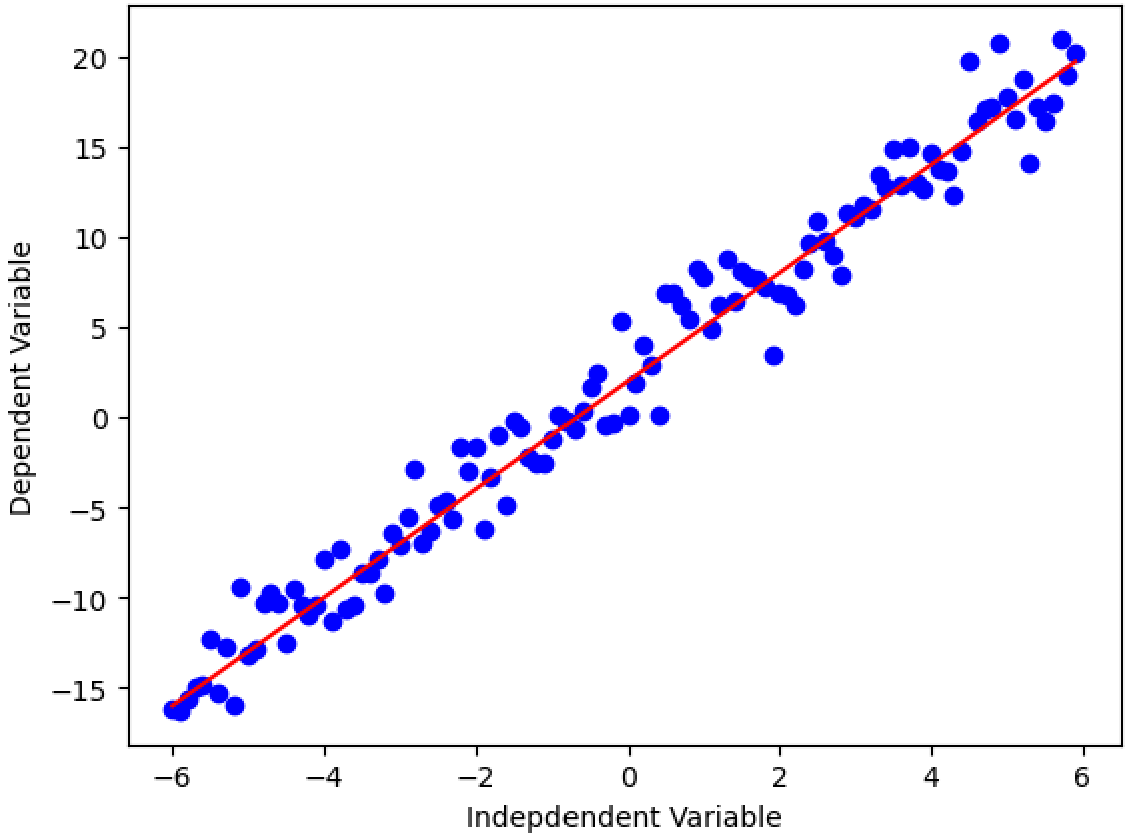
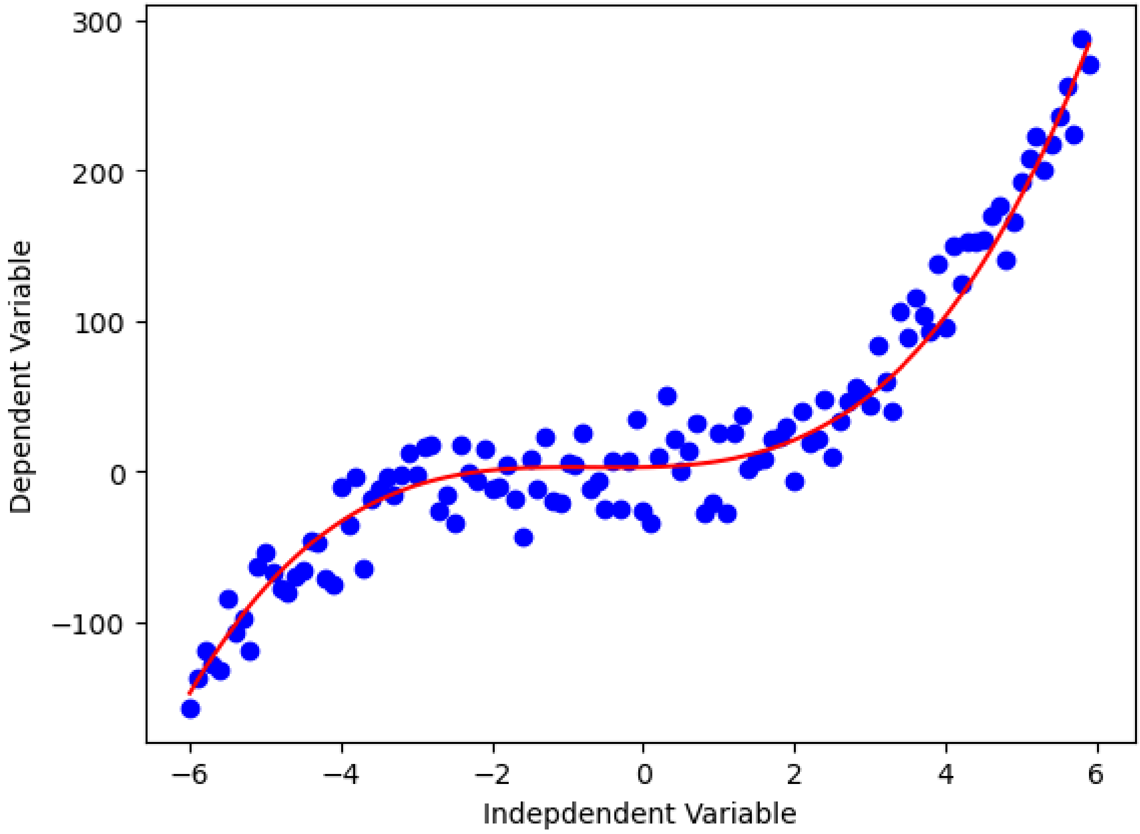
In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

