In [109]:

```
import statsmodels.formula.api as sfm #Biblioteca para estimar modelos est
import pandas as pd #Biblioteca para manipulación de marcos de datos
from pandas.plotting import scatter_matrix #Herramienta de Pandas para dia
import matplotlib.pyplot as plt #Biblioteca para la salida gráfica.
import numpy as np # Biblioteca de funciones matemáticas.
import seaborn as sns
from sklearn.linear_model import LinearRegression
```

In [110]:

```
df = pd.read_excel("datos tesis.xlsx") #Ruta del archivo datos.xlsx
df.head() #Despliegue de las 5 primeras filas del DataFrame
```

Out[110]:

	Date	Close BTC	Inflacion usa	china gdp	inlfacion china	FTSE CHINA	NASDAQ	S&P500	us
0	2015-01-01	217.464005	0.001186	11061.55308	0.015	10622.76	4635.24	1994.99	18206.(
1	2015-02-01	254.263000	0.001186	11061.55308	0.010	10875.82	4963.53	2104.50	18206.(
2	2015-03-01	244.223999	0.001186	11061.55308	0.009	11980.06	4900.88	2067.89	18206.(
3	2015-04-01	236.145004	0.001186	11061.55308	0.013	14158.26	4941.42	2085.51	18206.(
4	2015-05-01	230.190002	0.001186	11061.55308	0.016	13444.67	5070.02	2107.39	18206.(

In [4]:

```
df_2 = df.iloc[:,[1,2,3,4,5,6,7,8,9,10,11]] # Dataframe con las variables.
df_2.describe().transpose()
```

Out[4]:

	count	mean	std	min	25%	50%
Close BTC	97.0	13463.331599	16187.666361	217.464005	970.403015	7569.629883
Inflacion usa	97.0	0.027504	0.023794	0.001186	0.012616	0.021301
china gdp	97.0	14154.263725	2463.795110	11061.553080	12310.409371	14279.937501
inlfacion china	97.0	0.019670	0.009742	-0.004000	0.015000	0.018000
FTSE CHINA	97.0	12827.665155	2341.764282	8756.880000	10911.360000	12908.110000
NASDAQ	97.0	8589.786907	3323.980526	4557.950000	5614.790000	7671.790000
S&P500	97.0	2995.346804	815.966805	1920.030000	2278.870000	2816.290000
usa gdp	97.0	21072.527844	2332.562451	18206.020741	19477.336549	21060.473613
ineteres usa	97.0	0.009510	0.009939	0.000000	0.002500	0.005000
intereses china	97.0	0.041995	0.003890	0.036500	0.038500	0.043500
desempleo usa	97.0	0.048845	0.018688	0.034000	0.037000	0.044000

In [14]:

```
print(df.columns)
```

```
Index(['Date', 'Close BTC', 'Inflacion usa', 'china gdp', 'inlfacion chin
a ',
       'FTSE CHINA ', 'NASDAQ ', 'S&P500 ', 'usa gdp', 'ineteres usa',
       'intereses china', 'desempleo usa'],
      dtype='object')
```

In [15]:

```python
variables = ['Close BTC', 'Inflacion usa', 'china gdp', 'inlfacion china '
             'FTSE CHINA ', 'NASDAQ ', 'S&P500 ', 'usa gdp', 'ineteres usa
        'intereses china', 'desempleo usa'] #Variables with correlation
data = df[variables].copy()
data.rename(columns={'Close BTC':'CBTC',
                     'Inflacion usa':'IUSA',
                     'china gdp':'CGDP',
                     'inlfacion china ':'ICHINA',
                     'FTSE CHINA ':'FTSE',
                     'NASDAQ ':'NDAQ',
                     'S&P500 ':'SP500',
                     'usa gdp':'UGDP',
                     'ineteres usa':'inUSA',
                     'intereses china':'inchi',
                     'desempleo usa':'dusa'},
            inplace=True)
data.head()
```

Out[15]:

	CBTC	IUSA	CGDP	ICHINA	FTSE	NDAQ	SP500	UGDP	in
0	217.464005	0.001186	11061.55308	0.015	10622.76	4635.24	1994.99	18206.020741	0.(
1	254.263000	0.001186	11061.55308	0.010	10875.82	4963.53	2104.50	18206.020741	0.(
2	244.223999	0.001186	11061.55308	0.009	11980.06	4900.88	2067.89	18206.020741	0.(
3	236.145004	0.001186	11061.55308	0.013	14158.26	4941.42	2085.51	18206.020741	0.(
4	230.190002	0.001186	11061.55308	0.016	13444.67	5070.02	2107.39	18206.020741	0.(

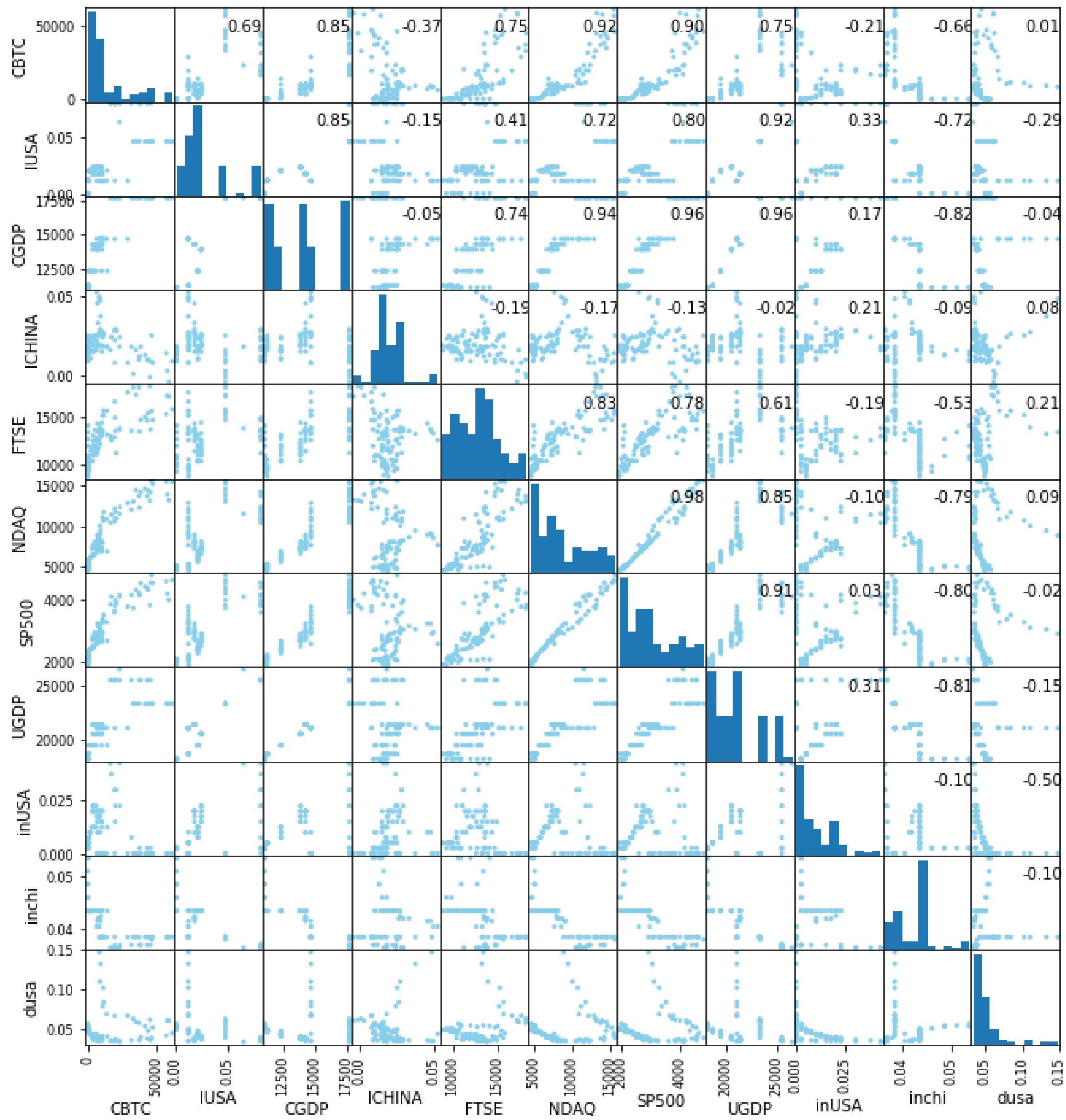
In [16]:

```python
print(data.columns)
```

```
Index(['CBTC', 'IUSA', 'CGDP', 'ICHINA', 'FTSE', 'NDAQ', 'SP500', 'UGDP',
       'inUSA', 'inchi', 'dusa'],
      dtype='object')
```

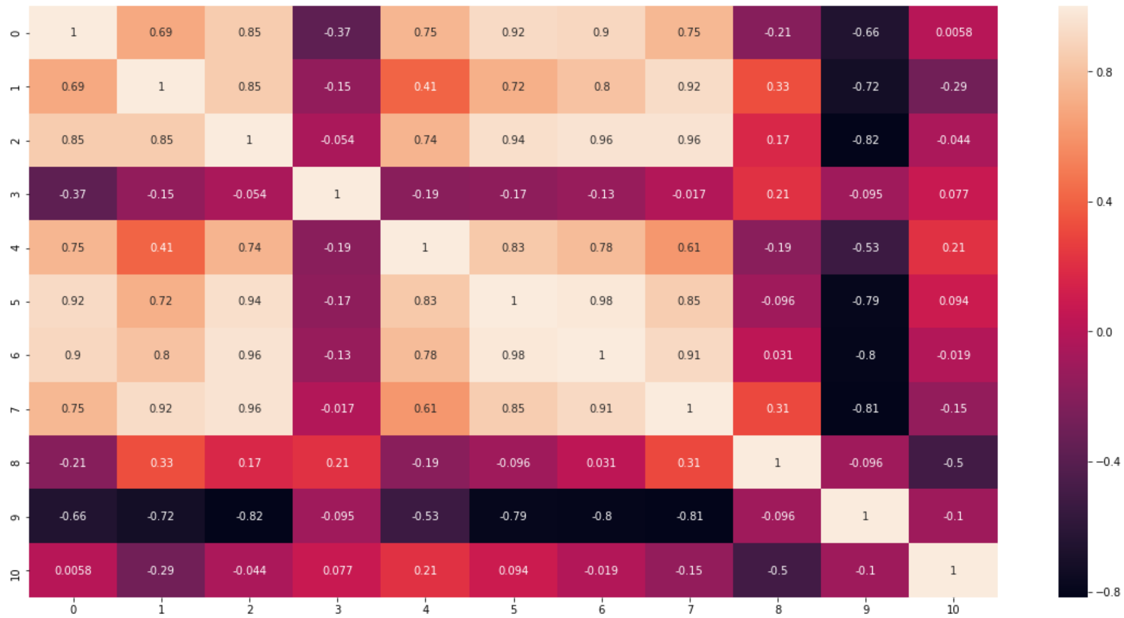
In [17]:

```
# Crear la matriz de gráficos de dispersión
axes = scatter_matrix(data, alpha=1, figsize=(11,12), color="skyblue")

# Calcular la matriz de correlación y agregar anotaciones de texto
corr = data.corr().values
for i, j in zip(*np.triu_indices_from(axes, k=1)):
    axes[i, j].annotate("%.2f" %corr[i,j], (0.8, 0.8), xycoords='axes frac

# Guardar la matriz de gráficos de dispersión en una imagen
plt.savefig("matrix_scatter.png", dpi=300)

# Mostrar la matriz de gráficos de dispersión en una ventana de visualizac
plt.show()
```



In [133]:

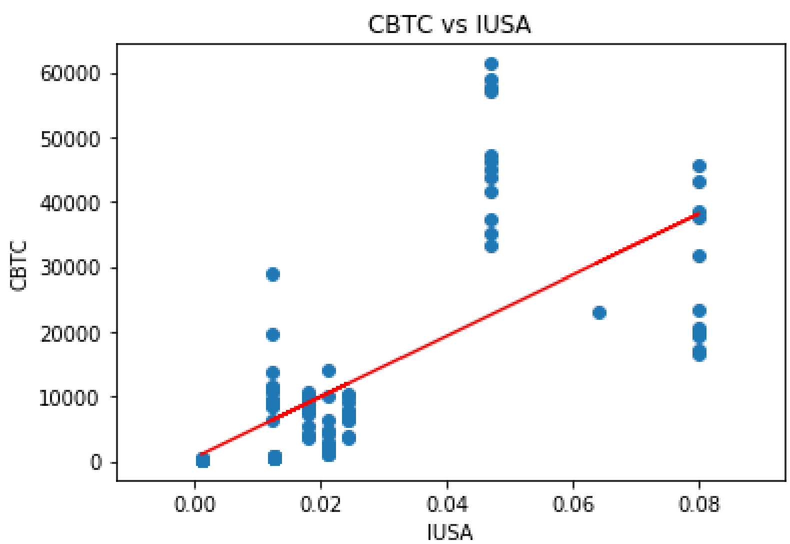
```
plt.figure(figsize = (20, 10))
sns.heatmap(corr, annot = True)
plt.show()
```



In [138]:

```
X = data['IUSA'].values.reshape(-1,1)
Y = data['CBTC'].values.reshape(-1,1)
model = LinearRegression()  # create object for the class
model.fit(X, Y)  # perform linear regression
r_sq = model.score(X, Y)
r_sq
print(f"coefficient of determination: {r_sq}")
print(f"intercept: {model.intercept_}")
print(f"slope: {model.coef_}")

Y_pred = linear_regressor.predict(X)  # make predictions
plt.scatter(X, Y)
plt.plot(X, Y_pred, color='red')
plt.title('CBTC vs IUSA')
plt.xlabel('IUSA')
plt.ylabel('CBTC')
plt.show()
```

```
coefficient of determination: 0.4757743339923085
intercept: [556.68900827]
slope: [[469258.0774742]]
```



In [112]:

```
# fitting the model

model = smf.ols(formula='CBTC ~ IUSA',data=data).fit()

# model summary
print(model.summary())
```

```
                            OLS Regression Results                            
==============================================================================
=====
Dep. Variable:                   CBTC   R-squared:                       
0.476
Model:                            OLS   Adj. R-squared:                  
0.470
Method:                 Least Squares   F-statistic:                     
86.22
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           5.5
7e-15
Time:                        16:11:36   Log-Likelihood:                -1
045.9
No. Observations:                  97   AIC:                             
2096.
Df Residuals:                      95   BIC:                             
2101.
Df Model:                           1                                         
Covariance Type:            nonrobust                                         
==============================================================================
=====
                 coef    std err          t      P>|t|      [0.025      
0.975]
------------------------------------------------------------------------------
-----
Intercept    556.6890   1833.885      0.304      0.762   -3084.033    419
7.411
IUSA       4.693e+05   5.05e+04      9.285      0.000    3.69e+05     5.
7e+05
==============================================================================
=====
Omnibus:                       31.042   Durbin-Watson:                   
0.214
Prob(Omnibus):                  0.000   Jarque-Bera (JB):                5
2.077
Skew:                           1.368   Prob(JB):                     4.9
2e-12
Kurtosis:                       5.325   Cond. No.                        
42.3
==============================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
```

In [116]:

```python
model2 = smf.ols(formula='CBTC ~ CGDP',data=data).fit()

# model summary
print(model2.summary())
```

```
                            OLS Regression Results
==========================================================================
=====
Dep. Variable:                   CBTC   R-squared:
0.715
Model:                            OLS   Adj. R-squared:
0.712
Method:                 Least Squares   F-statistic:
238.7
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           1.1
7e-27
Time:                        16:13:10   Log-Likelihood:               -1
016.3
No. Observations:                  97   AIC:
2037.
Df Residuals:                      95   BIC:
2042.
Df Model:                           1
Covariance Type:            nonrobust
==========================================================================
=====
                 coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------
-----
Intercept  -6.519e+04   5166.974    -12.616      0.000   -7.54e+04    -5.4
9e+04
CGDP           5.5567      0.360     15.448      0.000       4.843
6.271
==========================================================================
=====
Omnibus:                       14.988   Durbin-Watson:
0.321
Prob(Omnibus):                  0.001   Jarque-Bera (JB):                1
7.852
Skew:                           0.825   Prob(JB):                     0.0
00133
Kurtosis:                       4.300   Cond. No.                     8.4
2e+04
==========================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
[2] The condition number is large, 8.42e+04. This might indicate that the
re are
strong multicollinearity or other numerical problems.
```

In [117]:

```python
model3 = smf.ols(formula='CBTC ~ ICHINA',data=data).fit()

# model summary
print(model3.summary())
```

```
                            OLS Regression Results
==========================================================================
=====
Dep. Variable:                   CBTC   R-squared:
0.139
Model:                            OLS   Adj. R-squared:
0.130
Method:                 Least Squares   F-statistic:
15.29
Date:                Fri, 16 Jun 2023   Prob (F-statistic):            0.0
00173
Time:                        16:13:35   Log-Likelihood:                 -1
070.0
No. Observations:                  97   AIC:
2144.
Df Residuals:                      95   BIC:
2149.
Df Model:                           1
Covariance Type:            nonrobust
==========================================================================
=====
                 coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------
-----
Intercept   2.563e+04   3469.420      7.388      0.000    1.87e+04    3.2
5e+04
ICHINA     -6.187e+05   1.58e+05     -3.911      0.000   -9.33e+05   -3.0
5e+05
==========================================================================
=====
Omnibus:                       10.807   Durbin-Watson:
0.087
Prob(Omnibus):                  0.005   Jarque-Bera (JB):                1
1.952
Skew:                           0.859   Prob(JB):                       0.
00254
Kurtosis:                       2.939   Cond. No.
103.
==========================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
```

In [118]:

```
model4 = smf.ols(formula='CBTC ~ FTSE',data=data).fit()

# model summary
print(model4.summary())
```

```
                            OLS Regression Results
==============================================================================
=====
Dep. Variable:                   CBTC   R-squared:
0.562
Model:                            OLS   Adj. R-squared:
0.557
Method:                 Least Squares   F-statistic:
121.8
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           1.0
3e-18
Time:                        16:13:59   Log-Likelihood:                -1
037.2
No. Observations:                  97   AIC:
2078.
Df Residuals:                      95   BIC:
2084.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
=====
                 coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
-----
Intercept    -5.3e+04   6120.888     -8.659      0.000   -6.52e+04   -4.0
8e+04
FTSE           5.1812      0.469     11.036      0.000       4.249
6.113
==============================================================================
=====
Omnibus:                       14.559   Durbin-Watson:
0.352
Prob(Omnibus):                  0.001   Jarque-Bera (JB):                1
5.979
Skew:                           0.920   Prob(JB):                     0.0
00339
Kurtosis:                       3.752   Cond. No.                     7.3
0e+04
==============================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
[2] The condition number is large, 7.3e+04. This might indicate that ther
e are
strong multicollinearity or other numerical problems.
```

In [119]:

```python
model5 = smf.ols(formula='CBTC ~ NDAQ',data=data).fit()

# model summary
print(model5.summary())
```

```
                            OLS Regression Results
==============================================================================
=====
Dep. Variable:                   CBTC   R-squared:
0.847
Model:                            OLS   Adj. R-squared:
0.845
Method:                 Least Squares   F-statistic:
526.3
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           1.6
1e-40
Time:                        16:14:28   Log-Likelihood:                -9
86.18
No. Observations:                  97   AIC:
1976.
Df Residuals:                      95   BIC:
1982.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
=====
                 coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
-----
Intercept  -2.504e+04   1798.293    -13.923      0.000   -2.86e+04   -2.1
5e+04
NDAQ           4.4822      0.195     22.942      0.000       4.094
4.870
==============================================================================
=====
Omnibus:                       18.337   Durbin-Watson:
0.425
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               3
6.696
Skew:                           0.704   Prob(JB):                     1.0
8e-08
Kurtosis:                       5.664   Cond. No.                     2.5
6e+04
==============================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
[2] The condition number is large, 2.56e+04. This might indicate that the
re are
strong multicollinearity or other numerical problems.
```

In [120]:

```python
model6 = smf.ols(formula='CBTC ~ SP500',data=data).fit()

# model summary
print(model6.summary())
```

```
                            OLS Regression Results                            
==========================================================================
=====
Dep. Variable:                   CBTC   R-squared:                       
0.816
Model:                            OLS   Adj. R-squared:                  
0.814
Method:                 Least Squares   F-statistic:                     
421.1
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           1.1
0e-36
Time:                        16:14:44   Log-Likelihood:                -9
95.18
No. Observations:                  97   AIC:                             
1994.
Df Residuals:                      95   BIC:                             
2000.
Df Model:                           1                                         
Covariance Type:            nonrobust                                         
==========================================================================
=====
                 coef    std err          t      P>|t|      [0.025      
0.975]
--------------------------------------------------------------------------
-----
Intercept  -4.021e+04   2710.145    -14.838      0.000   -4.56e+04   -3.4
8e+04
SP500         17.9199      0.873     20.520      0.000      16.186      1
9.654
==========================================================================
=====
Omnibus:                       28.326   Durbin-Watson:                   
0.386
Prob(Omnibus):                  0.000   Jarque-Bera (JB):                5
9.900
Skew:                           1.098   Prob(JB):                     9.8
4e-14
Kurtosis:                       6.162   Cond. No.                     1.1
9e+04
==========================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
[2] The condition number is large, 1.19e+04. This might indicate that the
re are
strong multicollinearity or other numerical problems.
```

In [121]:

```python
model7 = smf.ols(formula='CBTC ~ UGDP',data=data).fit()

# model summary
print(model7.summary())
```

```
                            OLS Regression Results
==========================================================================
=====
Dep. Variable:                   CBTC   R-squared:
0.565
Model:                            OLS   Adj. R-squared:
0.560
Method:                 Least Squares   F-statistic:
123.3
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           7.3
5e-19
Time:                        16:16:44   Log-Likelihood:                -1
036.9
No. Observations:                  97   AIC:
2078.
Df Residuals:                      95   BIC:
2083.
Df Model:                           1
Covariance Type:            nonrobust
==========================================================================
=====
                 coef    std err          t      P>|t|      [0.025
0.975]
--------------------------------------------------------------------------
-----
Intercept  -9.645e+04   9956.901     -9.687      0.000   -1.16e+05   -7.6
7e+04
UGDP           5.2159      0.470     11.106      0.000       4.284
6.148
==========================================================================
=====
Omnibus:                       30.378   Durbin-Watson:
0.219
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               5
3.681
Skew:                           1.294   Prob(JB):                     2.2
0e-12
Kurtosis:                       5.566   Cond. No.                     1.9
4e+05
==========================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
[2] The condition number is large, 1.94e+05. This might indicate that the
re are
strong multicollinearity or other numerical problems.
```

In [122]:
```python
model8 = smf.ols(formula='CBTC ~ inUSA',data=data).fit()

# model summary
print(model8.summary())
```

```
                            OLS Regression Results
==============================================================================
=====
Dep. Variable:                   CBTC   R-squared:
0.043
Model:                            OLS   Adj. R-squared:
0.033
Method:                 Least Squares   F-statistic:
4.244
Date:                Fri, 16 Jun 2023   Prob (F-statistic):
0.0421
Time:                        16:17:07   Log-Likelihood:                    -1
075.1
No. Observations:                  97   AIC:
2154.
Df Residuals:                      95   BIC:
2159.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
=====
                 coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
-----
Intercept   1.667e+04   2242.924      7.431      0.000    1.22e+04    2.1
1e+04
inUSA      -3.368e+05   1.63e+05     -2.060      0.042   -6.61e+05   -1.2
2e+04
==============================================================================
=====
Omnibus:                       17.632   Durbin-Watson:
0.081
Prob(Omnibus):                  0.000   Jarque-Bera (JB):                  2
1.360
Skew:                           1.137   Prob(JB):                        2.3
0e-05
Kurtosis:                       3.339   Cond. No.
101.
==============================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
```

```
In [123]: model9 = smf.ols(formula='CBTC ~ inchi',data=data).fit()

          # model summary
          print(model9.summary())
```

```
                            OLS Regression Results
==============================================================================
=====
Dep. Variable:                   CBTC   R-squared:
0.434
Model:                            OLS   Adj. R-squared:
0.428
Method:                 Least Squares   F-statistic:
72.97
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           2.1
4e-13
Time:                        16:17:29   Log-Likelihood:                -1
049.6
No. Observations:                  97   AIC:
2103.
Df Residuals:                      95   BIC:
2108.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
=====
                 coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
-----
Intercept   1.286e+05   1.35e+04      9.500      0.000    1.02e+05    1.5
6e+05
inchi      -2.743e+06   3.21e+05     -8.542      0.000   -3.38e+06   -2.1
1e+06
==============================================================================
=====
Omnibus:                       27.157   Durbin-Watson:
0.161
Prob(Omnibus):                  0.000   Jarque-Bera (JB):                3
7.955
Skew:                           1.403   Prob(JB):                      5.7
3e-09
Kurtosis:                       4.231   Cond. No.
259.
==============================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
```

In [124]:

```python
model10 = smf.ols(formula='CBTC ~ dusa',data=data).fit()

# model summary
print(model10.summary())
```

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:                   CBTC   R-squared:                       0.000
Model:                            OLS   Adj. R-squared:                 -0.010
Method:                 Least Squares   F-statistic:                  0.003248
Date:                Fri, 16 Jun 2023   Prob (F-statistic):              0.955
Time:                        16:22:35   Log-Likelihood:                -1077.3
No. Observations:                  97   AIC:                             2159.
Df Residuals:                      95   BIC:                             2164.
Df Model:                           1                                         
Covariance Type:            nonrobust                                         
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept   1.322e+04   4644.565      2.845      0.005    3995.303    2.24e+04
dusa        5064.9858   8.89e+04      0.057      0.955   -1.71e+05    1.81e+05
==============================================================================
Omnibus:                       27.268   Durbin-Watson:                   0.078
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               38.190
Skew:                           1.449   Prob(JB):                     5.10e-09
Kurtosis:                       4.025   Cond. No.                         53.9
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

In [ ]:

In [132]:

```
import statsmodels.api as sm
# fitting the multiple linear regression model
y = df['Close BTC']
x=df[['Inflacion usa', 'china gdp', 'inlfacion china ',
       'FTSE CHINA ', 'NASDAQ ', 'S&P500 ', 'usa gdp', 'ineteres usa',
       'intereses china', 'desempleo usa']]
# with statsmodels
x = sm.add_constant(x) # adding a constant

model = sm.OLS(y, x).fit()
predictions = model.predict(x)

print_model = model.summary()
print(print_model)
```

```
                            OLS Regression Results
==============================================================================
=====
Dep. Variable:              Close BTC   R-squared:
0.939
Model:                            OLS   Adj. R-squared:
0.932
Method:                 Least Squares   F-statistic:
132.4
Date:                Fri, 16 Jun 2023   Prob (F-statistic):           8.2
7e-48
Time:                        16:45:03   Log-Likelihood:               -9
41.62
No. Observations:                  97   AIC:
1905.
Df Residuals:                      86   BIC:
1934.
Df Model:                          10
Covariance Type:            nonrobust
==============================================================================
===========
                      coef    std err          t      P>|t|      [0.025
0.975]
------------------------------------------------------------------------------
-----------
const            -1185.7096   2.08e+04     -0.057      0.955   -4.25e+04
4.01e+04
Inflacion usa     1.361e+04   8.02e+04      0.170      0.866   -1.46e+05
1.73e+05
china gdp            7.1408      1.453      4.916      0.000       4.253
10.028
inlfacion china  -3.926e+05   6.92e+04     -5.672      0.000    -5.3e+05
-2.55e+05
FTSE CHINA          -0.5141      0.430     -1.196      0.235      -1.368
0.340
NASDAQ              -3.6165      2.175     -1.663      0.100      -7.941
0.708
S&P500              24.2140      7.893      3.068      0.003       8.524
39.904
usa gdp             -4.8302      1.420     -3.401      0.001      -7.653
-2.007
ineteres usa     -4.705e+05    8.3e+04     -5.668      0.000   -6.35e+05
-3.05e+05
intereses china  -1.169e+05   2.58e+05     -0.454      0.651   -6.29e+05
3.95e+05
desempleo usa    -5.689e+04    3.3e+04     -1.725      0.088   -1.22e+05
8675.803
==============================================================================
=====
Omnibus:                       14.645   Durbin-Watson:
1.123
Prob(Omnibus):                  0.001   Jarque-Bera (JB):                1
6.348
Skew:                           0.876   Prob(JB):                      0.0
00282
Kurtosis:                       3.987   Cond. No.                      1.8
4e+07
```

```
==============================================================================
=====

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is co
rrectly specified.
[2] The condition number is large, 1.84e+07. This might indicate that the
re are
strong multicollinearity or other numerical problems.
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In [ ]:

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In [ ]:

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In [43]:

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In [ ]:

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