial item that can be settled net in cash or another financial instrument, or by exchanging financial instruments, as if the contracts were financial instruments, with the exception of contracts

[14] Energy derivatives being identified as a key audit matter is not only true for Axpo group, but also most of the other energy companies. For example, the Alpiq and BKW auditors also identify the classification and valuation of energy contracts as one of the key audit matters.

that were entered into and continue to be held for the purpose of the receipt or delivery of a non-financial item in accordance with the entity's expected purchase, sale or usage requirements. (IFRS 9.2.4)"

If a financial instrument is designated to be for the purpose of "own use", it should be treated as a normal executory contract and exempt from IFRS 9.[15] Since an own use contract is intended for normal purchase or sale, its fair value should not matter and therefore will not be shown on the balance sheet. Instead, the associated revenue and cost will be directly recorded on the income statement through profit/loss. On the contrary, if a financial instrument is determined to be within the scope of IFRS 9, it will be classified and reported at 1) amortized cost, 2) fair value through profit or loss (FVTPL), and 3) fair value through other comprehensive income (FVOCI). In the case of commodity trading, most of the derivative instruments within the IFRS 9 scope will be classified as "trading" and reported at fair value on the balance sheet.[16] Any change in its fair value will be recorded through profit or loss on the income statement.

IFRS 9 has detailed guidelines on how the classification can be determined, based on the business model for managing the asset and the contractual cash flow characteristics of the asset. Once established, the reporting classification cannot be switched unless there is a significant change in the business model.

IFRS 9 also includes new and enhanced hedge accounting guidance that aligns hedge accounting more closely with risk management practices. To qualify as a hedging instrument, a financial instrument must be specifically designated as a hedge at the time it is entered into, and must be effective in offsetting the risk that it is intended to hedge. The effectiveness of the hedge is determined by how closely the hedging instrument's price movements track the price movements of the asset being hedged. IFRS 9 has stringent requirements for testing and documentation for hedge accounting to apply. A financial instrument cannot be freely labelled or changed as hedging unless all requirements are met.

Axpo Trading Concept

Axpo's trading activities are classified by the nature of the business into three categories: asset-backed, merchant trading, and proprietary trading. According to Axpo Accounting Manual, "asset-backed business relates to the sale of own energy production. Energy is either generated in own power plants or comes from long-term energy procurement contracts." Merchant trading includes customer solutions (i.e., origination), "in which customers are offered tailored products", and retail business, which provides delivery to households and small and medium-sized customers. Prop trading is the kind of trading activities which "principal purpose is speculative".

One may intuitively think asset-backed trading activities should all be treated as "own use" in accounting, which is true with some companies in energy trading. However, Axpo's asset-backed trading is typically a three-step process involving first selling to Germany or France

[15] US GAAP has a very similar guidance. Derivative contracts that qualify for own use purpose are called "normal purchase normal sale (NPNS)" contracts and *could* be exempt from derivative accounting. However, under IFRS, "own use" contracts *must* be exempt from derivative accounting.
[16] In Axpo annual reports, all financial instruments classified as trading are reported in the line item "Derivative Financial Instruments" on the balance sheet at fair value, either as assets or liabilities. Previously, they were also called "Positive Replacement Values" and "Negative Replacement Values".

(which are considered in the same market as Switzerland for liquidity need) three years in advance, buying back when liquidity in Switzerland becomes available, and then finally selling to the Swiss customer. The three-step process was implemented due to the company's decision to hedge the production volume three years ahead and to manage the country spread at the same time. Since the second and third steps in the process often takes days or weeks to close, so that trading could take full advantage of market price changes, Axpo can only classify the first sale as own use and all subsequent transactions must be reported as trading under IFRS.