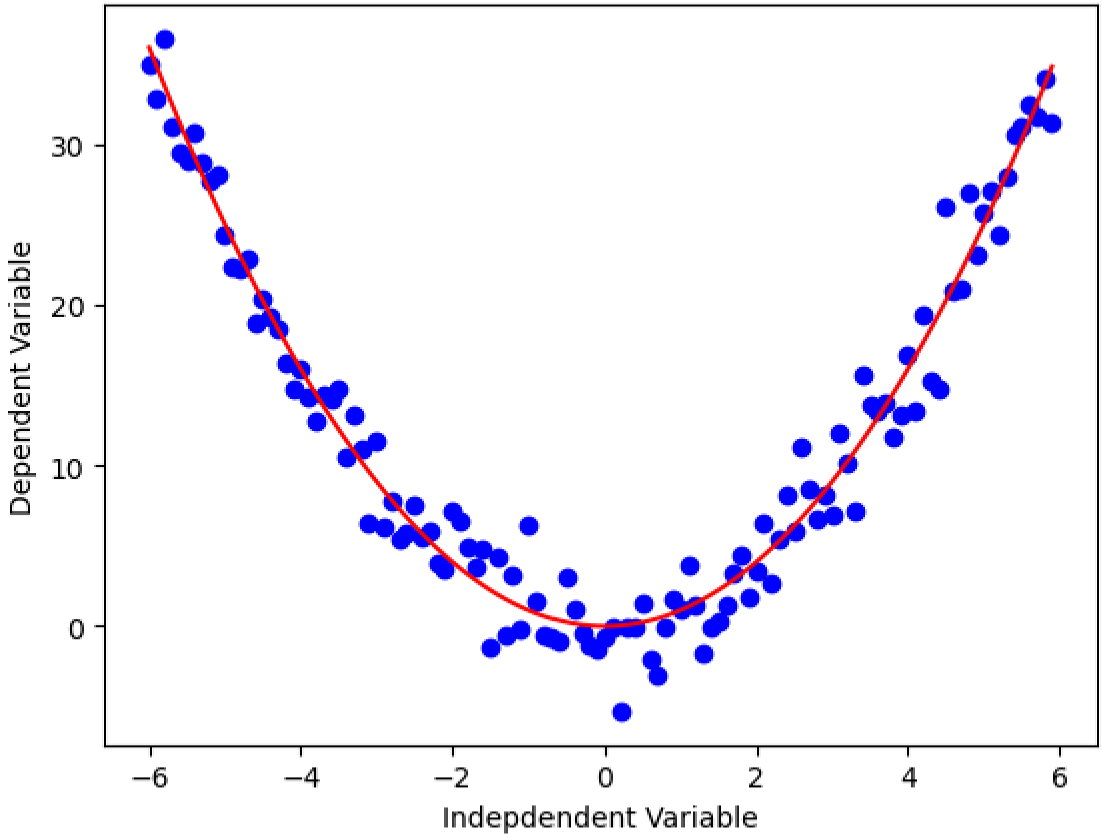
In [2]:
```
x = np.arange(-6.0, 6.0, 0.1)

##You can adjust the slope and intercept to verify the changes in the
y = 3*(x) + 2
y_noise = 2 * np.random.normal(size=x.size)
ydata = y + y_noise
#plt.figure(figsize=(8,6))
plt.plot(x, ydata,  'bo')
plt.plot(x,y, 'r')
plt.ylabel('Dependent Variable')
plt.xlabel('Indepdendent Variable')
plt.show()
```



