Compute a test statistic that would show that 1 model does better than the other. LS and WLS For example, if you picked LS and WLS, you would compute a statistic for each model, and show that one of those test statistics is better than the otherat different scenarios and datasets.

In [11]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
import statsmodels.formula.api as smf
import statsmodels.stats.api as sms

plt.rcParams["figure.figsize"]=(14,9) #Figure size and width
```

In [12]:
```
df = pd.read_csv("M2. module_2_data.csv")
df.head()
```

Out[12]:

	Date	DXY	METALS	OIL	US_STK	INTL_STK	X13W_TB	X10Y_
0	1/4/2016	0.002433	0.024283	-0.007559	-0.013980	-0.019802	0.047297	-0.010
1	1/5/2016	0.005361	-0.004741	-0.021491	0.001691	-0.001263	0.322581	0.001
2	1/6/2016	-0.002213	0.013642	-0.055602	-0.012614	-0.015171	0.000000	-0.031
3	1/7/2016	-0.009679	0.035249	-0.020606	-0.023992	-0.019255	-0.073171	-0.011
4	1/8/2016	0.003258	-0.028064	-0.003306	-0.010977	-0.010471	0.000000	-0.010

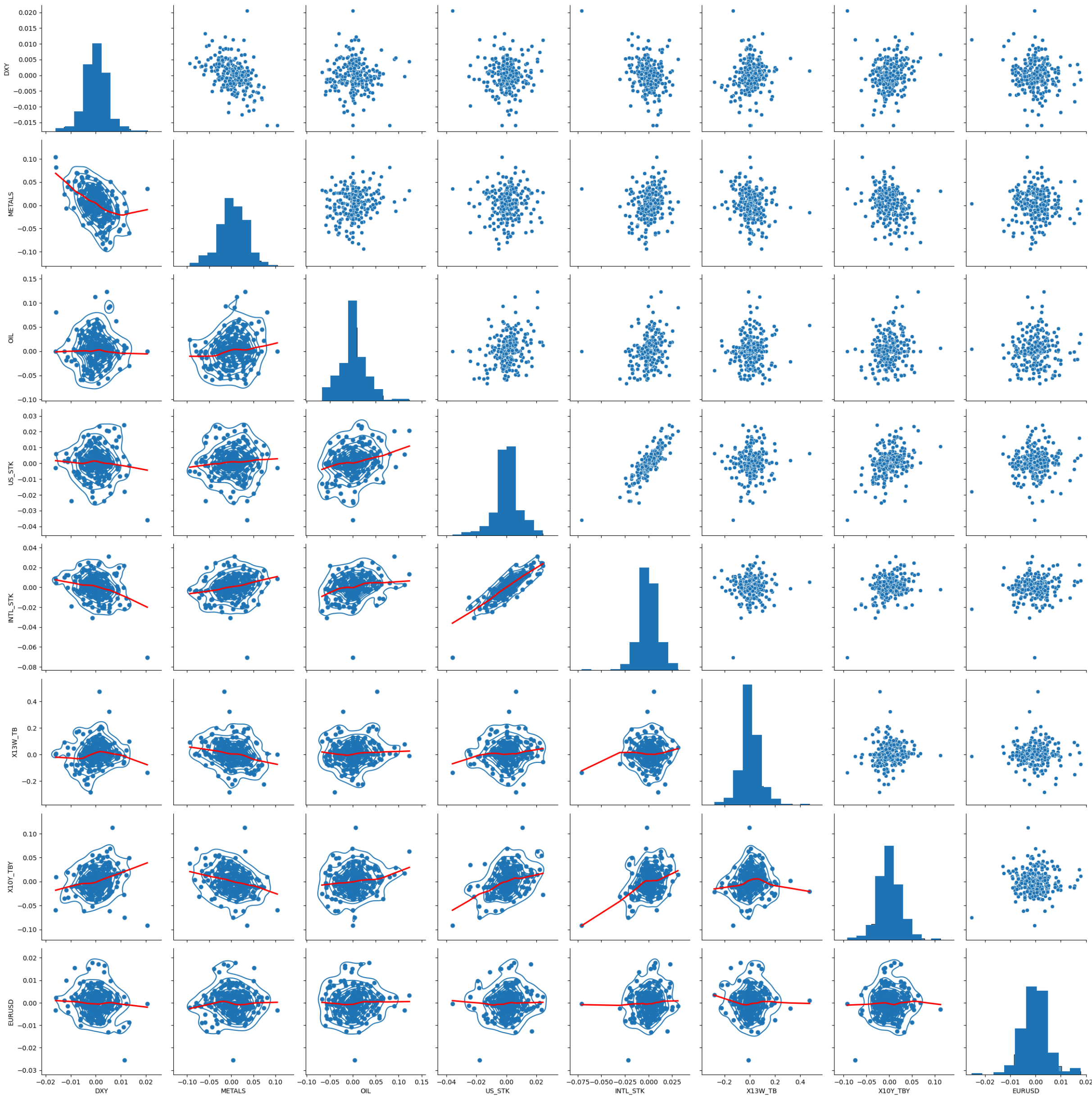
1. OLS - Ordinary Least Square Method

In this data we are assuming: Dependent Value : "DXY" Independent Value : "METALS","OIL","US_STK","INTL_STK","X13W_TB","X10Y_TBY","EURUSD"

In [18]:
```
#Scatterplot, Histogram, and Correlation graph matrix for Exogenous Variable
def corr(x,y,**kwargs):
    coef = np.corrcoeff(x,y)[0][1] # Calculate the value
    label = r"$\rho$ ="+ str(rand(coef,2)) # make the label
    # Add the label to the plot
    ax=plt.gca()
    ax.annotate(label,xy=(0.3,0.15),size=20,xycoords=ax.transAxes)
```

In [19]:
```
# Create a default pairplot
grid = sns.pairplot(df,vars=["DXY","METALS","OIL","US_STK","INTL_STK","X13W_
# Map a histogram to the diagonal
grid = grid.map_diag(plt.hist)