Therefore, asset-backed trading at Axpo do not automatically correspond to own use in financial reporting. Similarly, what is reported as "trading" in accounting does not correspond to prop trading. In fact, "trading" category includes all asset-backed business but first sale, origination, and prop trading in Axpo trading activities. Contrary to FG's conjecture, Axpo's prop trading is only a small portion of its "trading" in financial reporting.

Table 19 provides a summary of the accounting treatments of derivative instruments under IFRS 9 and how they reconcile with Axpo's trading concept. The last row shows clearly that that a big part of asset-backed trading and most of origination business at Axpo do not qualify as "own use" in accounting.

Key Question	Own use	Trading	Hedge Accounting
Is the derivative instrument within the scope of IFRS 9?	No	Yes	Yes
Included in "Derivative financial instrument" at fair value on balance sheet?	No	Yes	Yes
Fair value change recorded on income statement?	No. Revenue and cost directly recorded on income statement just like normal purchase or sale.	Yes. Fair value change recorded directly in income	No. Fair value change recorded in other comprehensive income (equity) on balance sheet
Which part is applicable from Axpo trading activities?	First sale in asset-backed trading (if using forwards); and retail business	Subsequent transactions in asset-backed trading; most of origination; and prop trading	First sale in asset-backed trading (if using futures)

Table 19: Accounting for derivative instruments and reconciliation with Axpo trading concept

4.4 Some of FG's misunderstanding of Axpo accounting for derivative instruments

Once we clarify the IFRS accounting treatments of derivative instruments and Axpo's own trading concept, it is not hard to see why FG (perhaps also some other readers of Axpo's financial information) misinterpreted the information from Axpo's annual reports. The general criticism by FG is that Axpo (and other Swiss utility companies) engage in too much speculative trading, which results in low profit and high risk. They claim that accounting is used to facilitate such behavior.

We list below several representative opinions that seem to be repeatedly raised by FK in their criticism of Axpo and other energy companies to illustrate the source of their misunderstanding.

Misunderstanding 1: Axpo reports high derivative financial instruments values, because it engages in too much prop trading.

FG repeatedly questioned the usefulness of balance sheet information reported by Axpo, Alpiq, and BKW, especially the line item of "Energy derivatives". In Frauendorfer and Gutsche (2018, 2022), they claimed that the reported values of energy derivatives cannot be replicated/explained through by the production volumes of the energy companies. They pointed out "Mit den obigen erwähnten Zusammenhängen stellt sich ein kritischer Leser unmittelbar die Frage nach der Aussagekraft der Bilanz eines Energieversorgers und insbesondere nach dem Risiko-Exposure, das die Unternehmen – versteckt – in sich tragen." They concluded through their analysis that these companies must be overly engaged in a prop trading, since otherwise there would not be such high replacement values of derivative financial instruments.

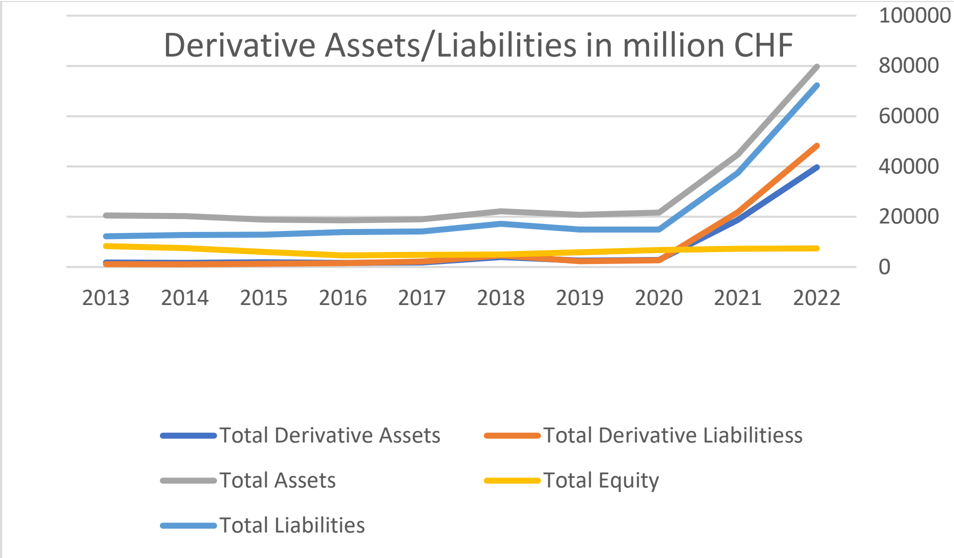
On Axpo's balance sheet, the amounts reported under "Derivative Financial Instruments" appear to be very high in relation to the amount of own energy production. However, recall that the financial position "derivative financial instruments" includes all but first sale in asset-backed business[17] and customer solution (origination) business in addition to prop trading. Therefore, the main two reasons that derivative assets and liabilities are high are 1) customer solution (origination) business, which volume is especially significant in Axpo; and 2) all but first sale of asset-backed business, which replacement value could become very high when the power market price rises. Prop trading is only a small portion of the business.

Misunderstanding 2: Axpo "Derivative Financial Instruments" values increased over the years, because it has been engaged in more and more prop trading.

Figure 19 presents the replacement values of Axpo derivative assets and liabilities during the past 10 years, both in CHF and as percentages of the company total assets/liabilities/equity. The amounts reported under "Derivative Financial Instruments" on Axpo balance sheet increased significantly in the last two years. Following the same logic of misunderstanding, one may naively think that Axpo is engaged in more and more prop trading. In Frauendorfer and Gutsche (2022), FG claimed "In our opinion, these increases cannot be explained by the rise in prices on the energy markets but are linked to the successive build-up of speculative proprietary trading positions during a fiscal year." However, the main reason behind the increase of derivative financial instruments on balance sheet is the significant increase of energy price as well as increased country spread between Germany and Switzerland, which results in higher replacement values for derivatives subsequent to the first sale.

In 2018, there was a price increase in the electric power market toward the end of the year, as can be seen in the slight bump in the amounts of derivative assets and liabilities. In 2021, the energy price increased significantly due to the war in Ukraine and related market uncertainties. As a result, the replacement values of both derivative assets and liabilities experienced an enormous increase.

[17] Before 2017, the trading concept at Axpo accounted the last sale of asset-backed business as own use and others as trading. Still, the same logic applies in that a big portion of asset-backed trading activities are reported under "trading".



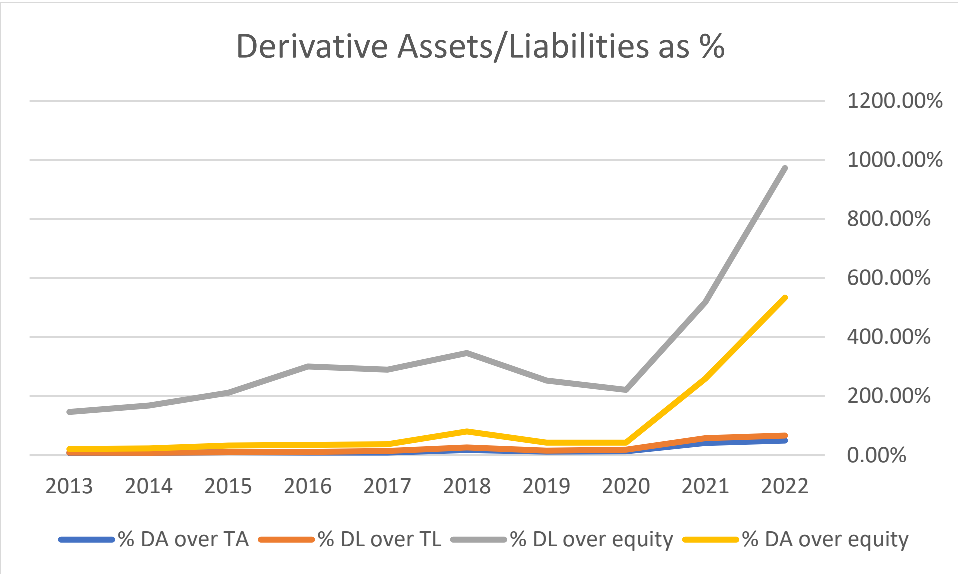


Figure 19: Derivative financial instruments in CHF and as % of total assets/liabilities/equity.

Misunderstanding 3: Axpo offsets the positive and negative replacement values (netting) to reduce the derivative assets and liabilities on the balance sheet.

In Frauendorfer and Gutsche (2018, 2022), FG also accused the energy companies including Axpo for offsetting the derivative assets and liabilities in order to report lower replacement values on the balance sheet. Specifically, they criticized that "Ferner erlauben die International Financial Reporting Standards (IFRS) unter bestimmten Voraussetzungen eine Verrechnung von Gegengeschäften und damit den Nettoausweis bestimmter Forderungen und Verbindlichkeiten in der Bilanz. Die Praxis zeigt, dass das Volumen der ausgewiesenen, verrechenbaren Geschäfte bis zu 100% des ausgewiesenen Eigenkapitals beträgt." In their opinion, the offsetting can be especially misleading when computing liquidity ratios against equity since the ratios would appear to be better.

IFRS 9 has strict requirement on how netting can be implemented. Axpo follows IFRS netting rules and applies them conservatively (e.g. only allowed on individual contracts, cross-country netting are very rarely allowed.).[18] Further, the gross amounts (before netting) are also disclosed in the notes of Axpo financial statements.[19] Since FG criticized the distortion in financial ratios computed when using netted amounts, it is worthwhile to point out that any financial statement readers would be able to construct the financial ratios based on their own choice of information with or without netting.

Misunderstanding 4: Axpo is hedging less than adequate, because they focus more on prop trading.

FG criticized that Axpo is hedging less than necessary, as total hedging reported has been decreasing in recent years. In Frauendorfer and Gutsche (2022), FG claimed that "[i]n the last two fiscal years, electricity trading shows very low hedging volumes in hedge accounting, with 10 TWh and 6.3 TWh respectively, well below the corridor set by the Board of Directors." "We thus recognize that the voluntary application of hedge accounting under IFRS allows electricity trading additional room for maneuver. This additional room for maneuver allows speculative elements in the decision of when and how much to open sales positions in the Trading Book and is thus completely opposite to a uniform hedge that rolls over the years in advance."

Again, they suspected that this is because Axpo is moving away from optimization of own production and engaging more in prop trading. However, the real reason that reported hedging amounts decreased since Axpo implemented the new trading concept in 2017 is that hedging using forward contracts is now reported as own use. Therefore, these hedging activities are treated as executory contracts on the income statement and no longer appear on the balance sheet. Additionally, in the financial year 2018/19 the first sales of self-produced energy by means of physically settled futures contracts have also been classified as own use contracts. These futures contracts were previously accounted for as cash flow hedges. Since September 30, 2019, the margin call of these futures contracts has been recorded as other receivables/other liabilities instead of through equity, as required by cash flow hedge. Therefore, the decreasing hedging amounts only reflect the remaining portion of the future contracts with the exchange.

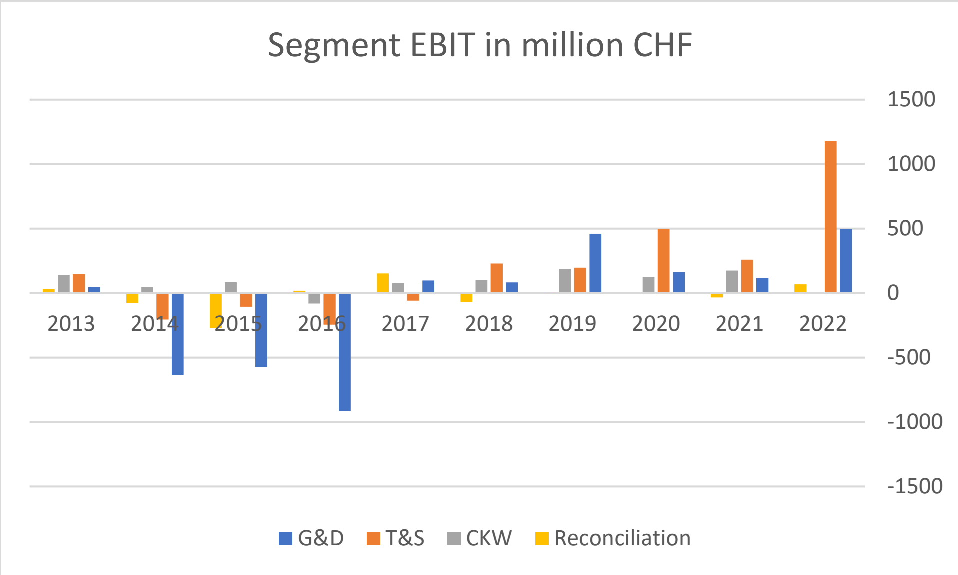
Misunderstanding 5: Axpo can switch between trading and own use books with discretion.

Throughout their papers, FG seemed to imply that trading and own use contracts are not clearly separated in energy trading. They repeatedly referred to possible poor internal control as a source of problem at Axpo and other energy companies. However, in reality, switching between the own use and the trading books is almost impossible. Once a financial instrument is designated as trading, it cannot be transferred to own use. According to Axpo Accounting Manual, "the same strict directives apply to the treatment of inter-company transactions as for internal transactions between different ledgers of an entity. From the point of view of the Axpo Group, this means that transactions between derivative financial instruments classified as trading (and measured at fair value on the balance sheet-date) and transactions classified as own use are basically not permitted." Further, this is also an issue on which the auditor would conduct audits and hence provide their own assurance.

[18] See Axpo Accounting Manual Chapter 4.5.6 Netting of Balance Sheet Items for more details.
[19] Typically reported in details in the footnote on "Derivative Financial Instruments" to the consolidated financial statements in the company annual reports.

Misunderstanding 6: Axpo shifts profits to the segment of trading (T&S) from other segments such as production and distribution (G&D).

Another accusation that FG often made against energy companies is that they subsidize their trading business (especially prop trading) by undercutting their production business and other segments. Specifically, they pointed out that the reported segment EBITs should be adjusted to expose the loss made by the trading business (Frauendorfer and Gustche, 2021).[20]



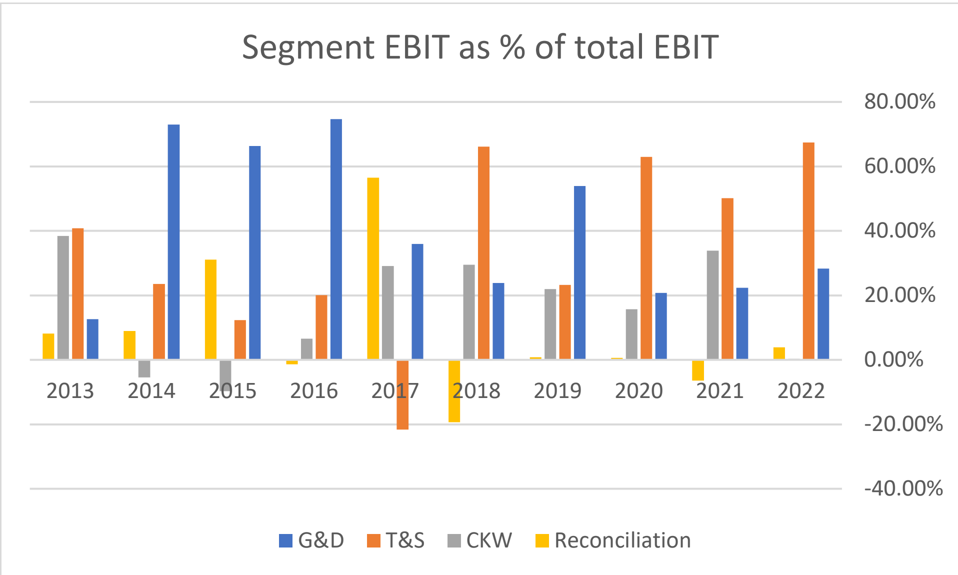


Figure 20: Axpo segment EBITs in CHF and as percentages of total EBIT

Segment reporting under IFRS is guided by IFRS 8 with a "management approach", which requires consistency between internal management decision and external reporting. That is, the segment information should be presented "to enable users of financial statements to see an entity's operations through the eyes of management" (IFRS 8 project summary). In Axpo, the three reporting business segments that met the reportable threshold are Generation and Distribution, Sales and Trading, and CKW. All unallocated business such as corporate

[20] See Chapter 2 of the report for more discussion on this issue.

overhead and services as well as eliminated inter-company transactions during consolidation are allocated to "Reconciliation". FG claimed that "Reconciliation" often showed a negative EBIT, which was not properly explained by Axpo, implying the company uses it to hide poor performance of other segments. However, it is quite natural that reconciliation shows a negative number since it primarily contains elimination of inter-company transactions that would have otherwise been double counted in the consolidation process.

Suggestions on disclosure strategy and potential improvement in accounting

While accounting intends to best reflect a company's business model and performance in a "true and fair" manner to outsiders, the reported financial information does not always meet the goal. In Axpo's case, the reporting of energy derivative contracts may lead to the impression that the company is trading speculatively more than they actually do. This misalignment between the preparers (the company) and the readers (investors and general public) of financial information is typically due to the high level of accounting complexity and inadequate disclosure. In the following, we provide several suggestions on the disclosure strategies and potential improvements in accounting that may help resolve some of the issues faced by Axpo.

4.5 Better Reconciliation of Trading Business Model and Accounting for Derivatives

As stated by KPMG, Axpo's statutory auditor, the classification and valuation of energy derivatives have significant impact on the company's financial statements and subject to considerable discretion. While IFRS offers more guidance than other feasible reporting standards in the accounting and reporting of financial instruments, the principle it provides must be interpreted for the unique and complex trading model at Axpo. The implementation is far from straightforward, even when compared to other companies in the same industry. Therefore, one important question to ask is whether the current trading concept in accounting presents a fair picture of the company's performance.

At the same time, it is also worthwhile to reconsider the business model and its implications in financial reporting and public perception. Certain legal and regulatory requirements can impose a very high cost on the company, and the same is true with reporting requirement. Sometimes a clearly set limit could relieve the company of many potential complications and misunderstandings. For Axpo, one solution would be to structure its asset-backed trading and customer solutions business so that they can be accounted as "own use". This arrangement would clearly separate normal optimization and hedging activities from proprietary trading, significantly strengthen internal control, and resolve the reporting dilemma from the very root. Nevertheless, this would introduce a major discrepancy between accounting and internal performance view. Axpo considers the view of its origination business based on mark-to-market treatment as a distinct competitive advantage and would internally never abandon this. It forces the economically correct valuation and optimal hedging of complex contracts in available markets.

4.6 Better Disclosure

Better disclosure is the key to many accounting-related problems. Due to the highly complex nature of accounting, disclosure serves to not only inform but also to educate investors and the public about the company. Effective disclosure could preempt mistrust, speculation, and other unfavourable perceptions from arising in the first place. A public image of transparency and reliability could benefit a company greatly in building investor and public confidence.

One example of the usefulness of disclosure is Axpo's recent disclosure of gross margins associated with different types of trading: asset-backed, origination, and prop trading. Since such information was added in the company's annual report in 2021, FG's recent analysis of Axpo directly cites the disclosed information instead of conjecturing the numbers himself. Although it doesn't appear that they have given up their criticism of the company's trading strategy, there is now much less space for conjectures and speculation.

Below we provide several suggestions on potential improvements in Axpo's disclosure about energy derivatives.

- Provide better explanation of the trading business. Emphasize the activities of T&S segment in asset-backed and customer solutions business, to eliminate the possible misunderstanding that they focus on prop trading. Draft a better description of the segment activity in the footnote 2.1 Segment information to the financial statements in the annual report. A special report on trading business model at Axpo could also be helpful, such as the E.On investor presentation on E.On trading.
- Provide better explanation on Axpo trading concept and IFRS 9 accounting for derivatives. At the current state, Axpo financial statements offer very little information about how asset-backed trading is reported. Including a paragraph in the footnote 4.5 Risk management to the financial statements to explain the line item "derivative financial instruments" include asset-backed business could be of help to reduce the confusion. For example, BKW provides more information on their asset-backed vs. prop trading business.[21] Another example is the Alpiq annual report footnote to their line item "energy derivative" that often includes the following explanation: "Of which, a net amount of CHF xx million (previous year: CHF xx million) stems from own use contracts designated at fair value on initial recognition." Alpiq must provide such details in the footnote, which helps clarify the difference in the nature of contracts even though they are all reported at fair value. Similar explanation could be helpful for Axpo too.
- Provide more explanation on origination business. One common approach that FG often used when trying to guess the proper amount of hedging is through the companies' own production volume. They often assumed that the companies have no other trading activities but the power they generated or (outsourced through long-term contracts) themselves. Clarifying the importance of origination business could help resolve this puzzle for outsiders.
- Prepare a list of common Q&A to address issues that could cause such misunderstandings. The purpose of such Q&A is to educate investors and the public as well as preempting potential mistrust and speculations.
- Set up a special task force team with representatives from trading, accounting, and investor/public relations. Set a clear strategy in the disclosure and communication with the public and actively manage problems that may endanger the public image of the company.

Of course, disclosure is not without cost. Disclosing proprietary information could especially endanger a company's competitive advantage among peers. Therefore, companies must trade

[21] Of course, this is also due to the reason that BKW has a very different trading business model.

off the costs and benefits of disclosure. In Axpo's case, disclosing detailed amounts in TWh of own production and customer solutions in trading may cause such concerns.

4.7 Public Scrutiny is Unavoidable

Energy companies have always faced high level of public scrutiny in almost every country. Due to the high level of regulatory requirement and government involvement, energy companies that are not publicly traded often behave as if they are. Energy companies typically voluntarily adopt high accounting and reporting standards and maintain regular publications of financial information as well as other channels of communications with the public. Further, research in accounting on "political cost hypothesis" shows that firms facing high political cost tend to exhibit more conservative behavior in accounting choices to avoid public criticism.

Axpo is a highly visible company in Switzerland. Given the sensitive nature of power industry, it is not surprising that Axpo as well as other big energy companies in the country are constantly being scrutinized by the public. The recent request for liquidity support from the government has especially ignited the debate about company's trading business. While FG could be an extreme case, their opinion could to some degree represent that held by the public. Therefore, when setting the company's accounting policy and disclosure strategy, public scrutiny should always be expected and taken into consideration.

As we have discussed earlier, many of FG's accusations against Axpo are the results of misunderstanding or lack of knowledge in accounting. They argue that Axpo uses accounting discretions to help hide a loss-making prop trading business. However, they do not have access to internal company information and thus interpret the company's financial reports freely to support their argument. In our opinion, many of these misunderstanding could be eliminated through better disclosure and investor/public communication if done properly and proactively by the company.

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