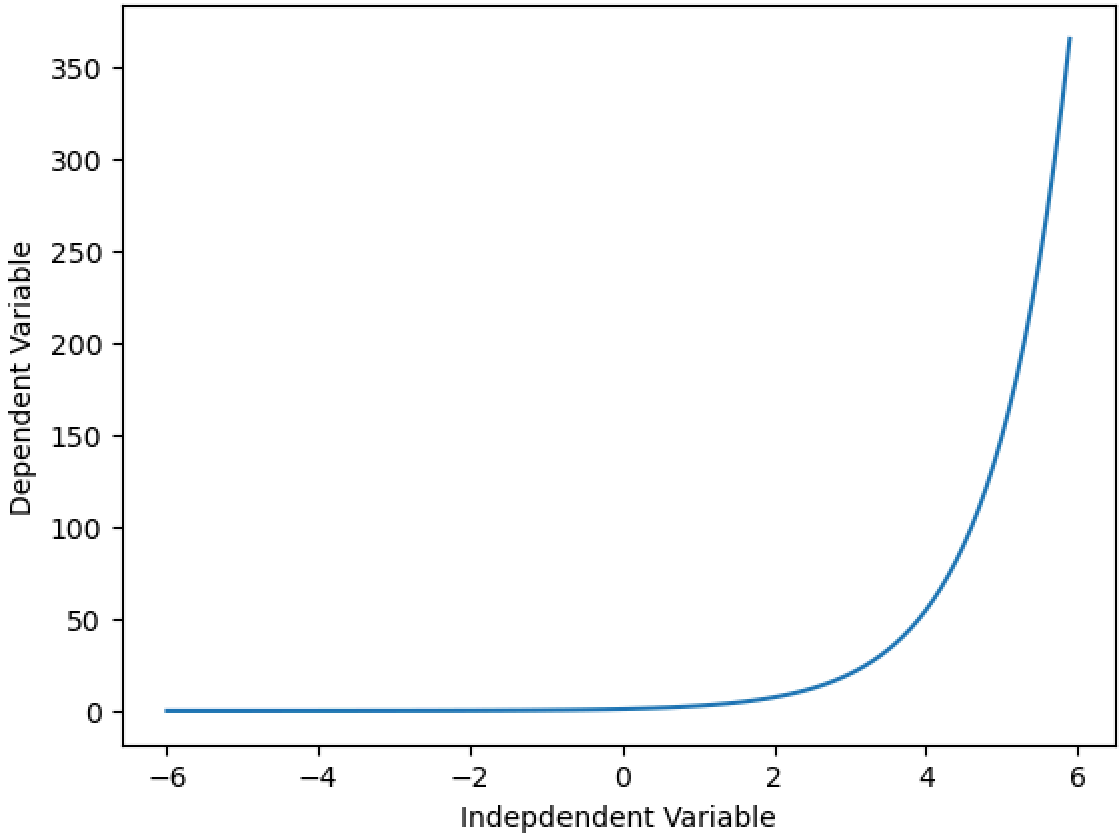
In [3]:
```
x = np.arange(-6.0, 6.0, 0.1)

##You can adjust the slope and intercept to verify the changes in the
y = 1*(x**3) + 2*(x**2) + 1*x + 3
y_noise = 20 * np.random.normal(size=x.size)
ydata = y + y_noise
plt.plot(x, ydata,  'bo')
plt.plot(x,y, 'r')
plt.ylabel('Dependent Variable')
plt.xlabel('Indepdendent Variable')
plt.show()
```



