Exploratory Data Analysis: CPI PPI Forecast Inflation

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Curvenote

0.1 Introduction

In this notebook, we will explore inflation patterns in the Historical Consumer Price Index (CPI) and Historical Producer Price Index (PPI) forecast series.

Both datasets contain annual percent-change forecasts from 1974–2024 for multiple food-related categories.

Specifically, we will examine:

- Inflation trends over time via line plots
- Cross-category comparisons using bar charts
- The top 5 fastest-inflating categories
- The most volatile categories, measured by standard deviation

These results will later be summarized in the main narrative notebook.

0.2 Imports and Load Data

```
import os
import pandas as pd
import matplotlib.pyplot as plt
import sys
sys.path.append('..')  # Just add the parent directory for utils
from utils.data_loader import load_inflation_data
from utils.transformers import reshape_to_long_format

plt.rcParams["figure.figsize"] = (14, 6)
plt.rcParams["axes.grid"] = True

# Load processed data
```

```
cpi, ppi = load_inflation_data()

display(cpi.head())
display(ppi.head())
```

	Year	All_food	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	1974	14.3	2.9	29.9	18.6	0.4	41.9	15.3	14.9	12.7	...	16.5	1.8	2.2	19.3	21.4	3.1	-0.5	-5.1	NaN	52.4
1	1975	8.5	1.0	11.3	3.1	-1.8	10.7	8.5	8.2	9.4	...	3.1	8.5	8.5	15.0	12.8	5.9	22.4	10.5	NaN	26.1
2	1976	3.0	-3.2	-2.2	8.1	9.2	-12.5	11.7	2.1	6.8	...	2.6	0.2	0.9	19.6	4.1	5.9	1.3	-4.1	NaN	-11.3
3	1977	6.3	-0.7	1.6	2.7	-3.2	10.1	10.8	5.9	7.6	...	9.2	-2.3	-0.6	50.6	3.4	-0.6	-5.4	0.7	NaN	5.0
4	1978	9.9	22.9	9.0	6.8	-5.4	9.6	9.4	10.5	9.1	...	11.1	18.6	16.7	5.8	8.0	17.7	12.9	10.4	NaN	12.3

5 rows × 23 columns

	Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	1974	-10.2	-3.0	6.3	19.3	-4.7	17.4	33.3	14.0	18.9	5.2	-3.1	11.6	59.4	1.1	-11.3	29.4
1	1975	-1.7	-0.6	9.5	4.2	-18.4	-8.7	-19.7	8.4	-2.4	1.3	11.1	6.5	-13.1	32.4	17.0	-13.5
2	1976	-7.1	12.1	1.2	11.6	6.0	-7.7	-13.3	-0.3	-5.1	-0.8	-11.4	8.1	-20.9	-6.2	-9.7	-9.5
3	1977	2.3	-9.6	11.1	0.8	18.8	3.7	-22.5	5.3	2.8	0.9	0.9	3.0	16.5	-5.6	4.3	-19.6
4	1978	32.4	-2.1	20.3	8.4	-5.8	7.0	24.3	9.0	6.5	12.6	28.3	8.6	8.5	15.3	12.0	19.1

0.2.1 Tidy Long Formatting

```
cpi_long = reshape_to_long_format(cpi)
cpi_long.head()
```

	Year	category	pct_change
0	1974	All_food	14.3
1	1975	All_food	8.5
2	1976	All_food	3.0
3	1977	All_food	6.3
4	1978	All_food	9.9

```
ppi_long = reshape_to_long_format(ppi)
ppi_long.head()
```

	Year	category	pct_change
0	1974	Farm_level_cattle	-10.2
1	1975	Farm_level_cattle	-1.7
2	1976	Farm_level_cattle	-7.1
3	1977	Farm_level_cattle	2.3
4	1978	Farm_level_cattle	32.4

0.3 Line plots of inflation over time

Line plots can show how forecast inflation changes year-to-year for each category.

By plotting all categories in each dataset, we will be able to visually inspect:

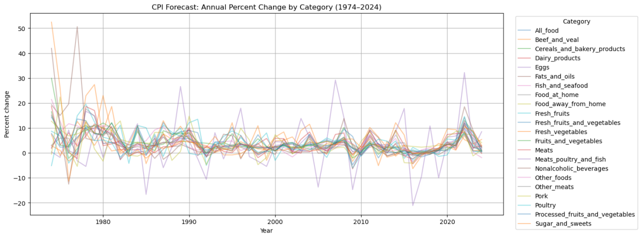
- Long-run trends in food price forecasts
- Periods of high inflation (e.g., 1970s, post-2020)
- How different categories move together or diverge

We first start with CPI, then repeat for PPI.

0.3.1 CPI Line Plot:

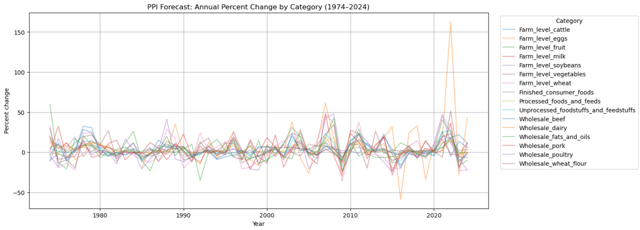
```
fig, ax = plt.subplots()

for cat, df_cat in cpi_long.groupby("category"):
    ax.plot(
        df_cat["Year"],
        df_cat["pct_change"],
        alpha=0.4,
        label=cat
    )

ax.set_title("CPI Forecast: Annual Percent Change by Category (1974-
2024)")
ax.set_xlabel("Year")
ax.set_ylabel("Percent change")

ax.legend(
    title="Category",
    bbox_to_anchor=(1.02, 1),
    loc="upper left"
)
```

```
plt.savefig('../figures/cpi_annual_change_by_category.png')
plt.show()
```



0.3.2 PPI Line Plot:

```
fig, ax = plt.subplots()

for cat, df_cat in ppi_long.groupby("category"):
    ax.plot(
        df_cat["Year"],
        df_cat["pct_change"],
        alpha=0.4,
        label=cat
    )

ax.set_title("PPI Forecast: Annual Percent Change by Category (1974-
2024)")
ax.set_xlabel("Year")
ax.set_ylabel("Percent change")

ax.legend(
    title="Category",
    bbox_to_anchor=(1.02, 1),
    loc="upper left"
)
plt.savefig('../figures/ppi_annual_change_by_category.png')
plt.show()
```



0.4 Bar charts comparing categories

To compare categories more directly, we will now collapse the time dimension and compute the average annual percent change for each category.

This will give us a single summary number for each category, which we visualize with bar charts. Higher means indicate categories that, on average, are forecasted to inflate more quickly.

0.4.1 1. Compute mean inflation per category

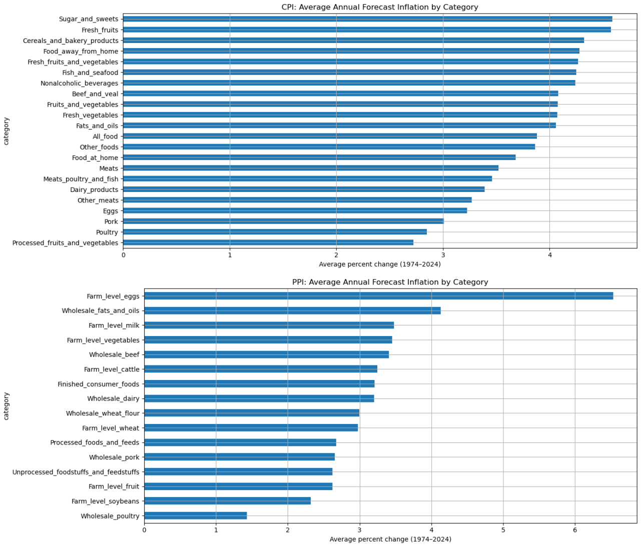
```
cpi_mean = (
    cpi_long
    .groupby("category")["pct_change"]
    .mean()
    .sort_values(ascending=False)
)

display(cpi_mean)

ppi_mean = (
    ppi_long
    .groupby("category")["pct_change"]
    .mean()
    .sort_values(ascending=False)
)

display(ppi_mean)
```

```
category
Sugar_and_sweets                   4.588235
Fresh_fruits                       4.576471
Cereals_and_bakery_products        4.321569
Food_away_from_home                4.278431
Fresh_fruits_and_vegetables        4.268627
Fish_and_seafood                   4.250980
Nonalcoholic_beverages             4.239216
Beef_and_veal                      4.078431
Fruits_and_vegetables              4.076471
Fresh_vegetables                   4.072549
Fats_and_oils                      4.060784
All_food                           3.882353
Other_foods                        3.864706
Food_at_home                       3.682353
Meats                              3.519608
Meats_poultry_and_fish             3.458824
Dairy_products                     3.390196
Other_meats                        3.270588
```

```
Eggs                               3.225490
Pork                               3.009804
Poultry                            2.849020
Processed_fruits_and_vegetables    2.723077
Name: pct_change, dtype: float64

category
Farm_level_eggs                          6.534694
Wholesale_fats_and_oils                  4.131373
Farm_level_milk                          3.476471
Farm_level_vegetables                    3.450980
Wholesale_beef                           3.409804
Farm_level_cattle                        3.247059
Finished_consumer_foods                  3.207843
Wholesale_dairy                          3.200000
Wholesale_wheat_flour                    2.996078
Farm_level_wheat                         2.978431
Processed_foods_and_feeds                2.672549
Wholesale_pork                           2.654902
Unprocessed_foodstuffs_and_feedstuffs    2.623529
Farm_level_fruit                         2.621569
Farm_level_soybeans                      2.317647
Wholesale_poultry                        1.429412
Name: pct_change, dtype: float64
```

0.4.2 2. Bar charts of all categories

```
# CPI:
cpi_mean.plot(kind="barh")
plt.gca().invert_yaxis() # top to bottom
plt.title("CPI: Average Annual Forecast Inflation by Category")
plt.xlabel("Average percent change (1974-2024)")
plt.tight_layout()
plt.savefig('../figures/cpi_avg_annual_change_by_category.png')
plt.show()

# PPI:
ppi_mean.plot(kind="barh")
plt.gca().invert_yaxis() # top to bottom
plt.title("PPI: Average Annual Forecast Inflation by Category")
plt.xlabel("Average percent change (1974-2024)")
plt.tight_layout()
plt.savefig('../figures/ppi_avg_annual_change_by_category.png')
plt.show()
```



0.5 Top 5 fastest-inflating categories

Next, we explicitly rank categories by their average annual forecast inflation and highlight the top 5 for each dataset.

These categories represent the food items with the most persistent upward price pressure in the forecast data.

0.5.1 Extract top 5

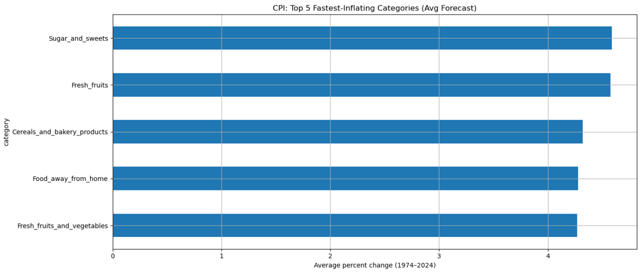
```
cpi_top5 = cpi_mean.head(5)
ppi_top5 = ppi_mean.head(5)

display(cpi_top5)
display(ppi_top5)
```

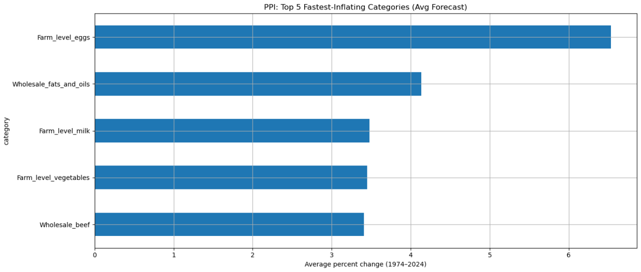
```
category
Sugar_and_sweets               4.588235
Fresh_fruits                   4.576471
Cereals_and_bakery_products    4.321569
Food_away_from_home            4.278431
Fresh_fruits_and_vegetables    4.268627
Name: pct_change, dtype: float64

category
Farm_level_eggs            6.534694
Wholesale_fats_and_oils    4.131373
Farm_level_milk            3.476471
Farm_level_vegetables      3.450980
```

```
Wholesale_beef             3.409804
Name: pct_change, dtype: float64
```

0.5.2 Plot top 5 (CPI & PPI)

```
# CPI:
cpi_top5.plot(kind="barh")
plt.gca().invert_yaxis() # top to bottom
plt.title("CPI: Top 5 Fastest -Inflating Categories (Avg Forecast)")
plt.xlabel("Average percent change (1974-2024)")
plt.tight_layout()
plt.savefig('../figures/cpi_top_5_fastest_inflating_categories.png')
plt.show()

# PPI:
ppi_top5.plot(kind="barh")
plt.gca().invert_yaxis() # top to bottom
plt.title("PPI: Top 5 Fastest -Inflating Categories (Avg Forecast)")
plt.xlabel("Average percent change (1974-2024)")
plt.tight_layout()
plt.savefig('../figures/ppi_top_5_fastest_inflating_categories.png')
plt.show()
```





0.6 Most volatile categories (year-to-year)

To measure how unstable inflation forecasts are, we will look at the standard deviation of the annual percent change for each category:

A higher standard deviation means the category's inflation forecast fluctuates more from year to year (higher volatility).

0.6.1 Compute volatility per category

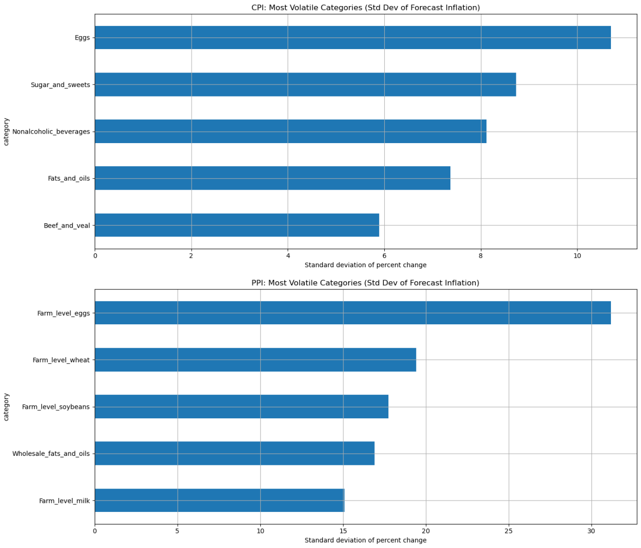
```
cpi_vol = (
    cpi_long
    .groupby("category")["pct_change"]
    .std()
    .sort_values(ascending=False)
)

ppi_vol = (
    ppi_long
    .groupby("category")["pct_change"]
    .std()
    .sort_values(ascending=False)
)

display(cpi_vol)
display(ppi_vol)
```

```
category
Eggs                               10.696875
Sugar_and_sweets                    8.731842
Nonalcoholic_beverages              8.114507
Fats_and_oils                       7.371705
Beef_and_veal                       5.891666
Pork                                5.629574
Fresh_fruits                        5.314719
Cereals_and_bakery_products         5.037909
Fresh_vegetables                    4.717079
Meats                               4.407041
Dairy_products                      4.298477
Fresh_fruits_and_vegetables         4.078014
Other_foods                         4.033501
Poultry                             4.014343
Other_meats                         3.773502
Fish_and_seafood                    3.756827
Fruits_and_vegetables               3.730769
Meats_poultry_and_fish              3.722804
Processed_fruits_and_vegetables     3.258995
Food_at_home                        3.232504
All_food                            2.886500
Food_away_from_home                 2.644263
Name: pct_change, dtype: float64
```

```
category
Farm_level_eggs                         31.169660
Farm_level_wheat                        19.420044
Farm_level_soybeans                     17.729610
Wholesale_fats_and_oils                 16.889482
Farm_level_milk                         15.097080
Farm_level_vegetables                   12.094914
Wholesale_wheat_flour                   12.071768
Wholesale_pork                          11.294287
Farm_level_cattle                       10.915628
Unprocessed_foodstuffs_and_feedstuffs    9.721823
Farm_level_fruit                         9.421535
Wholesale_beef                           9.167383
Wholesale_poultry                        7.644143
Wholesale_dairy                          6.664203
Processed_foods_and_feeds                6.581309
Finished_consumer_foods                  3.545580
Name: pct_change, dtype: float64
```

0.6.2 Plot most volatile categories (top 5)

```
# CPI:
cpi_vol.head(5).plot(kind="barh")
plt.gca().invert_yaxis() # top to bottom
plt.title("CPI: Most Volatile Categories (Std Dev of Forecast Inflation)")
plt.xlabel("Standard deviation of percent change")
plt.tight_layout()
plt.savefig('../figures/cpi_most_volatile_categories.png')
plt.show()

# PPI:
ppi_vol.head(5).plot(kind="barh")
plt.gca().invert_yaxis() # top to bottom
plt.title("PPI: Most Volatile Categories (Std Dev of Forecast Inflation)")
plt.xlabel("Standard deviation of percent change")
plt.tight_layout()
plt.savefig('../figures/ppi_most_volatile_categories.png')
plt.show()
```



1 Saving Summary Tables for Later Use

```
# make a directory called eda_summary under ../outputs/
save_directory = "../outputs/eda_summary/"
os.makedirs(save_directory, exist_ok=True)

cpi_mean.to_csv(save_directory + "cpi_mean_inflation.csv")
cpi_vol.to_csv(save_directory + "cpi_volatility.csv")
ppi_mean.to_csv(save_directory + "ppi_mean_inflation.csv")
ppi_vol.to_csv(save_directory + "ppi_volatility.csv")
```