In [1]:
```
import pandas as pd
import statsmodels.api as sm
```

1.) Import Data from FRED

In [2]:
```
data = pd.read_csv("TaylorRuleData.csv", index_col = 0)
```

In [3]:
```
data.index = pd.to_datetime(data.index)
```

In [7]:
```
data.dropna(inplace=True)
```

In [8]:
```
data
```

Out[8]:

	FedFunds	Unemployment	HousingStarts	Inflation
1959-01-01	2.48	6.0	1657.0	29.010
1959-02-01	2.43	5.9	1667.0	29.000
1959-03-01	2.80	5.6	1620.0	28.970
1959-04-01	2.96	5.2	1590.0	28.980
1959-05-01	2.90	5.1	1498.0	29.040
...	...	...	...	...
2023-07-01	5.12	3.5	1451.0	304.348
2023-08-01	5.33	3.8	1305.0	306.269
2023-09-01	5.33	3.8	1356.0	307.481
2023-10-01	5.33	3.8	1359.0	307.619
2023-11-01	5.33	3.7	1560.0	307.917

779 rows × 4 columns

2.) Do Not Randomize, split your data into Train, Test Holdout

In [10]:
```
split_1 = int(len(data)*.6)
split_2 = int(len(data)*.9)
data_in = data[:split_1]
data_out = data[split_1:split_2]
data_hold = data[split_2:]
```

In [11]:
```
X_in = data_in.iloc[:,1:]
y_in = data_in.iloc[:,0]
X_out = data_out.iloc[:,1:]
y_out = data_out.iloc[:,0]
X_hold = data_hold.iloc[:,1:]
y_hold = data_hold.iloc[:,0]
```

In [12]:
```
# Add Constants
X_in = sm.add_constant(X_in)
X_out = sm.add_constant(X_out)
X_hold = sm.add_constant(X_hold)
```

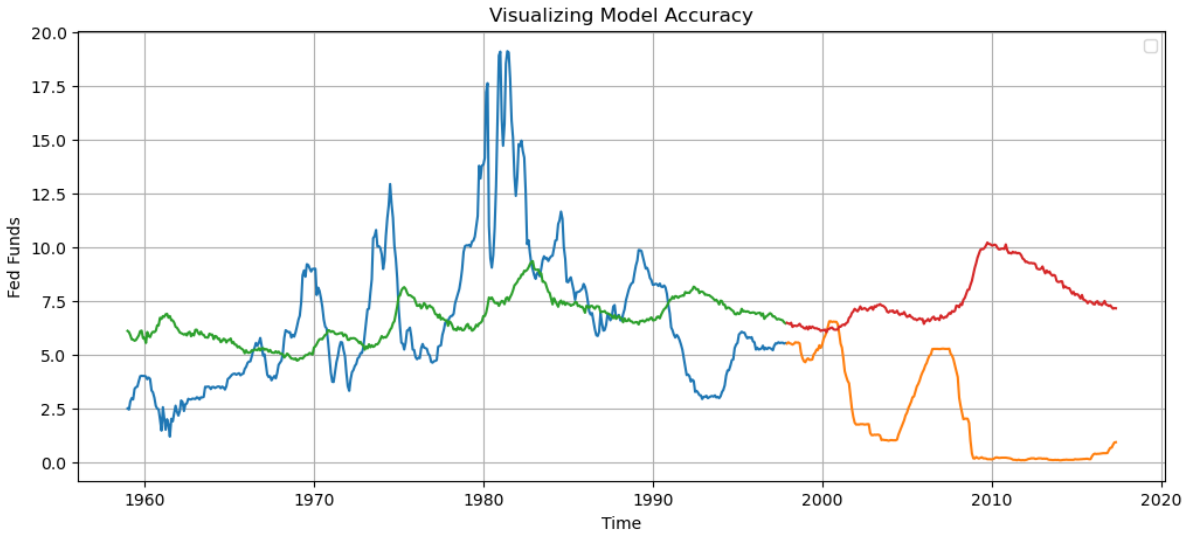
3.) Build a model that regresses FF~Unemp, HousingStarts, Inflation