# Map a density plot and regression line to the lower triangle
grid = grid.map_lower(sns.kdeplot)
grid = grid.map_lower(sns.regplot, lowess=True, line_kws={"color": "red"})
```



Observations : 1. The upper right triangle of the matrix showcases the correlation values of all two-way correlation value of all two way combinations. 2. The lower left triangle of the matrix showcases the scatterplots for all the two way combinations of all the variables. 3. The graph of the diagonal of the matrix are the histogram of all variables.

In [41]:
```
#Linear regression result
model = smf.ols("DXY ~ METALS+OIL+US_STK+INTL_STK+X13W_TB+X10Y_TBY+EURUSD",c
print(model.summary())
```

```
                            OLS Regression Results                            
==============================================================================
==
Dep. Variable:                    DXY   R-squared:                       0.3
81
Model:                            OLS   Adj. R-squared:                  0.3
63
Method:                 Least Squares   F-statistic:                     21.
31
Date:                Tue, 26 Aug 2025   Prob (F-statistic):           2.72e-
22
Time:                        00:13:49   Log-Likelihood:                 104
3.0
No. Observations:                 250   AIC:                            -207
0.
Df Residuals:                     242   BIC:                            -204
2.
Df Model:                           7                                         
Covariance Type:            nonrobust                                         
==============================================================================
==
                 coef    std err          t      P>|t|      [0.025      0.97
5]
------------------------------------------------------------------------------
--
Intercept      0.0002      0.000      0.747      0.456      -0.000       0.0
01
METALS        -0.0540      0.009     -6.036      0.000      -0.072      -0.0
36
OIL            0.0195      0.009      2.224      0.027       0.002       0.0
37
US_STK         0.3064      0.058      5.327      0.000       0.193       0.4
20
INTL_STK      -0.3340      0.045     -7.406      0.000      -0.423      -0.2
45
X13W_TB       -0.0003      0.003     -0.111      0.912      -0.006       0.0
06
X10Y_TBY       0.0196      0.011      1.731      0.085      -0.003       0.0
42
EURUSD        -0.0693      0.045     -1.532      0.127      -0.158       0.0
20
==============================================================================
==
Omnibus:                        9.767   Durbin-Watson:                   2.1
85
Prob(Omnibus):                  0.008   Jarque-Bera (JB):               18.0
12
Skew:                           0.131   Prob(JB):                     0.0001
23
Kurtosis:                       4.289   Cond. No.                         29
3.
==============================================================================
==

Notes:
```

```
[1] Standard Errors assume that the covariance matrix of the errors is corre
ctly specified.
```

IN ORDER TO COMPARE THE OLS AND WLS REGRESSION MODEL WE ARE SELECTING ONE INDEPENDENT VARIABLE AS A DEFAULT PARAMETER "X10Y_TBY"

In [42]:
```python
#Linear regression result
model_1 = smf.ols("DXY ~ X10Y_TBY",data=df).fit()
print(model_1.summary())
```

```
                            OLS Regression Results
==============================================================================
==
Dep. Variable:                    DXY   R-squared:                       0.0
30
Model:                            OLS   Adj. R-squared:                  0.0
26
Method:                 Least Squares   F-statistic:                     7.7
38
Date:                Tue, 26 Aug 2025   Prob (F-statistic):            0.005
82
Time:                        00:14:07   Log-Likelihood:                 986.
78
No. Observations:                 250   AIC:                            -197
0.
Df Residuals:                     248   BIC:                            -196
3.
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
==
                 coef    std err          t      P>|t|      [0.025      0.97
5]
------------------------------------------------------------------------------
--
Intercept      0.0001      0.000      0.474      0.636      -0.000       0.0
01
X10Y_TBY       0.0336      0.012      2.782      0.006       0.010       0.0
57
==============================================================================
==
Omnibus:                       26.741   Durbin-Watson:                   1.9
09
Prob(Omnibus):                  0.000   Jarque-Bera (JB):               94.9
18
Skew:                           0.322   Prob(JB):                     2.45e-
21
Kurtosis:                       5.949   Cond. No.                         4
0.7
==============================================================================
==

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is corre
ctly specified.
```

In [43]:
```
#Parameters with 6 significant digits
model_1.summary2().tables[1]
```

Out[43]:

	Coef.	Std.Err.	t	P>|t|	[0.025	0.975]
Intercept	0.000141	0.000297	0.474101	0.635845	-0.000444	0.000725
X10Y_TBY	0.033568	0.012067	2.781725	0.005823	0.009800	0.057336

The estimate from the above variables result showcases that: 1. If the Oil increase by 0.01 or 1% the value for DXY will increase by 0.019497 or (~ 1.95%). 2. Whereas, the (Independent variable) P-values < 0.05, has more significant or impact over the (Dependent Varaible) As a repercussion, the independent variable with p-value greater than the designated parameter can be remove from the model to increase the model efficacy.

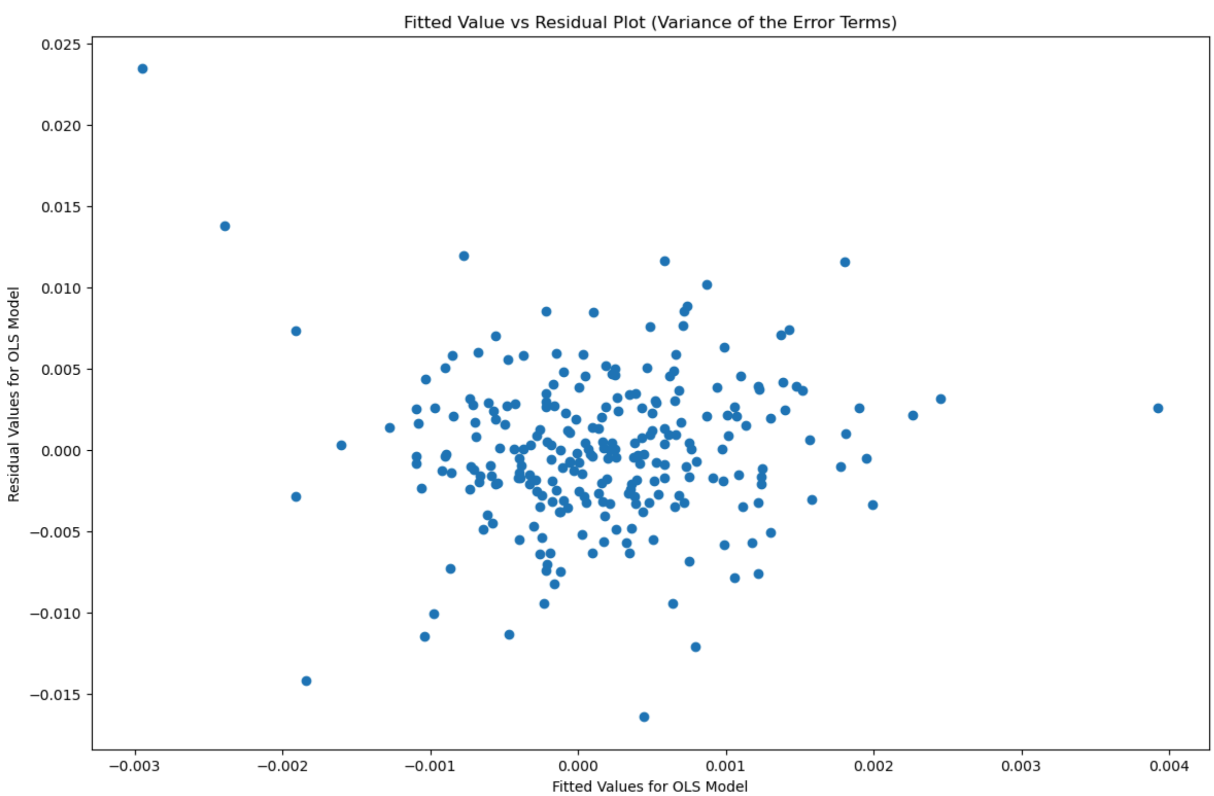
2. WLS - Weighted Least Square Regression

2.1 Scatter Plot for OLS Fitted Values and OLS Residual

In [44]:
```
# Scatter Plot for OLS Fitted Value and OLS Residuals

#Calculate the fitted Value and Residuals
model_1fitted = model_1.fittedvalues
model_1residual = model_1.resid

plt.scatter(x=model_1fitted,y=model_1residual)
plt.title("Fitted Value vs Residual Plot (Variance of the Error Terms)")
plt.xlabel("Fitted Values for OLS Model")
plt.ylabel("Residual Values for OLS Model")
plt.show()
```



The conclusion draw from this sccatter plot about the presense of heteroskedasticity is somewhat ambigous. However, from visual aid it has been clear that there is a clear low concentration of the scatter point when we move from 0 towards positive values. Although, to double confirm we will run Breusch-Pagan test.

2.2 Breusch-Pagan Test

In [45]:
```
# Breusch-Pagan Test
name = ["Lagrange multiplier statistic", "p-value", "f-value", "f p-value"]
test = sms.het_breuschpagan(model_1.resid, model_1.model.exog)
pd.DataFrame(test, index=name, columns=[""])
```

Out[45]:

Lagrange multiplier statistic	13.897238
p-value	0.000193
f-value	14.597521
f p-value	0.000168

It is confirmed that the model_1 consists of the Heteroskedasticity as the p-value is less than 0.005. As a repercussion we can eliminate the Null Hypothesis, that the model consists Homoscedasticity.

2.3 WLS Reggression Result

In [47]:
```
# Add absolute Residuals and Fitted Values to dataset columns
df["abs_residuals"]=np.abs(model_1.resid)
df["fitted_values"]=model_1.fittedvalues

# Fit OLS model with absolute residuals and fitted values
model_temp = smf.ols("abs_residuals ~ fitted_values",data=df).fit()

#Compute the weights and add it to the dataset columns
weights = model_temp.fittedvalues
weights = weights**-2
df["weights"]=weights

#Fit WLS Model
Y = df["DXY"].tolist()
X = df["X10Y_TBY"].tolist()
X = sm.add_constant(X) # Add the intercept point

model_2 = sm.WLS(Y,X,df["weights"]).fit()
print(model_2.summary())
```

```
                            WLS Regression Results                            
==============================================================================
==
Dep. Variable:                      y   R-squared:                       0.1
00
Model:                            WLS   Adj. R-squared:                  0.0
96
Method:                 Least Squares   F-statistic:                     27.
59
Date:                Tue, 26 Aug 2025   Prob (F-statistic):           3.23e-
07
Time:                        00:24:55   Log-Likelihood:                 994.
52
No. Observations:                 250   AIC:                            -198
5.
Df Residuals:                     248   BIC:                            -197
8.
Df Model:                           1                                         
Covariance Type:            nonrobust                                         
==============================================================================
==
                 coef    std err          t      P>|t|      [0.025      0.97
5]
------------------------------------------------------------------------------
--
const          0.0001      0.000      0.346      0.730      -0.000       0.0
01
x1             0.0516      0.010      5.253      0.000       0.032       0.0
71
==============================================================================
==
Omnibus:                       10.978   Durbin-Watson:                   1.9
65
Prob(Omnibus):                  0.004   Jarque-Bera (JB):               23.4
75
Skew:                           0.063   Prob(JB):                     7.99e-
06
Kurtosis:                       4.496   Cond. No.                         3
5.0
==============================================================================
==

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is corre
ctly specified.
```

Observations :

1. The "X10Y_TBY" stil has a positive coefficient and coefficient is still significant.
2. The R squared value has also improved from 0.3 to 0.10. It implies that the independent variable more accurately explains the movement of dependent variable in the WLS Regression Model as compared to the OLS Regression Model.

In [ ]: