Welcome to my Data Report! We will be investigating the relationship between Labor Force Participation Rate of Females Over the Age of 15 Against GDP. Our main question: Does an association between the two exist? Let's find out!

In [148]:
```
import pandas as pd
import time
import os
import matplotlib.pyplot as plt
import numpy as np
import pyarrow as pa
import pyarrow.parquet as pq
from colorama import Fore, Back, Style
```

In [149]:
```
file_name = '/Users/EricsHome/Data_Bootcamp_Eric_Boyda _Spring_2019/World_Bank_Data.xlsx'
file_name_1 = '/Users/EricsHome/Data_Bootcamp_Eric_Boyda _Spring_2019/GDP in Current US Dollars 2.xlsx'
file_name_2 = '/Users/EricsHome/Data_Bootcamp_Eric_Boyda _Spring_2019/population_sizes.xlsx'

lf_df_all = pd.read_excel(file_name)
gdp_df_all = pd.read_excel(file_name_1)
pop_df_all = pd.read_excel(file_name_2)
```

In [150]:
```
def clean_function(df):
    df.columns = df.iloc[1]
    df = df.reindex(df.index.drop(1))
    df.drop([0], inplace = True)
    df = df.drop(columns = [1960.0,
 1961.0,
 1962.0,
 1963.0,
 1964.0,
 1965.0,
 1966.0,
 1967.0,
 1968.0,
 1969.0,
 1970.0,
 1971.0,
 1972.0,
 1973.0,
 1974.0,
 1975.0,
 1976.0,
 1977.0,
 1978.0,
 1979.0,
 1980.0,
 1981.0,
 1982.0,
 1983.0,
 1984.0,
 1985.0,
 1986.0,
 1987.0,
 1988.0,
 1989.0, 2018.0, "Country Code", "Indicator Name", "Indicator Code"])
    df.dropna(inplace = True)
    return df
```

In [151]:
```
lf_df_all = clean_function(lf_df_all)
gdp_df_all = clean_function(gdp_df_all)
pop_df_all = clean_function(pop_df_all)
```

In [152]:
```
regions_df = pop_df_all.sort_values(by = 2017.0, ascending = False)
```

In [153]:
```
regions_df.drop(regions_df.index[15:17], inplace = True)
regions_df.drop(regions_df.index[41:52], inplace = True)
regions_df.drop(regions_df.index[42:64], inplace = True)
regions_df.drop(regions_df.index[43:53], inplace = True)
regions_df.drop(regions_df.index[44:], inplace = True)
```

In [154]:
```
country_list = lf_df_all["Country Name"]
gdp_df_all = gdp_df_all[(gdp_df_all["Country Name"].isin(country_list))]
```

In [155]:
```
country_list_2 = gdp_df_all["Country Name"]
lf_df_all = lf_df_all[(lf_df_all["Country Name"].isin(country_list_2))]
```

In [156]:
```
pop_df_all = pop_df_all[(pop_df_all["Country Name"].isin(country_list_2
))]
regions_df = regions_df[(regions_df["Country Name"].isin(country_list_2
))]
```

In [157]:
```
lf_df = lf_df_all.drop(regions_df.index, axis=0)
gdp_df = gdp_df_all.drop(regions_df.index, axis=0)
pop_df = pop_df_all.drop(regions_df.index, axis=0)
```

All of the code above cleaned the functions of 'nan' values and assured that each dataframe would have the same list of countries. I kept a dataframe with just the regions and three dataframes with everything, just in case I needed it.

In this section, I wish to investigate how the top and lowest performing countries, in terms of labor force growth for women, compared to their GDP. I performed the counter for the countries with the highest and lowest GDP performances over the last 27 years.

In [158]:
```
lf_df_all["Δlf"] = lf_df[2017.0] - lf_df[1990.0]
```

In [159]:
```
gdp_df_all["Δgdp"] = gdp_df[2017.0] - gdp_df[1990.0]
```

In [160]:
```
lf_df["Δlf"] = lf_df[2017.0] - lf_df[1990.0]
```

In [161]:
```
gdp_df["Δgdp"] = gdp_df[2017.0] - gdp_df[1990.0]
```

In [162]:
```
gdp_df_all = gdp_df_all.sort_values(by = "Δgdp", ascending = False)
```

In [163]:
```
lf_df_all = lf_df_all.sort_values(by = "Δlf", ascending = False)
```

In [164]:
```
lf_df = lf_df.sort_values(by = "Δlf", ascending = False)
```

In [165]:
```
gdp_df = gdp_df.sort_values(by = "Δgdp", ascending = False)
```

In [166]:
```
lf_df.head(5)
```

Out[166]:

1	Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	
45	Colombia	29.856001	30.379999	30.976000	31.450001	32.861000	34.294998	35.751999	37.2
186	Peru	43.134998	43.500999	44.584000	45.688999	46.824001	50.083000	52.778000	55.5
158	Mali	35.404999	35.433998	35.373001	35.367001	35.382999	35.400002	35.452000	35.5
152	Maldives	20.212999	21.652000	23.184999	24.799999	26.475000	28.186001	29.974001	31.7
146	Macao SAR, China	44.164001	44.419998	45.953999	46.387001	47.289001	48.328999	55.490002	55.1

5 rows × 30 columns

In [167]:
```
top_5_lf = ["Colombia", "Peru", "Mali" , "Maldives" , "Macao SAR, China"
]
```

In [168]:
```
lf_df.tail(5)
```

Out[168]:

1	Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	1
16	Burundi	90.783997	90.345001	89.845001	89.282997	88.665001	87.992996	87.262001	86.4
262	Yemen, Rep.	16.832001	16.792999	16.761000	16.806999	16.848000	17.761999	18.707001	19.6
40	China	73.197998	73.083000	72.971001	72.851997	72.707001	72.519997	72.296997	72.0
201	Romania	62.076000	62.212002	62.381001	62.236000	62.043999	61.828999	58.709999	59.5
19	Burkina Faso	76.218002	76.285004	75.478996	74.650002	73.792000	72.907997	71.987999	71.0

5 rows × 30 columns

In [169]:
```
bottom_5_lf = ["Burundi", "Yemen, Rep.", "China", "Romania", "Burkina Fa
so"]
```

In [170]:
```
gdp_df.head(5)
```

Out[170]:

1	Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	19
251	United States	5.979589e+12	6.174043e+12	6.539299e+12	6.878718e+12	7.308755e+12	7.664060e
40	China	3.608579e+11	3.833733e+11	4.269157e+11	4.447313e+11	5.643247e+11	7.345479e
109	India	3.209790e+11	2.701053e+11	2.882084e+11	2.792960e+11	3.272756e+11	3.602820e
55	Germany	1.764968e+12	1.861874e+12	2.123131e+12	2.068556e+12	2.205966e+12	2.591620e
119	Japan	3.132818e+12	3.584420e+12	3.908809e+12	4.454144e+12	4.907039e+12	5.449116e

5 rows × 30 columns

In [171]:
```
top_5_gdp = ["United States", "China", "India", "Germany", "Japan"]
```

In [172]:
```
gdp_df.tail(5)
```

Out[172]:

1	Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	
258	Vanuatu	1.583974e+08	1.888700e+08	1.961426e+08	1.880804e+08	2.192603e+08	2.33902
46	Comoros	4.296221e+08	4.241088e+08	4.573886e+08	4.528814e+08	3.191892e+08	3.98461
253	St. Vincent and the Grenadines	2.403653e+08	2.548296e+08	2.779541e+08	2.863078e+08	2.894385e+08	3.16008
34	Central African Republic	1.440711e+09	1.377375e+09	1.411918e+09	1.278781e+09	8.511744e+08	1.11539
239	Tonga	1.135638e+08	1.322011e+08	1.370663e+08	1.384899e+08	1.937759e+08	2.02547

5 rows × 30 columns

In [173]:
```
bottom_5_gdp = ["Vanuatu", "Comoros", "St. Vincent and the Grenadines",
"Central African Republic", "Tonga"]
```

In [174]:
```
lf_df_all_transposed = lf_df_all.set_index(["Country Name"], inplace = T
rue)
lf_df_all_transposed = lf_df_all.transpose()
lf_df_all_transposed = lf_df_all_transposed.drop("Δlf", axis = 0)
```

In [175]:
```
lf_df_transposed = lf_df.set_index(["Country Name"], inplace = True)
lf_df_transposed = lf_df.transpose()
lf_df_transposed = lf_df_transposed.drop("Δlf", axis = 0)
```

