# Import Libraries

Import libraries and set date parameters for Regression Model.

In [19]:
```
import pandas_datareader as pdr
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import statsmodels.api as sm
import matplotlib.pyplot as plt
import datetime as dt
import statsmodels.formula.api as smf

# set date parameters
start = dt.datetime(2017, 1, 1)
end = dt.datetime.now()


print("Date Parameters:"
      ,"\nStart Date:",start
```

```
Date Parameters:
Start Date: 2017-01-01 00:00:00
End Date 2022-12-01 23:21:23.076011
```

# Pull Crypto Data

Using Pandas Data Reader, retrieve Bitcoin, Ethereum Historical Data

In [2]:
```
cryptodata = pdr.get_data_fred(['CBBTCUSD','CBETHUSD'], start, end)

#Seperate crypto data into their own dataframe
X =pdr.get_data_fred(['CBBTCUSD']) #Use variable X to define our indepdent(explanatory) Variable, in this cas
Y =pdr.get_data_fred(['CBETHUSD']) #Use variable Y to define our dependent(response) Variable, in this case, 

#X = sm.add_constant(X)  #add constant to our Bitcoin dataset

print(cryptodata) # prevew our BTC-ETH dataset
#print(X)          # preview our bitcoin dataset
```

```
            CBBTCUSD  CBETHUSD
DATE
2017-01-01    992.95      8.18
2017-01-02   1011.45      8.38
2017-01-03   1020.67      9.59
2017-01-04   1130.30     11.17
2017-01-05   1007.00     10.23
...              ...       ...
2022-11-27  16428.77   1193.72
2022-11-28  16193.89   1166.69
2022-11-29  16441.63   1216.23
2022-11-30  17179.78   1295.80
2022-12-01  16980.55   1276.41

[2161 rows x 2 columns]
```

# Execute Regression Model (Ordinary Least Squares Method)

In [3]:
```
# Y(depdent variable) ~ X(indepdent variable)
reg1='CBETHUSD~CBBTCUSD'

model=smf.ols(reg1,cryptodata).fit()

print(model.summary())

#Believe this code was cleaning data to forward/backward fill
X= X.fillna(method = "pad")
Y = Y.fillna(method = "pad")
X = pd.DataFrame(X.replace([np.inf, -np.inf], np.nan))
X = X.fillna(method='ffill')
X = X.fillna(method='bfill')
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                CBETHUSD   R-squared:                       0.863
Model:                            OLS   Adj. R-squared:                  0.863
Method:                 Least Squares   F-statistic:                 1.365e+04
Date:                Thu, 01 Dec 2022   Prob (F-statistic):               0.00
Time:                        23:08:59   Log-Likelihood:                -16155.
No. Observations:                2160   AIC:                         3.231e+04
Df Residuals:                    2158   BIC:                         3.232e+04
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept   -135.8108     13.336    -10.183      0.000    -161.964    -109.657
CBBTCUSD       0.0639      0.001    116.833      0.000       0.063       0.065
==============================================================================
Omnibus:                      543.583   Durbin-Watson:                   0.013
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1934.306
```

In [4]:
```
print("Parameters: ", model.params)                          #obtain parameters (EFFR Coefficient, Intercept)
print("R-Squared: ", round(model.rsquared *100,2),"%")       #obtain rsquared   - validate model: 99%
```

```
Parameters:  Intercept   -135.810792
CBBTCUSD       0.063897
dtype: float64
R-Squared:  86.35 %
```

# Residuals Analysis

1) Describe Residuals Dataset

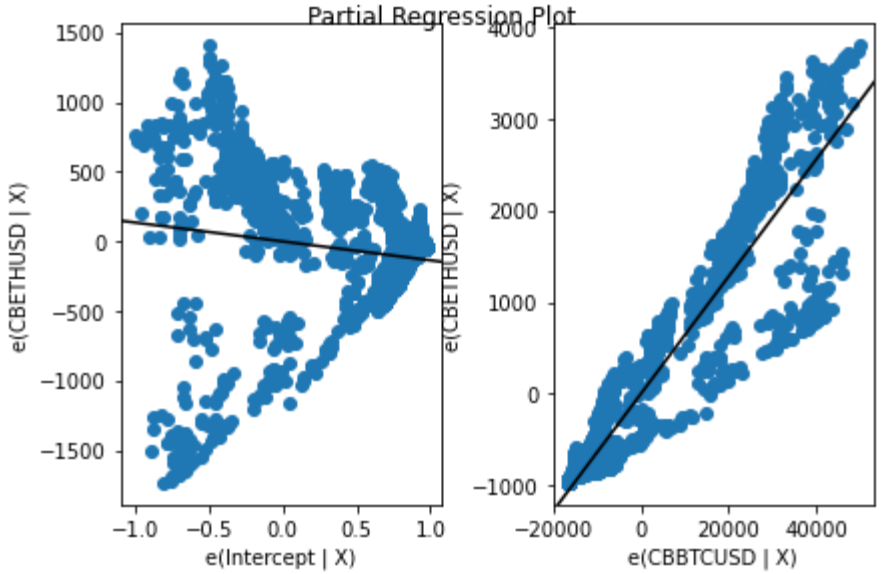
2) Plot Residuals

In [5]:
```
what   model.resid # Map out Residuals
```

Partial Regression Plot

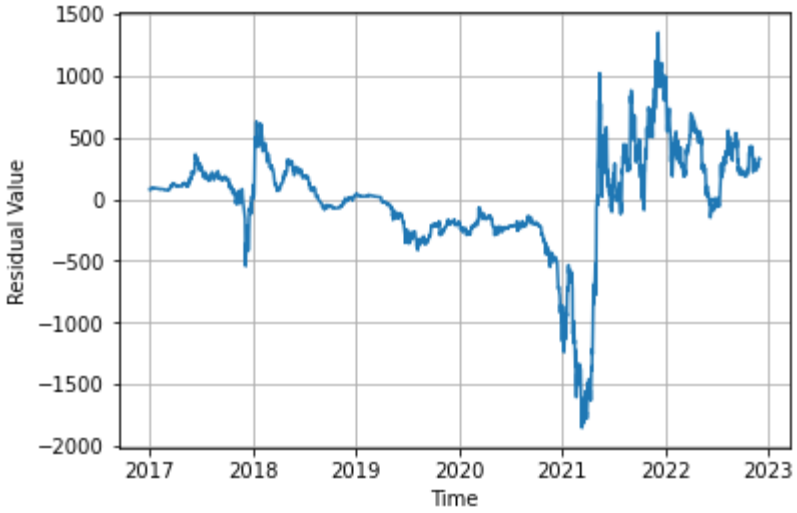
In [6]:
```
fig = sm.graphics.plot_partregress_grid(model)
```

```
eval_env: 1
eval_env: 1
```



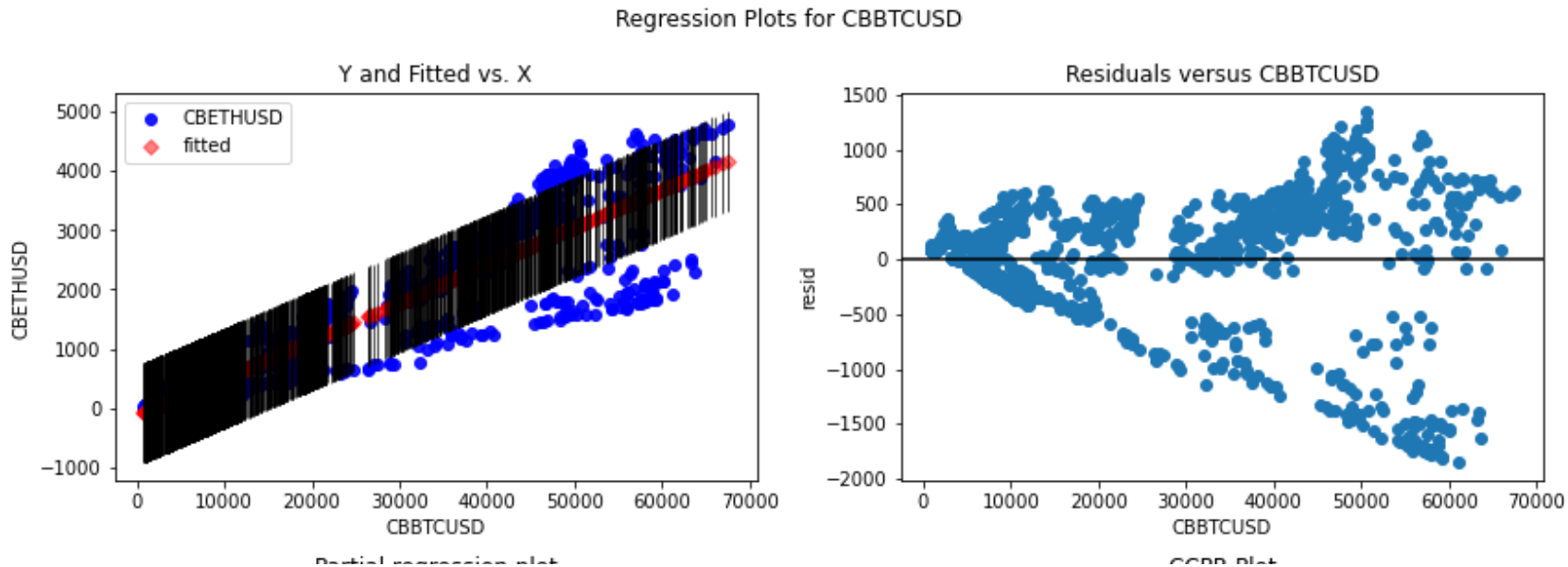
In [7]:
```
plt.plot(uhat)          # Plot Residuals
plt.xlabel('Time')
plt.ylabel('Residual Value')
plt.grid(True)
plt.show
```

Out[7]: <function matplotlib.pyplot.show(close=None, block=None)>



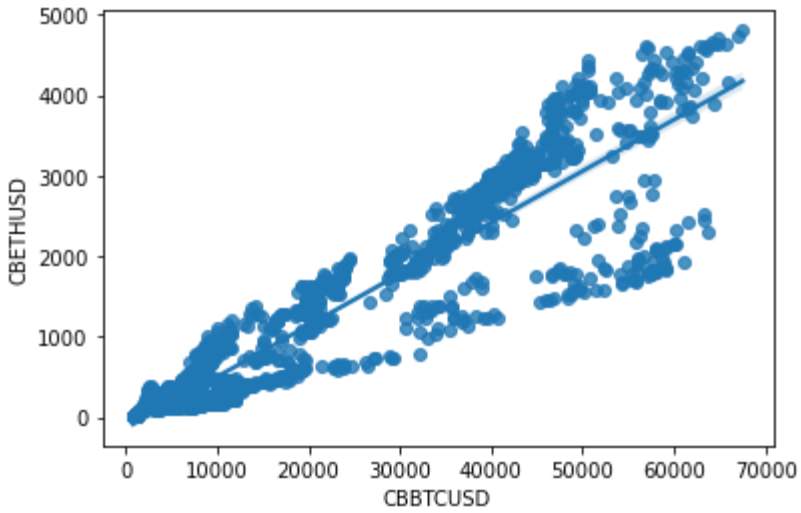
In [8]:
```
fig = plt.figure(figsize=(12,8))
```

```
eval_env: 1
```



In [9]:
```
import seaborn as sns
```

Out[9]: <AxesSubplot:xlabel='CBBTCUSD', ylabel='CBETHUSD'>




In [10]:
```
#ax = motif.plot(x='motifScore', y='expression', kind='scatter')

# plot regression line on the same axes, set x-axis limits
#ax.plot(x, p.const + p.motifScore * x)
```

Residuals Analysis Conclusion:

Time Frame: 2017 - 2021

Our residuals during ths time frame are consistently within our zero line and at times range from (- 500,500). Towards the end of this time frame, we begin to see our residuals stray further away from the zero line and a higher variablity begins during this time frame (end of 2020 - 2021).

Time Frame: 2022 - Today

Our Residuals range (-100, 600) is within a more normal range at this point.

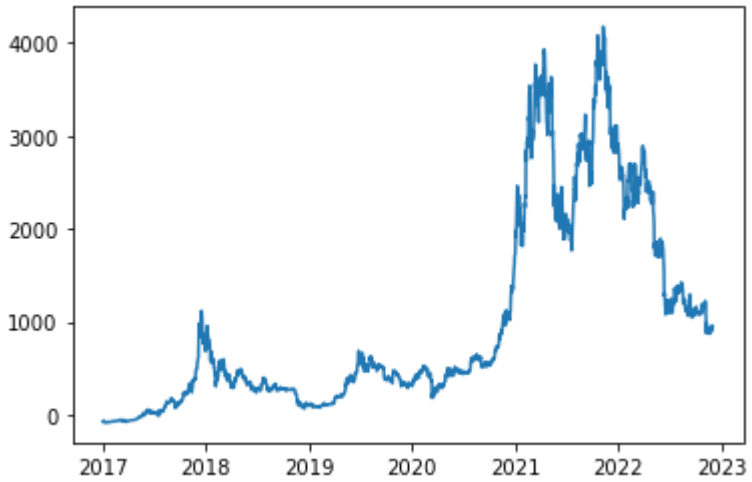
Overall conclusion: Our high R-Squared results (86.35%) indicates that Ethereum moves relatively in line with the movement of Bitcoin.

# Visualizing our Fitted Line against Actual ETH

In [11]:

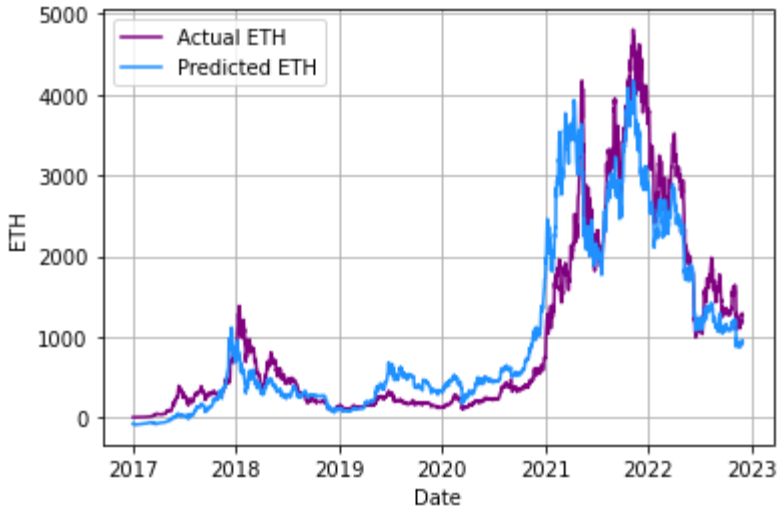
In [12]:

Out[12]: [<matplotlib.lines.Line2D at 0x28c3fc7c0a0>]



In [13]:
```
plt.plot(cryptodata.CBETHUSD, label = "Actual ETH", color = 'purple')
plt.plot(yhat, label = "Predicted ETH", color = 'dodgerblue')
plt.xlabel('Date')
plt.ylabel('ETH')
plt.grid(True)
legend=plt.legend()
```

Out[13]: <function matplotlib.pyplot.show(close=None, block=None)>



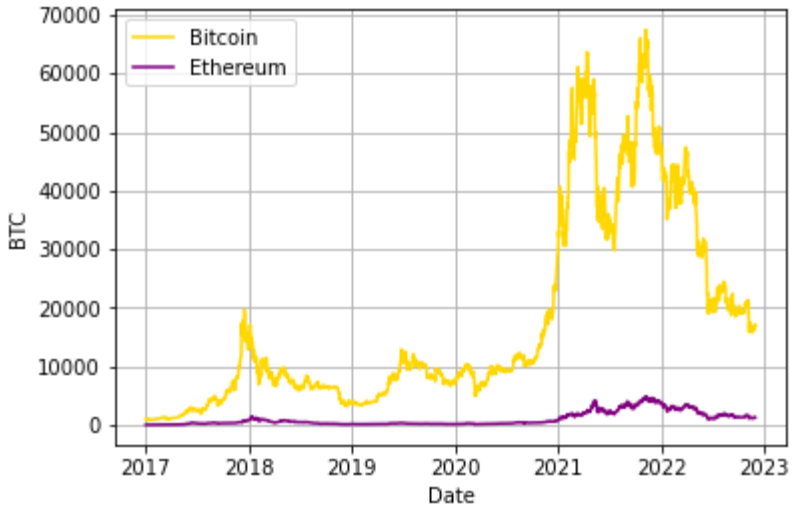

In [15]:
```
sp = cryptodata.plot(x = 'CBBTCUSD',y = 'CBETHUSD', kind = 'scatter')
sp
```

```
  Input In [15]
    print('Yhat = (x)',mode.params[CBBTCUSD'],model.params['Intercept']]
                                                ^
SyntaxError: invalid syntax
```

# Bitcoin Actuals Vs Ethereum Actuals

In [16]:
```
plt.plot(cryptodata.CBBTCUSD,  label = "Bitcoin", color = 'gold')
plt.plot(cryptodata.CBETHUSD, label = "Ethereum", color = 'purple')
plt.xlabel('Date')
plt.ylabel('BTC')
plt.grid(True)
legend=plt.legend()
```

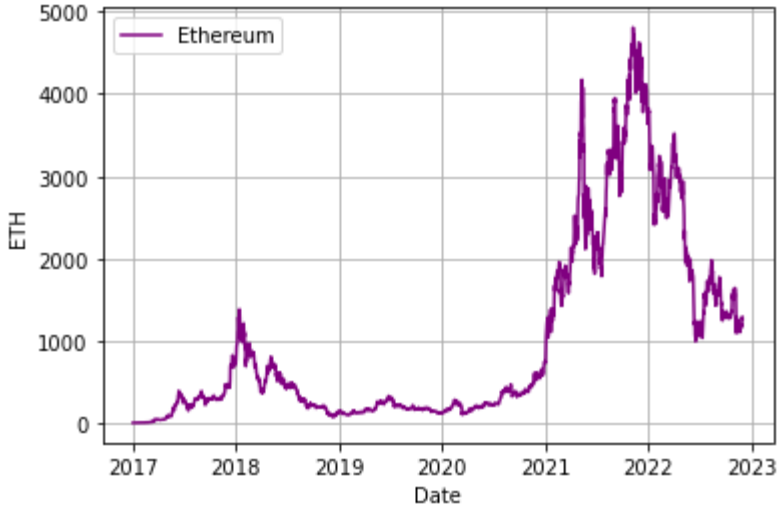
Out[16]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```




Ethereum Actuals due to incompatability of scaling on previous plot

In [17]:
```
plt.plot(cryptodata.CBETHUSD, label = "Ethereum", color = 'purple')
plt.xlabel('Date')
plt.ylabel('ETH')
plt.grid(True)
legend=plt.legend()
```

Out[17]:
```
<function matplotlib.pyplot.show(close=None, block=None)>
```




Ehtereum Actuals to visually compare against Bitcoin Actuals. Demonstrating similr behavior to Bitcoin.