In [13]:
```
model1 = sm.OLS(y_in,X_in).fit()
```

4.) Recreate the graph fro your model

In [14]:
```
import matplotlib.pyplot as plt
```

In [16]:
```
plt.figure(figsize = (12,5))

plt.plot(y_in)

plt.plot(y_out)
plt.plot(model1.predict(X_in))
plt.plot(model1.predict(X_out))

plt.ylabel("Fed Funds")
plt.xlabel("Time")
plt.title("Visualizing Model Accuracy")
plt.legend([])
plt.grid()
plt.show()
```



"All Models are wrong but some are useful" - 1976 George Box

5.) What are the in/out of sample MSEs

In [18]:
```
from sklearn.metrics import mean_squared_error
```

In [19]:
```
in_mse_1 = mean_squared_error(y_in,model1.predict(X_in))
out_mse_1 = mean_squared_error(y_out,model1.predict(X_out))
```

In [20]:
```
print("Insample MSE : ", in_mse_1)
print("Outsample MSE : ", out_mse_1)
```

```
Insample MSE :  10.071422013168641
Outsample MSE :  40.36082783566732
```

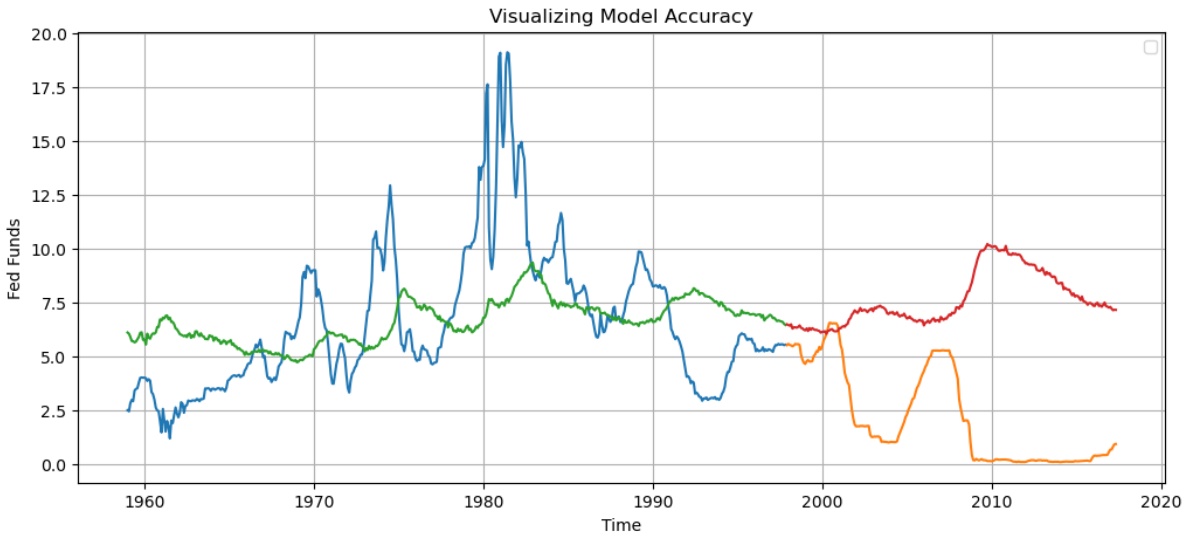
6.) Using a for loop. Repeat 3,4,5 for polynomial degrees 1,2,3

In [54]:
```
from sklearn.preprocessing import PolynomialFeatures
```

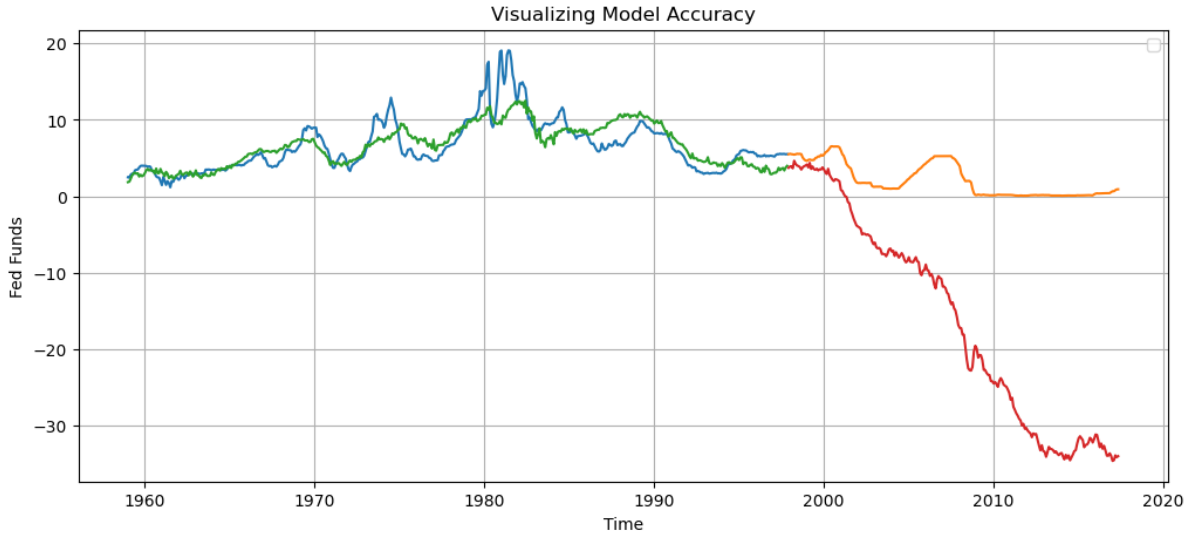
In [55]:
```
max_degrees = 3
```

In [65]:
```
for degrees in range(1, 1+max_degrees):
    print("DEGREES:", degrees)
    poly = PolynomialFeatures( degree = degrees)

    X_in_poly = poly.fit_transform(X_in)
    X_out_poly = poly.fit_transform(X_out)

    #Q3.
    model1 = sm.OLS(y_in,X_in_poly).fit()
    #Q4.

    plt.figure(figsize = (12,5))
    in_preds = model1.predict(X_in_poly)
    in_preds = pd.DataFrame (in_preds,index = y_in.index )
    plt.plot(y_in)
    plt.plot(y_out)

    plt.plot(data_in.index,model1.predict(X_in_poly))
    plt.plot(data_out.index,model1.predict(X_out_poly))
    plt.ylabel("Fed Funds")
    plt.xlabel("Time")
    plt.title("Visualizing Model Accuracy")
    plt.legend([])
    plt.grid()
    plt.show()
```

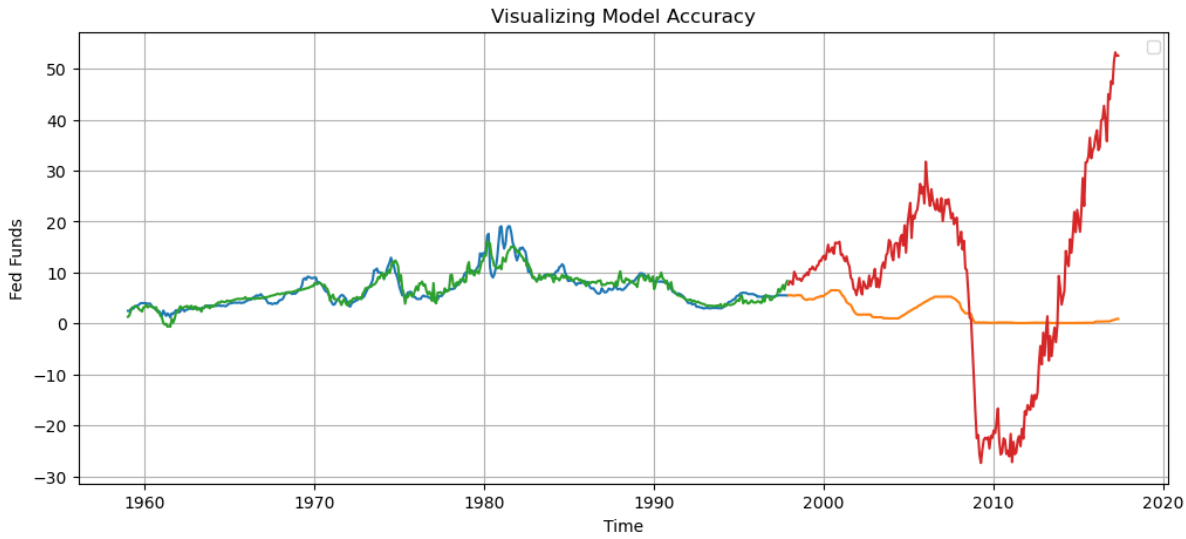
```
DEGREES: 1
```



DEGREES: 2



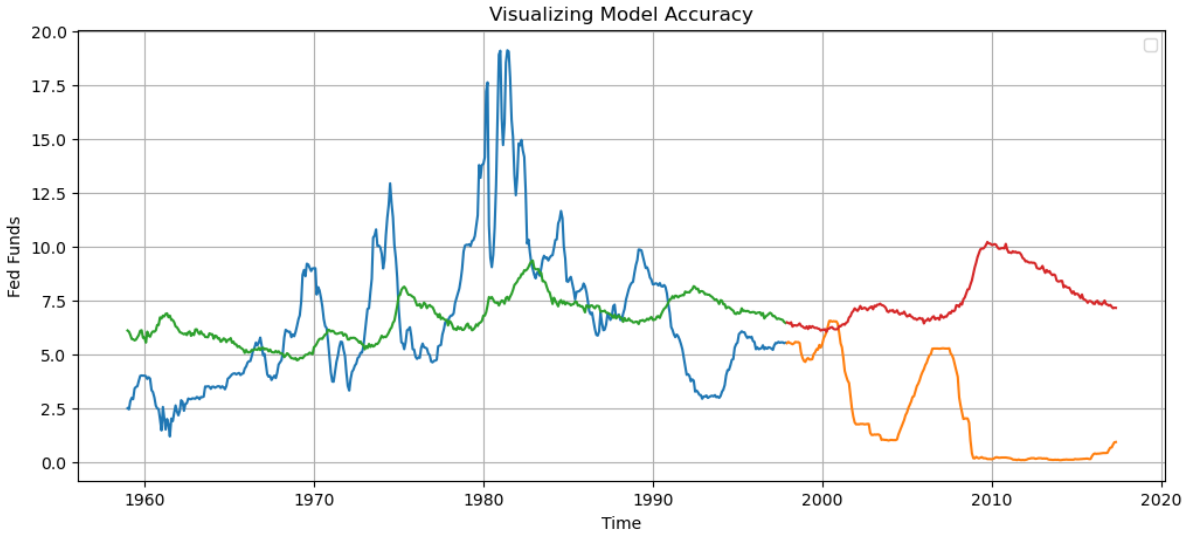
DEGREES: 3



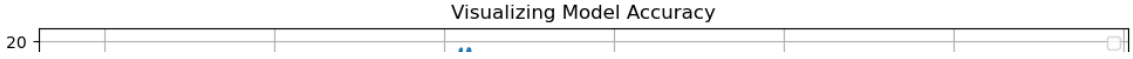
In [69]:

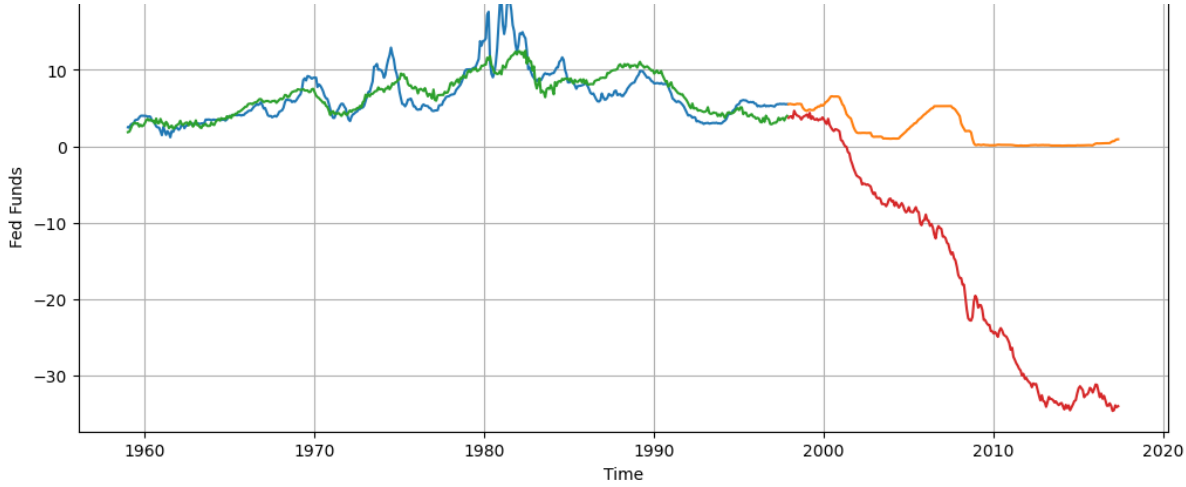
```
for degrees in range(1, 1+max_degrees):
    print("DEGREES:", degrees)
    poly = PolynomialFeatures( degree = degrees)

    X_in_poly = poly.fit_transform(X_in)
    X_out_poly = poly.fit_transform(X_out)

    #Q3.
    model1 = sm.OLS(y_in,X_in_poly).fit()
    #Q4.

    plt.figure(figsize = (12,5))
    in_preds = model1.predict(X_in_poly)
    in_preds = pd.DataFrame (in_preds,index = y_in.index )
    plt.plot(y_in)
    plt.plot(y_out)

    plt.plot(data_in.index,model1.predict(X_in_poly))
    plt.plot(data_out.index,model1.predict(X_out_poly))
    plt.ylabel("Fed Funds")
    plt.xlabel("Time")
    plt.title("Visualizing Model Accuracy")
    plt.legend([])
    plt.grid()
    plt.show()

    in_mse_1 = mean_squared_error(y_in,model1.predict(X_in_poly))
    out_mse_1 = mean_squared_error(y_out,model1.predict(X_out_poly))
    print("Insample MSE : ", in_mse_1)
    print("Outsample MSE : ", out_mse_1)
```

```
DEGREES: 1
```

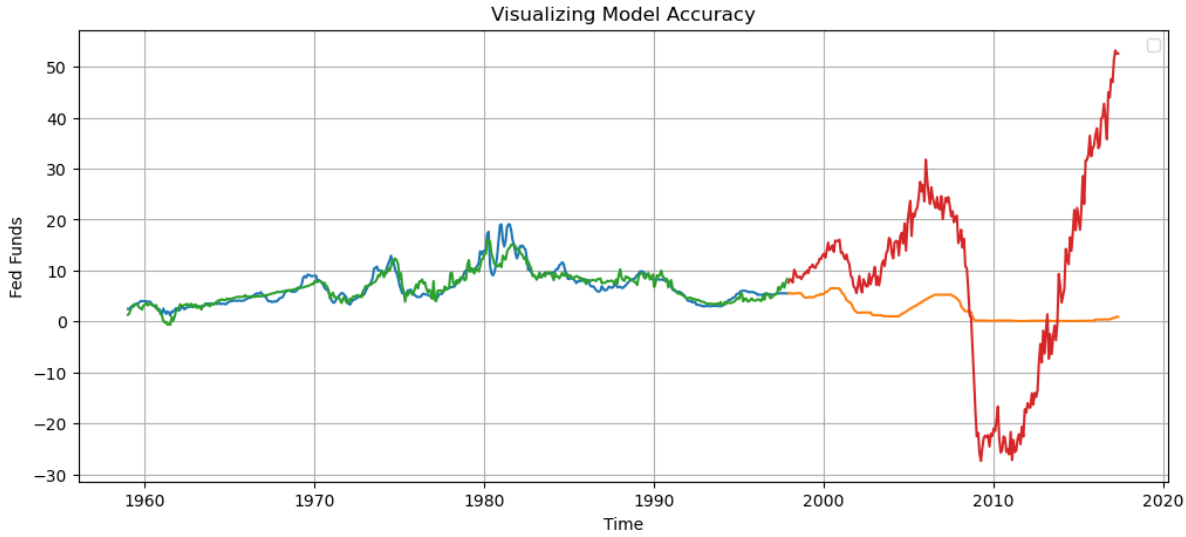



```
Insample MSE :  10.071422013168641
Outsample MSE :  40.360827835665916
DEGREES: 2
```






```
Insample MSE :  3.863477139276069
Outsample MSE :  481.44650991792037
DEGREES: 3
```




```
Insample MSE :  1.8723636267594668
Outsample MSE :  371.7677889463972
```

7.) State your observations :

simplest model does not perform that well. The second model performs much better in in sample. but then out of sample is not perfroming well. In the third we hope that the out of sample perfrroms betters with increase in complexity.