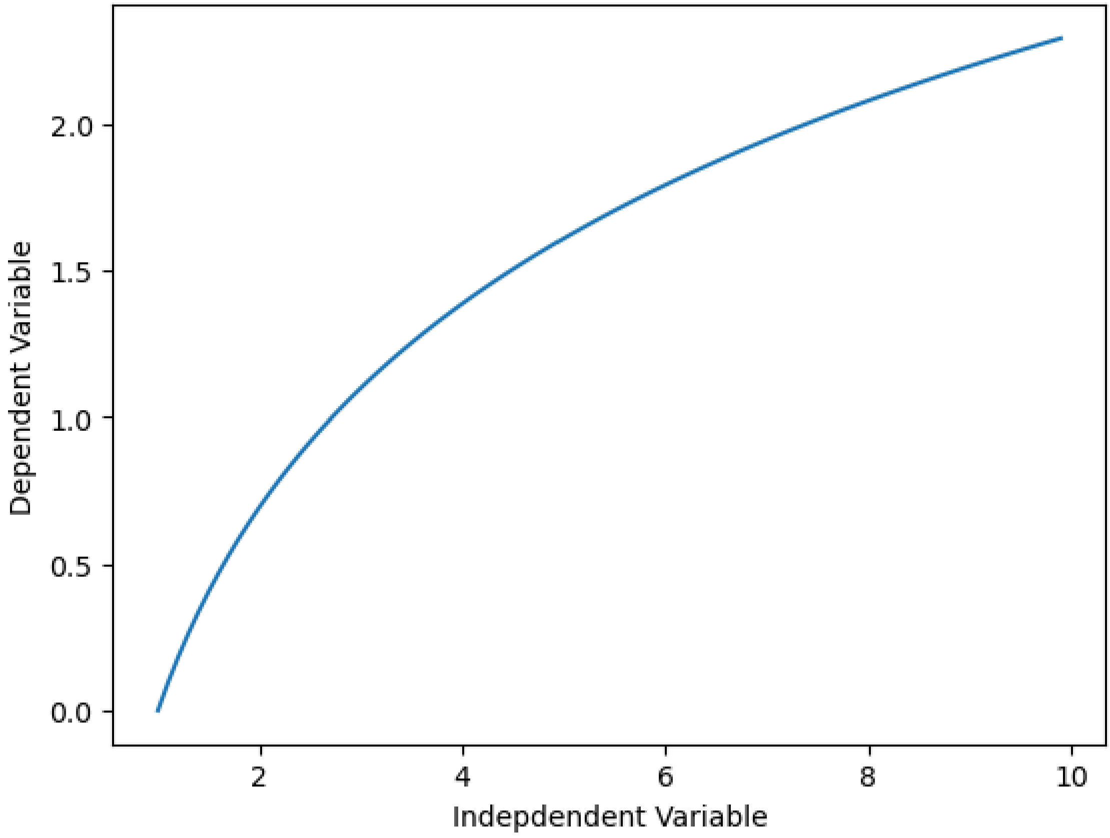
In [4]:
```
x = np.arange(-6.0, 6.0, 0.1)

##You can adjust the slope and intercept to verify the changes in the

y = np.power(x,2)
y_noise = 2 * np.random.normal(size=x.size)
ydata = y + y_noise
plt.plot(x, ydata,  'bo')
plt.plot(x,y, 'r')
plt.ylabel('Dependent Variable')
plt.xlabel('Indepdendent Variable')
plt.show()
```



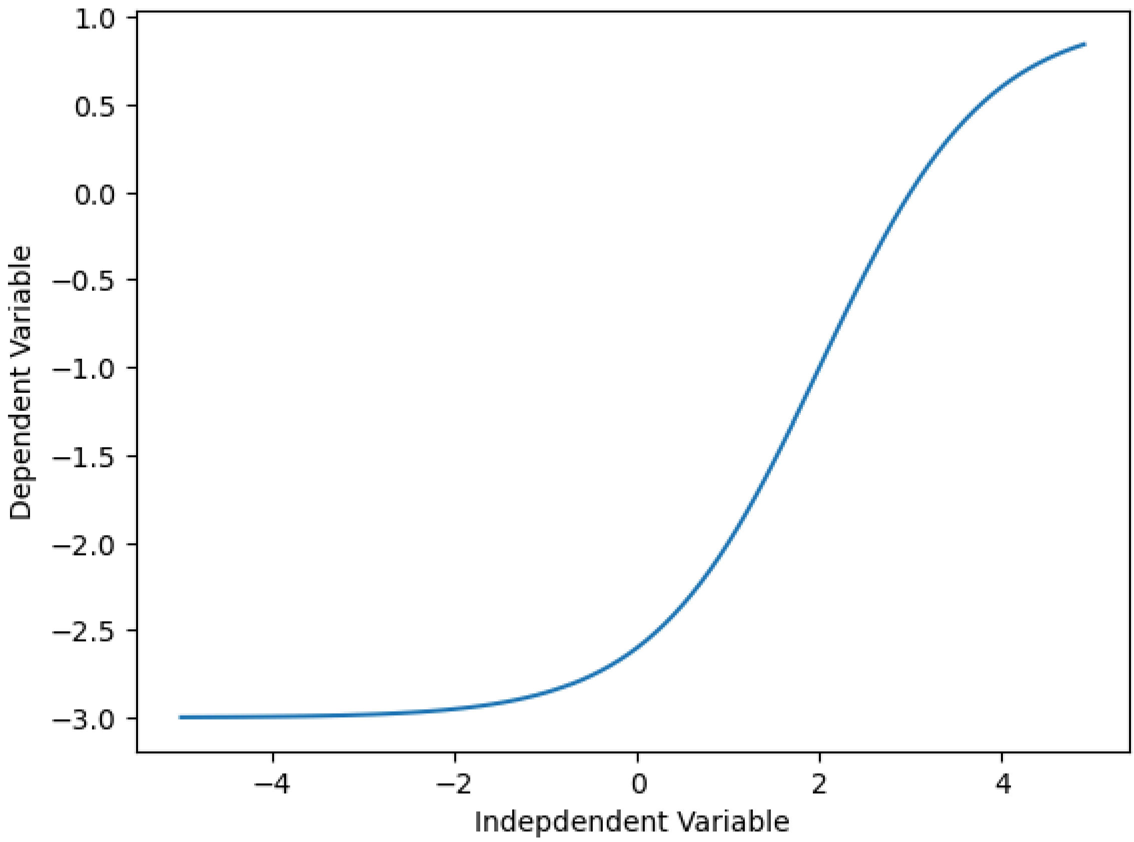
In [5]:
```
X = np.arange(-6.0, 6.0, 0.1)

##You can adjust the slope and intercept to verify the changes in the

Y= np.exp(X)

plt.plot(X,Y)
plt.ylabel('Dependent Variable')
plt.xlabel('Indepdendent Variable')
plt.show()
```



In [6]:
```
X = np.arange(1.0, 10.0, 0.1)

Y = np.log(X)

plt.plot(X,Y)
plt.ylabel('Dependent Variable')
plt.xlabel('Indepdendent Variable')
plt.show()
```



In [7]:
```
X = np.arange(-5.0, 5.0, 0.1)


Y = 1-4/(1+np.power(3, X-2))

plt.plot(X,Y)
plt.ylabel('Dependent Variable')
plt.xlabel('Indepdendent Variable')
plt.show()
```

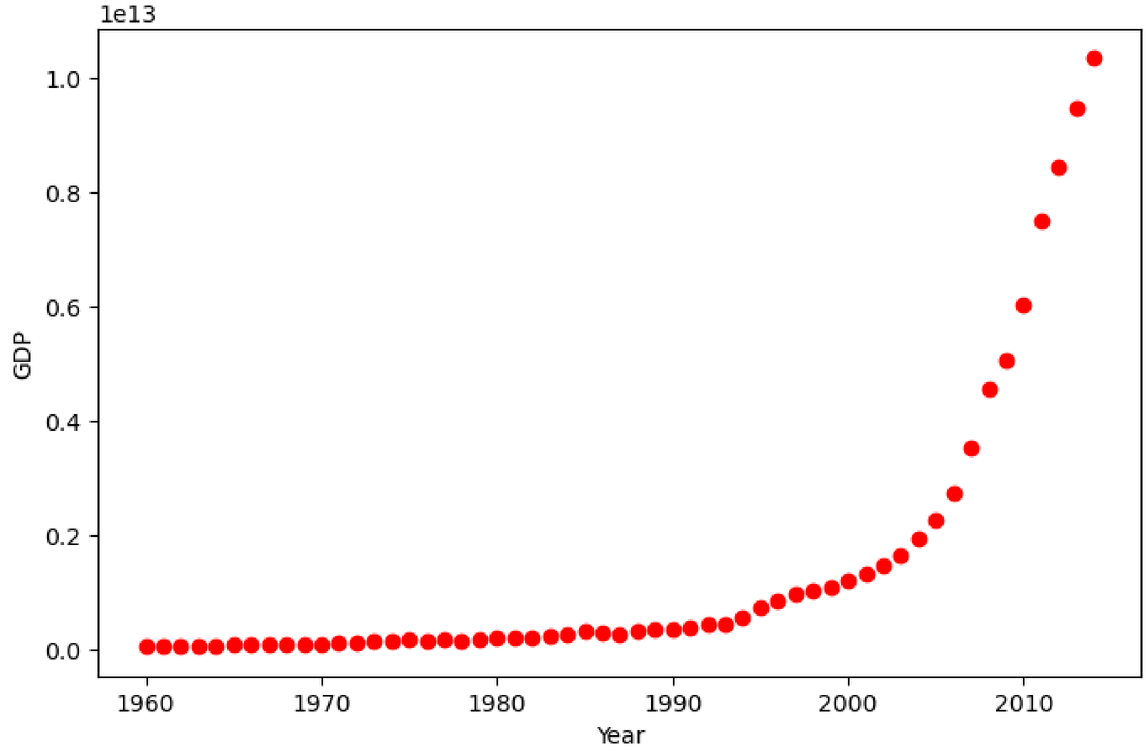


In [8]:
```
import pandas as pd

df = pd.read_csv("/Users/akheruddinahmed/ML/china_gdp.csv")
df.head(10)
```

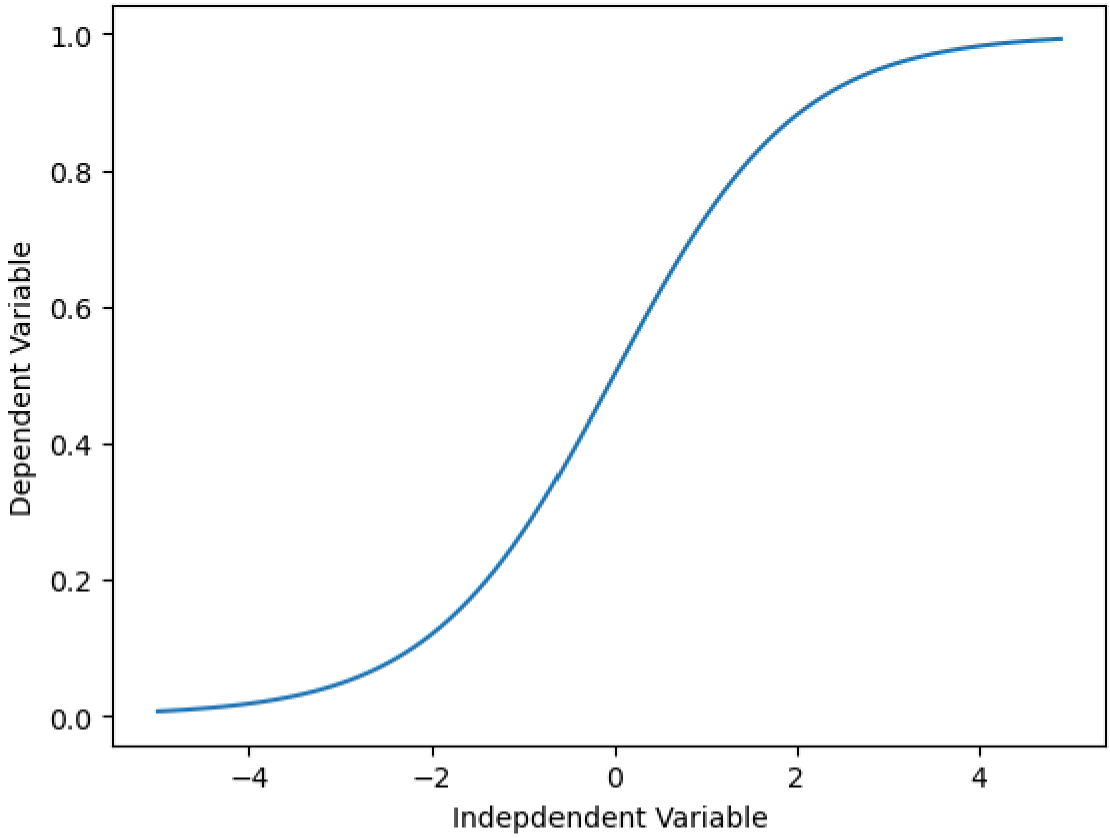
Out[8]:

	Year	Value
0	1960	5.918412e+10
1	1961	4.955705e+10
2	1962	4.668518e+10
3	1963	5.009730e+10
4	1964	5.906225e+10
5	1965	6.970915e+10
6	1966	7.587943e+10
7	1967	7.205703e+10
8	1968	6.999350e+10
9	1969	7.871882e+10

In [9]:
```
plt.figure(figsize=(8,5))
x_data, y_data = (df["Year"].values, df["Value"].values)
plt.plot(x_data, y_data, 'ro')
plt.ylabel('GDP')
plt.xlabel('Year')
plt.show()
```



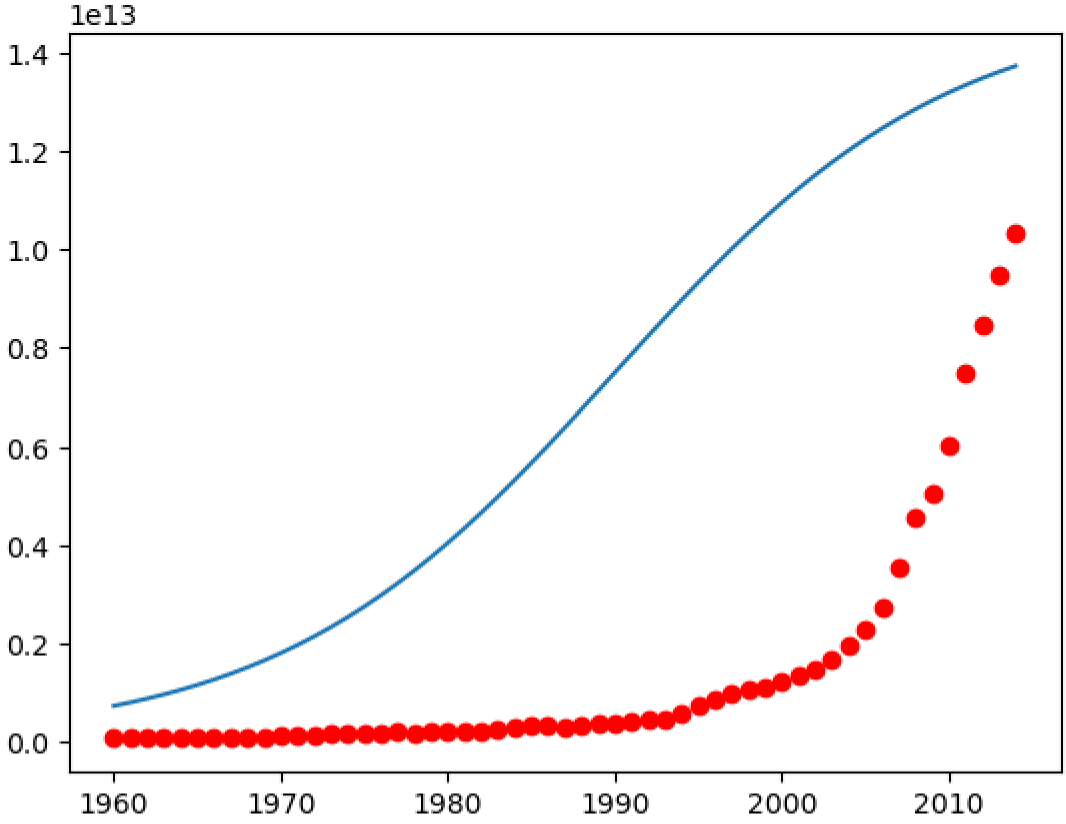
In [10]:
```
X = np.arange(-5,5.0, 0.1)
Y = 1.0 / (1.0 + np.exp(-X))

plt.plot(X,Y)
plt.ylabel('Dependent Variable')
plt.xlabel('Indepdendent Variable')
plt.show()
```



In [11]:
```
def sigmoid(x, Beta_1, Beta_2):
     y = 1 / (1 + np.exp(-Beta_1*(x-Beta_2)))
     return y
```

In [12]:
```
beta_1 = 0.10
beta_2 = 1990.0

#logistic function
Y_pred = sigmoid(x_data, beta_1 , beta_2)

#plot initial prediction against datapoints
plt.plot(x_data, Y_pred*15000000000000.)
plt.plot(x_data, y_data, 'ro')
```

Out[12]:
```
[<matplotlib.lines.Line2D at 0x142c10610>]
```

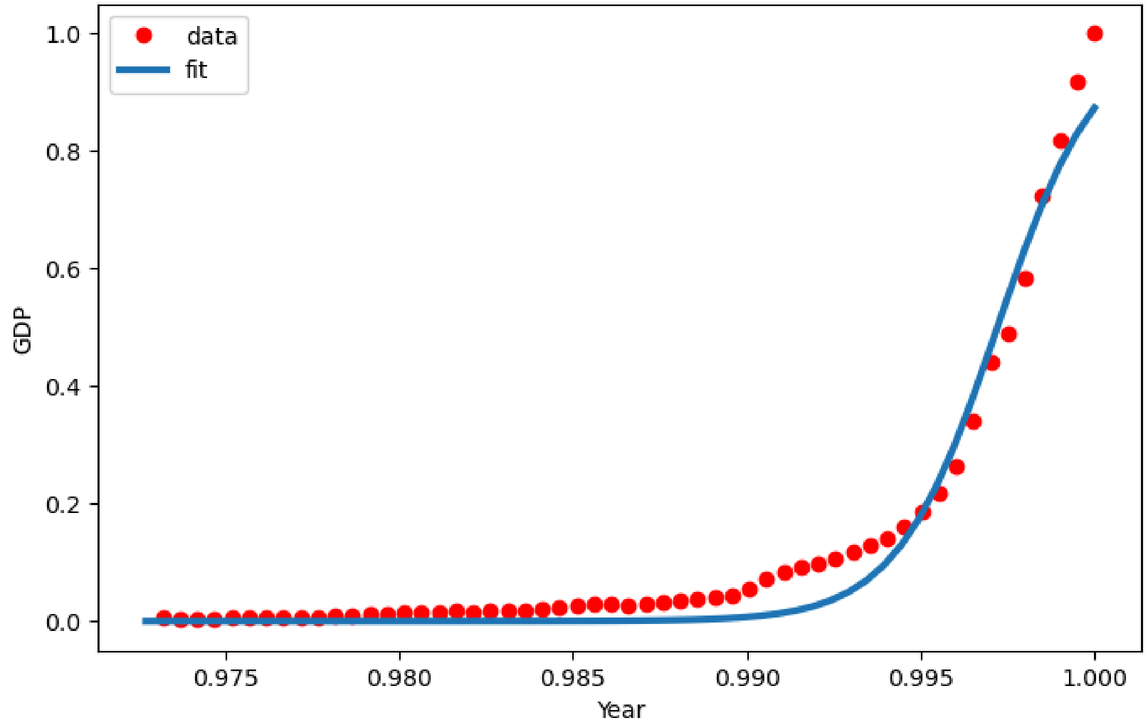


In [13]:
```
# Lets normalize our data
xdata =x_data/max(x_data)
ydata =y_data/max(y_data)
```

In [14]:
```
from scipy.optimize import curve_fit
popt, pcov = curve_fit(sigmoid, xdata, ydata)
#print the final parameters
print(" beta_1 = %f, beta_2 = %f" % (popt[0], popt[1]))
```

```
 beta_1 = 690.451714, beta_2 = 0.997207
```

In [15]:
```
x = np.linspace(1960, 2015, 55)
x = x/max(x)
plt.figure(figsize=(8,5))
y = sigmoid(x, *popt)
plt.plot(xdata, ydata, 'ro', label='data')
plt.plot(x,y, linewidth=3.0, label='fit')
plt.legend(loc='best')
plt.ylabel('GDP')
plt.xlabel('Year')
plt.show()
```



In [16]:
```
# split data into train/test
msk = np.random.rand(len(df)) < 0.8
train_x = xdata[msk]
test_x = xdata[~msk]
train_y = ydata[msk]
test_y = ydata[~msk]

# build the model using train set
popt, pcov = curve_fit(sigmoid, train_x, train_y)

# predict using test set
y_hat = sigmoid(test_x, *popt)

# evaluation
print("Mean absolute error: %.2f" % np.mean(np.absolute(y_hat - test_y
print("Residual sum of squares (MSE): %.2f" % np.mean((y_hat - test_y)
from sklearn.metrics import r2_score
print("R2-score: %.2f" % r2_score(y_hat , test_y) )
```

```
Mean absolute error: 0.03
Residual sum of squares (MSE): 0.00
R2-score: 0.97
```

In [ ]: