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Pairs Trading

MGMT 638: future-Driven Investments: Equity

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Overview

- Find stock pairs that usually track together
- When the relationship is broken:
    - Buy the stock that is cheap compared to the usual relationship
    - Short sell the stock that is expensive compared to the usual relationship
- Hope the usual relationship is soon restored.

Model

- $P_1/P_2 \approx \text{constant}$
- When the ratio goes above the constant, it tends to come down.
- When the ratio goes below the constant, it tends to come up.

$$\Delta P_1/P_2 = \begin{cases} + \text{ when } P_1/P_2 < \text{constant} \\ - \text{ when } P_1/P_2 > \text{constant} \end{cases}$$

-Assume the change is larger when the ratio is further from the constant as

$$\Delta P_1/P_2 = k(\text{constant} - P_1/P_2)$$

for a constant $k > 0$.

- The model is equivalent to

$$\Delta P_1/P_2 = a + bP_1/P_2$$

where $a = k \times \text{constant}$, $b = -k$.

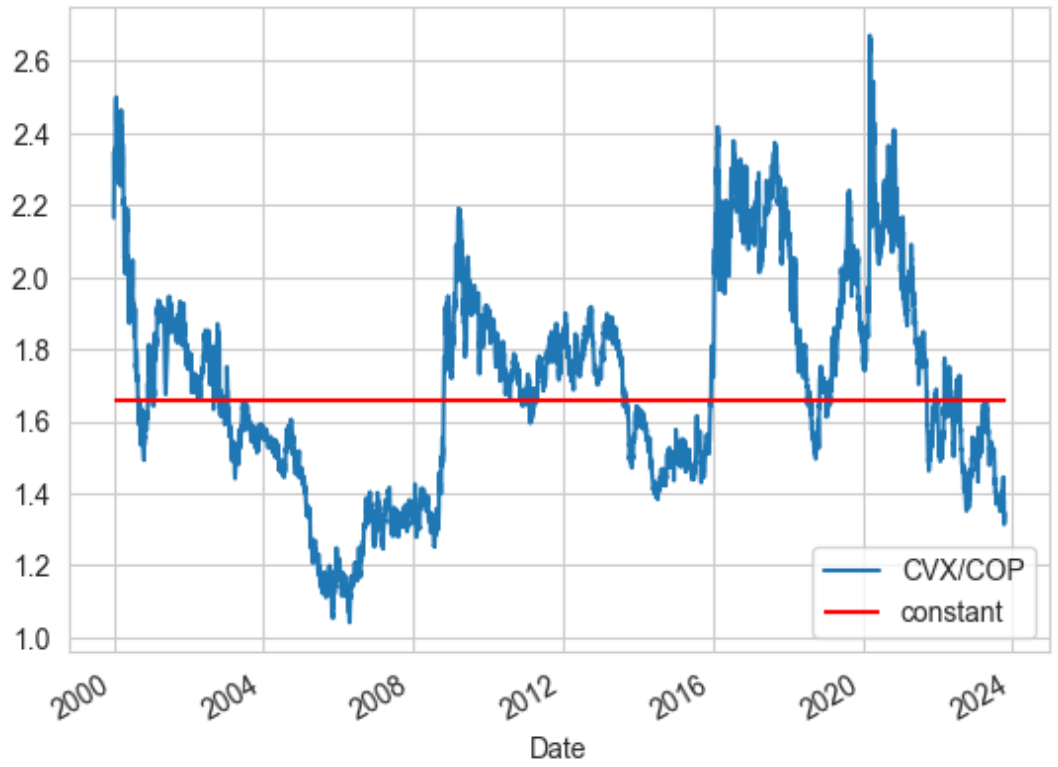
- Estimate a and b by linear regression.
- Should get $a > 0$, $b < 0$.
- If so, $\text{constant} = -a/b$.
- Hold asset 1 and short 2 when $P_1/P_2 < -a/b - \text{threshold}$.
- Hold asset 2 and short 1 when $P_1/P_2 > -a/b + \text{threshold}$.

Example

- Chevron (CVX) and Conoco-Phillips (COP) from 2000 on
- Adjusted closing prices from Yahoo Finance
- Compute the price ratio: CVX / COP

In [2]:

```
data.ratio.plot(label="CVX/COP")
plt.hlines(
    y=-a/b,
    xmin = data.index[0],
    xmax=data.index[-1],
    color="red",
    label="constant"
)
plt.legend(loc="lower right")
plt.show()
```



Returns

- $-a/b = 1.66$
- Set threshold = 0.2 as an example
- Buy COP and short CVX when CVX / COP is above 1.86
- Buy CVX and short COP when CVX / COP is below 1.46

Market Neutrality

- The pairs strategy is an example of a market neutral strategy, meaning its market beta should be approximately zero.
- If it has a return above the risk-free rate, then adding some of it to the market portfolio can improve performance relative to holding the market.
- This is the same as saying that the strategy has a positive alpha.
- It is also the same as saying

$$\text{Sharpe ratio of strategy} > \text{Sharpe ratio of market} \times \text{correlation with market}$$

- Get the market return from Ken French's data library.

In [4]:
```
print(f"mean return of pairs strategy = {252*data.ret.mean():.2%} annualized"
print(f"correlation of pairs strategy with market = {data.ret.corr(data.mkt):
```

```
mean return of pairs strategy = 5.92% annualized
correlation of pairs strategy with market = 4.48%
```

Avoid Look-Ahead Bias

- Compute the parameter of the strategy (the constant $-a/b$) from data through 2015
- Test the strategy from 2015 on.

In [8]:
```
print(f"mean return of pairs strategy = {252*future.ret.mean():.2%} annualize
print(f"correlation of pairs strategy with market = {future.ret.corr(future.m
```

```
mean return of pairs strategy = 6.52% annualized
correlation of pairs strategy with market = 10.74%
```