

AutoCommodity Data Collection & Analysis

Analyzing the Relationship Between Used Car & Commodity Prices

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1 Project Overview

1.1 The Storyline (Potential Business Problem)

The Swiss used car market is highly competitive. Our **fictional client** AutoHelvetia AG, a leading national **used car dealer**, faces the challenge of optimizing their pricing & purchasing strategy. In recent years, commodity prices are volatile and affects pricing of cars. So AutoHelvetia AG delegated the task to us: to understand the relationship between used car prices and commodity prices.

1.2 Our Solution

This project delivers an **advanced data collection** and **analysis** framework. Our goal is to collect valuable **market data** and uncover relationships between used car prices and key commodity markets. We develop a tool box using **web scraping of AutoScout24.ch** and integrating with **Yahoo Finance commodity data**, to provide AutoHelvetia AG data-driven insights for:

- Optimize Pricing Strategies
- Gain Competitive Advantage

1.3 Project Structure

```
project_scraping_CIP_analysis_car_commodity_price/
    Analysis/                      # Analysis notebooks and scripts
        RQ1/                         # Research Question 1 script & analysis
        RQ2/                         # Research Question 2 script & analysis
        RQ3/                         # Research Question 3 script & analysis
    Data/                          # Data storage
        API_data_pull/               # API-fetched commodity data & script
        clean_data/                  # Processed and cleaned datasets & script
        Scraping/                   # Web scraped data and scripts & scraper script
    Documentation.md              # This documentation file
    README.md                     # Project overview
    AI_Disclosure.md             # Gen AI usage disclosure and guidelines
    requirements.txt              # Project dependencies
    .gitignore
```

1.4 Initial Findings

2 Feasibility Research

2.1 Ethical Feasibility of Web Scraping AutoScout24.ch

This web scraping project was evaluated for both technical and legal feasibility. We focused on the academic research context and our analysis of AutoScout24.ch's robots.txt file and terms of service indicates that the project operates within acceptable boundaries for academic research purposes.

- **robots.txt Analysis:** - Allowed: General listing pages without filters - Restricted: User account pages (/de/account/, /de/member/)
- Restricted: Filtered search results with specific URL parameters (e.g., sort=, pricefrom=) - Restricted: Administrative functions

2.1.1 Technical Feasibility

- **Data Extraction:** Ethically extracts vehicle specifications, pricing, and listing details with Scraper and Yahoo Finance API, involving selenium and beautifulsoup.
- **Data Availability:** We found consistent and abundant data, which is appropriate for analysis for both used car listings and Commodity Data

2.1.2 Analytical Feasibility

- **Statistical Methods:** Appropriate statistical methods can be applied for analysis, including correlation analysis, regression analysis, and time series analysis, etc.
- **Potential Conclusions:** The project can provide potential valuable insights into the relationship between used car prices and commodity prices, helping stakeholders make informed decisions

3 Data Sources & Collection

3.1 Web Scraping Implementation

3.1.1 Target Website

- **Primary Source:** AutoScout24.ch (<https://www.autoscout24.ch>)
- **Target Path:** /de/autos/alle-marken (All car listings)
- **Scope:** Used car listings across all makes and models available on the platform

3.1.2 Technical Implementation

3.1.2.1 Core Toolkits

- **Selenium WebDriver:** For browser automation and dynamic content loading
- **BeautifulSoup4:** For HTML parsing and data extraction
- **Custom Parser:** Combines multiple extraction methods(json, html, css, regex) for robustness

3.1.2.2 Scraping Methodology

1. **Pagination Handling:**
 - Iterates through listing pages systematically and click on next page
 - Implements smart navigation with randomized delays (5-15s between pages)
2. **Data Extraction Strategy:**
 - **Primary Method:** Structure-aware parsing using SVG icon titles and sibling elements
 - **Combination of Methods:**
 - JSON structured data extraction
 - CSS class-based element targeting
 - Regular expression fallbacks for critical fields

3.1.3 Data Points Collected

Data Field	Description	Example
car_model	Full vehicle make and model	“Volkswagen Golf 2.0 TDI”
price_chf	Listing price in CHF	25,900
mileage	Vehicle mileage in km	85,200
engine_power_hp	Engine power in HP	150
power_mode	Fuel/power type	Diesel, Petrol, Electric, Hybrid
transmission	Transmission type	Automat, Manuell, Halbautomatik
production_date	Production date	2018
listing_url	Direct URL to the listing	[Link]

3.2 Yahoo Finance API Integration

[Document the API integration, including: - APIs used (Yahoo Finance, etc.) - Authentication process - Data retrieval methods - Rate limits and handling]

4 Data Transformation and Cleaning

Across the project we apply a standard data-science cleaning cadence: validate dataframe, coerce types, handle missing values with data quality strategies, and normalize key features before exporting analysis-ready datasets.

4.0.1 1. Autoscout Listing Standardization

Script: Data/clean_data/Autoscout_Cleaner_Standardizer.py - **Brand & Model Extraction:** Uses regex-based patterns to parse the car_model field into brand and base model tokens, removing unwanted information (e.g., VW TIGUAN TSI 2.0 S VERSION BERN TOP ZUSTAND vs VW TIGUAN TSI 2.0 S). - **Model Normalization:** Applies a replacement dictionary to outlier variants (e.g., “TESLA Model Y” → “Model Y”). Keeping consistent models during analysis. - **Field Selection & Export:** Outputs a curated schema (brand, model, car_model, pricing, powertrain, and URL fields) to Autoscout_Cleaned_Standardized.csv, preserving only analytics-ready columns.

4.0.2 2. Commodity Price Cleaning

Script: Data/clean_data/load_data_cleaning.py - **Type Coercion:** Converts Date to datetime and commodity columns to numeric by replacing European decimal separators. - **Missing Value Strategy:** - Reports gaps before/after processing for clarity. - Fills missing commodity prices with a 7-day rolling mean, then rounds to two decimals. - **Temporal Date Standardization:** Generates a formatted Date string (%d-%m-%Y) for later joins and saves the cleaned series as Data/Final Data/yahoo_spot_cleaned.csv.

4.0.3 3. Scraper Output Post-processing

Script: Data/Scraping/Scraper.py - **Schema Consistency:** The scraper normalizes fuel types, transmission labels, and numeric fields (“N/A” fallbacks) to reduce later data cleaning steps. - **Hybrid Extraction:** Combines JSON-LD fields with HTML parsing, ensuring critical attributes (price_chf, mileage, production_date, listing_url, etc.) are captured.

4.0.4 4. Research Dataset Post-Processing

Script: Analysis/RQ3/RQ3_Analysis.py - **Autoscout Cleaning & Missing Value Imputation:** - Converts production_date strings (including “Neues Fahrzeug”) to October 2025 and makes a Month period column. - Imputes continuous fields (price_chf, mileage, engine_power_hp) with rounded means. - Customized fill for consumption_1_per_100km (EV=0, then model mean, brand mean, global mean). - Categorical fills (power_mode, transmission) based on model majority vote, defaulting to “Unknown”. - **Commodity Cleaning & Missing Value Imputation:** - Builds monthly periods, fills gaps from daily Date entries, and aggregates to one row per month. - Keeps _Monthly_Avg features and drops duplicates for consistent joins. - **Merge Output:** Produces Final_Merged_Data_RQ3.csv, the master clean dataset

5 Analysis & Visualization

5.1 Research Questions

In our feasibility study we set out three potential questions for the client:

1. **RQ1 — Commodity Index vs. Used Car Prices:** How do used car prices in Switzerland correlate with historical commodity price indices for key automotive materials (steel, aluminum, copper,

crude oil)? We can construct a weighted composite commodity index and examine Pearson/Spearman correlations with median used car prices while controlling for vehicle age and mileage.

2. **RQ2 — Powertrain Sensitivity:** Do different vehicle power modes (petrol, diesel, electric, hybrid) exhibit distinct sensitivity to commodity price movements? We expect electric vehicles to react more to battery metals, while ICE vehicles respond to energy and structural metals.
3. **RQ3 — Brand-Level Differences:** How does the relationship between commodity prices and used car values vary across popular Swiss car brands? We segment by brand to detect whether luxury vs. volume manufacturers show different exposure to raw material cost pressures.

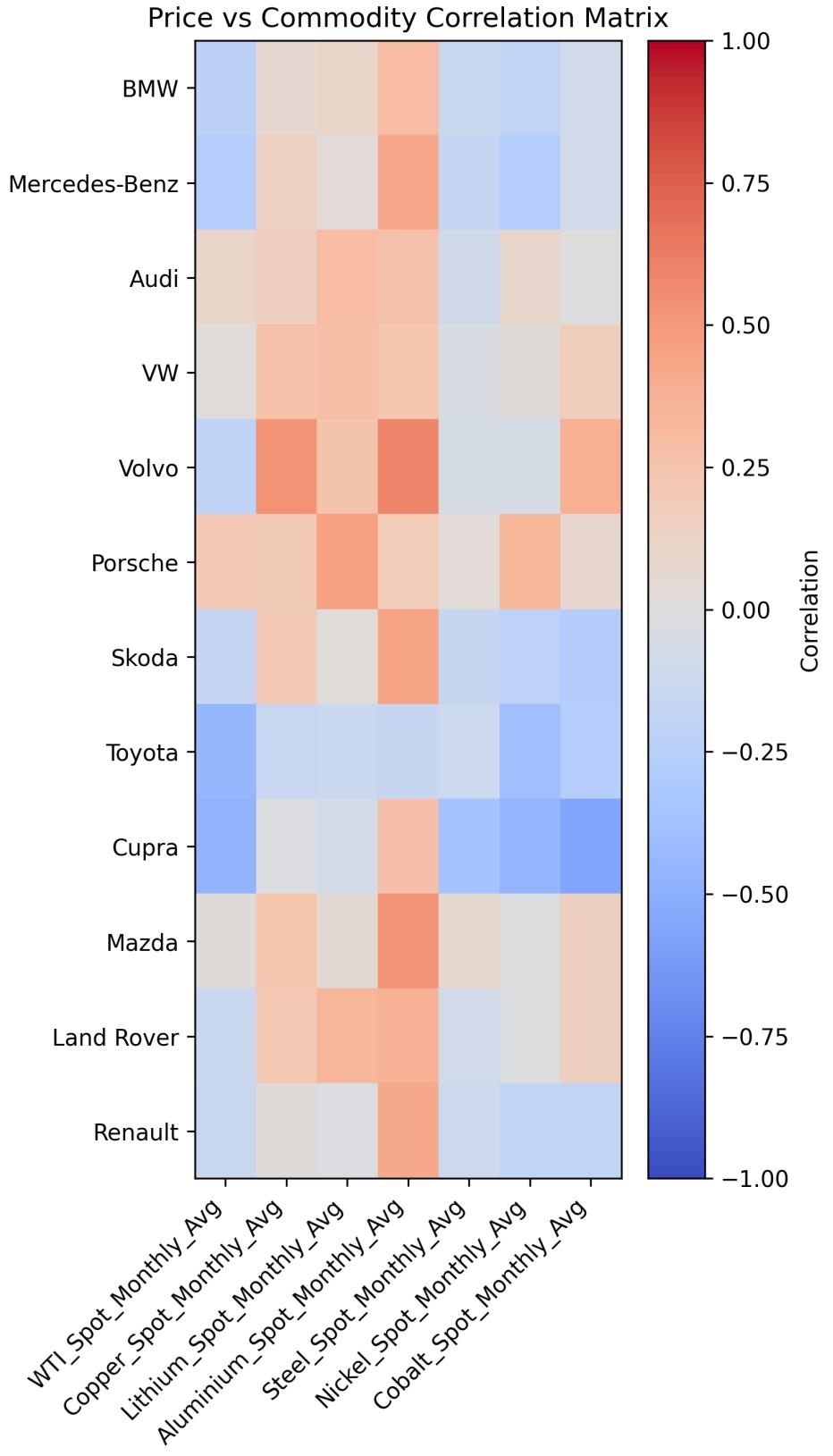
6 Results and Findings

6.1 RQ1 — Commodity Index vs. Used Car Prices

6.2 RQ2 — Powertrain Sensitivity

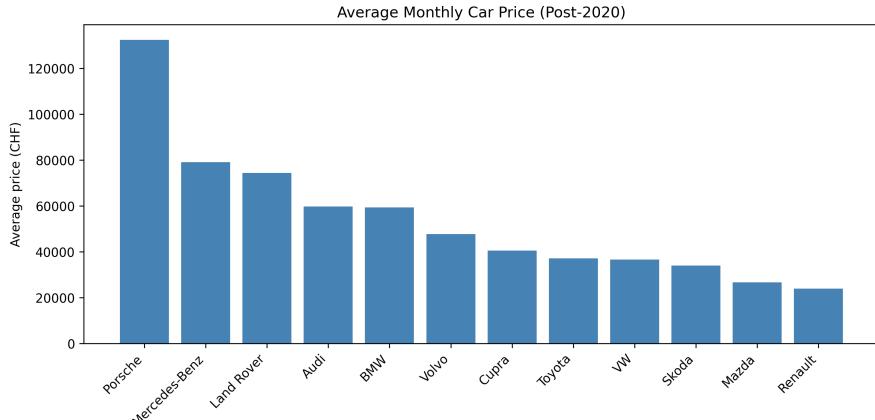
6.3 RQ3 — Brand-Level Differences

1. **Volvo & Porsche Track Battery Metals** — Volvo prices co-move with Copper (~0.52) and Cobalt (~0.38), while Porsche aligns with Nickel (~0.34), underscoring the exposure of electrified and luxury

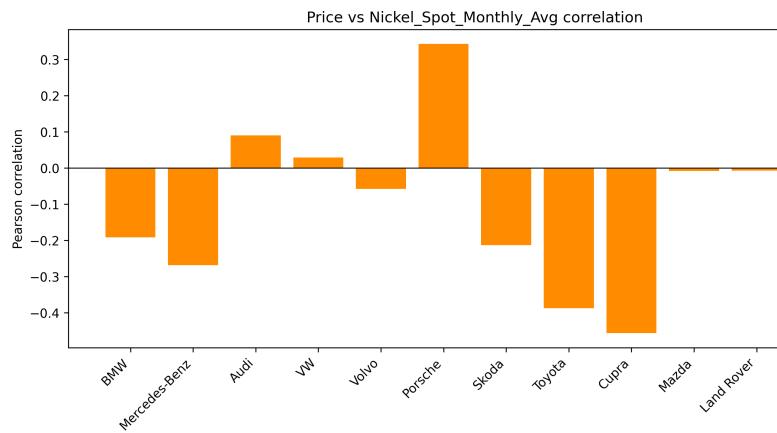


lineups to battery-heavy alloys.

2. **European Mass-Market Brands Show Mild Sensitivity** — VW, Audi, and Skoda maintain small positive links to copper and steel, suggesting moderate effect of industrial metal costs.



3. **Asian Brands Move Differently** — Toyota and potentially other Asian brands exhibit negative correlations with multiple commodities (WTI -0.45, Nickel -0.39), hinting at alternative supply strategies



or value positioning that buffer raw material shocks.

Overall, brand equity and product mix modulate how commodity swings influence Swiss used car prices.

[Present key findings, including:] 1. [Research Question 1] 2. [Research Question 2] 3. [Research Question 3] - Summary statistics - Visualizations - Key insights - Limitations

7 Conclusion and Limitations

7.1 Conclusion

7.2 Recommendations for our Client

7.3 Limitations

[Provide conclusions and potential future improvements]