In [176]:
```
gdp_df_all_transposed = gdp_df_all.set_index(["Country Name"], inplace =
True)
gdp_df_all_transposed = gdp_df_all.transpose()
gdp_df_all_transposed = gdp_df_all_transposed.drop("Δgdp", axis = 0)
```

In [177]:
```
gdp_df_transposed = gdp_df.set_index(["Country Name"], inplace = True)
gdp_df_transposed = gdp_df.transpose()
gdp_df_transposed = gdp_df_transposed.drop("Δgdp", axis = 0)
```

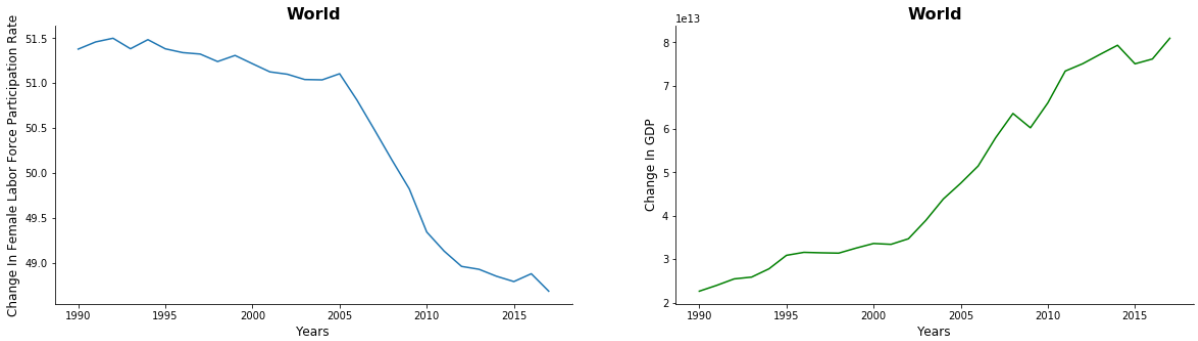
In [178]:
```
master_list = ['top_5_lf', 'bottom_5_lf', 'top_5_gdp', 'bottom_5_gdp']
```

All of the code above simply puts these high end or low end performing countries into groups so I can call on them later.

Let's start by looking at the world as a whole first

In [179]:
```
print(Fore.BLUE + Style.BRIGHT + "                World: Change in Femal
e Labor Force Participation Rate Against Change in GDP Over Time ")

fig, (ax1, ax2) = plt.subplots(nrows = 1, ncols = 2, figsize= (20,5))

ax1.plot(lf_df_all_transposed.index, lf_df_all_transposed["World"])

ax1.set_xlabel("Years", fontsize = 12)
ax1.set_ylabel("Change In Female Labor Force Participation Rate", fontsi
ze = 12)

ax1.set_title("World", fontsize = 16, fontweight = "bold")

ax1.spines["right"].set_visible(False)
ax1.spines["top"].set_visible(False)

ax2.plot(gdp_df_all_transposed.index, gdp_df_all_transposed["World"], co
lor = 'green')

ax2.set_xlabel("Years", fontsize = 12)
ax2.set_ylabel("Change In GDP", fontsize = 12)

ax2.set_title("World", fontsize = 16, fontweight = "bold")

ax2.spines["right"].set_visible(False)
ax2.spines["top"].set_visible(False)

plt.savefig("world_change.png", bbox_inches = "tight")

plt.show()
```

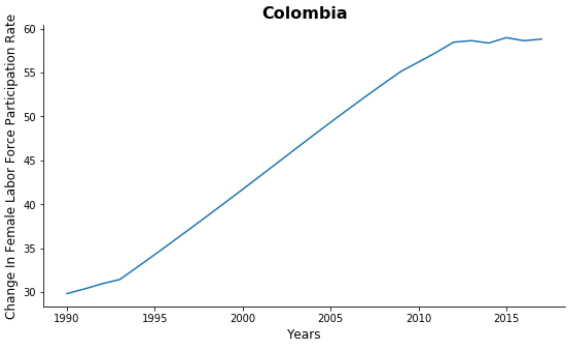
```
                World: Change in Female Labor Force Participation Rate
Against Change in GDP Over Time
```

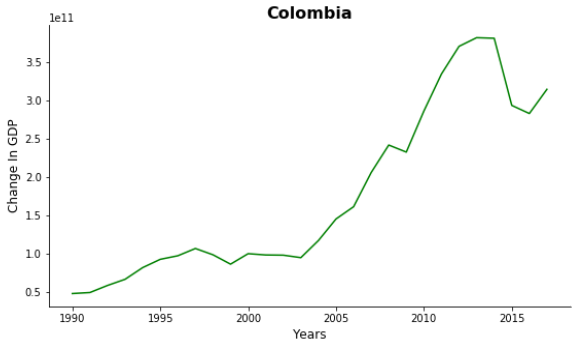


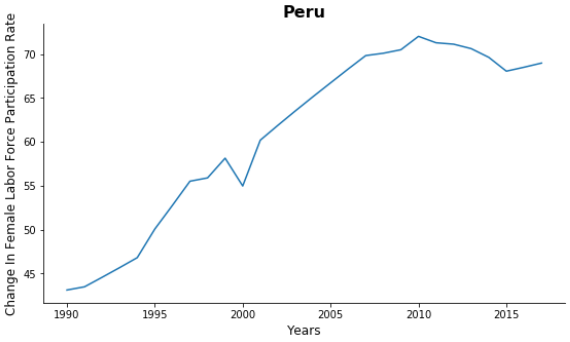
So the global figures do not support a positive association between Female Labor Force Growth and GDP. Let's look at the countries on an individual basis

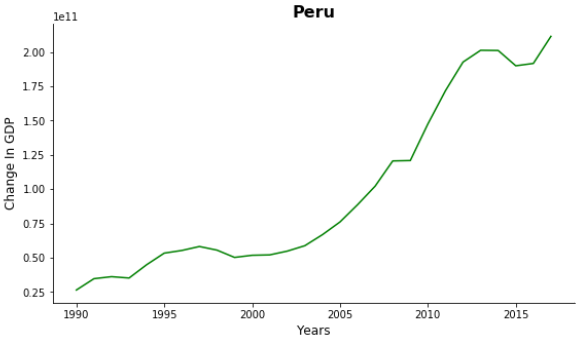
In [180]:
```
print(Fore.BLUE + Style.BRIGHT + "                Top Five Countries: Gr
owth in their Female Labor Force Participation Rate Over Time")

for country in top_5_lf:

    fig, (ax1, ax2) = plt.subplots(nrows = 1, ncols = 2, figsize= (20,5
))

    ax1.plot(lf_df_transposed.index, lf_df_transposed[country])

    ax1.set_xlabel("Years", fontsize = 12)
    ax1.set_ylabel("Change In Female Labor Force Participation Rate", fo
ntsize = 12)

    ax1.set_title(country, fontsize = 16, fontweight = "bold")

    ax1.spines["right"].set_visible(False)
    ax1.spines["top"].set_visible(False)

    ax2.plot(gdp_df_transposed.index, gdp_df_transposed[country], color
= 'green')

    ax2.set_xlabel("Years", fontsize = 12)
    ax2.set_ylabel("Change In GDP", fontsize = 12)

    ax2.set_title(country, fontsize = 16, fontweight = "bold")

    ax2.spines["right"].set_visible(False)
    ax2.spines["top"].set_visible(False)

    plt.savefig("top_5_labor_force.png", bbox_inches = "tight")

    plt.show()
```

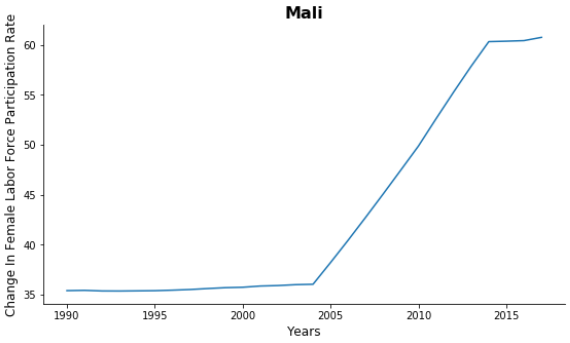
Top Five Countries: Growth in their Female Labor Force Participation Rate Over Time

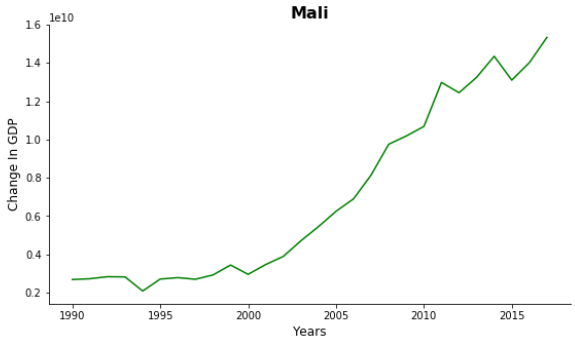


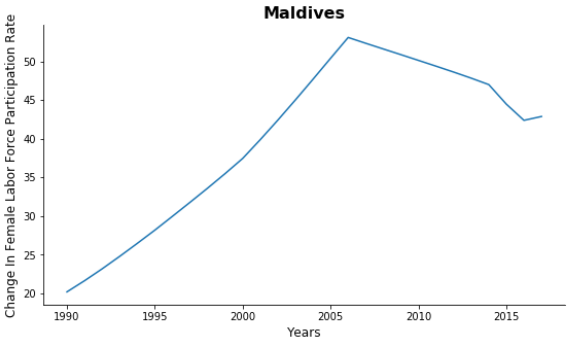


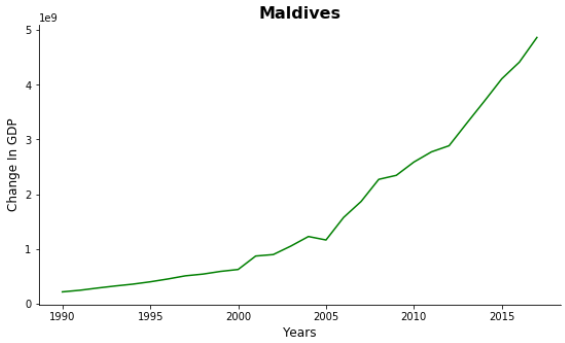


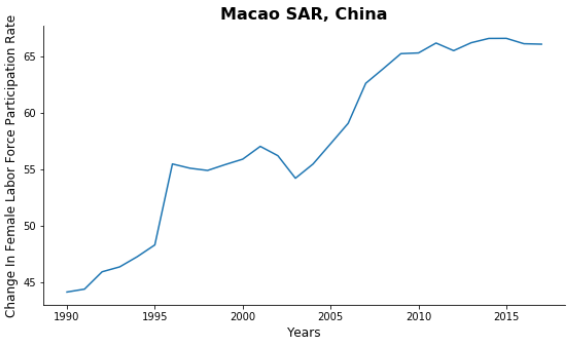


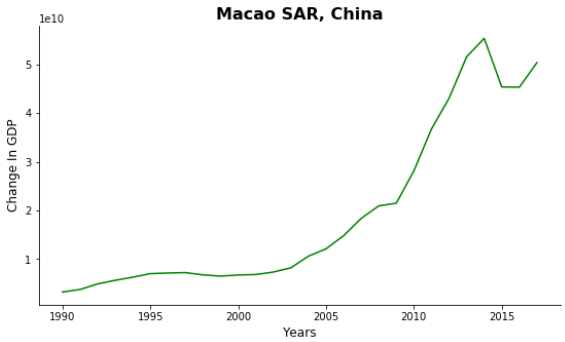






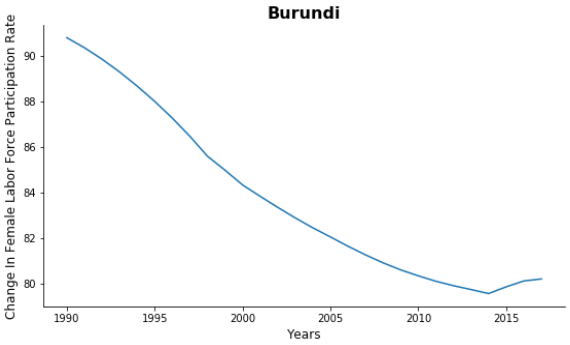


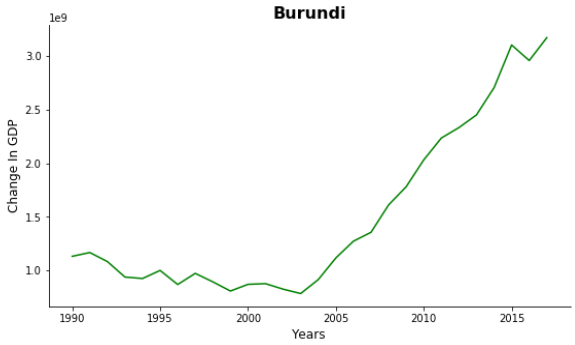


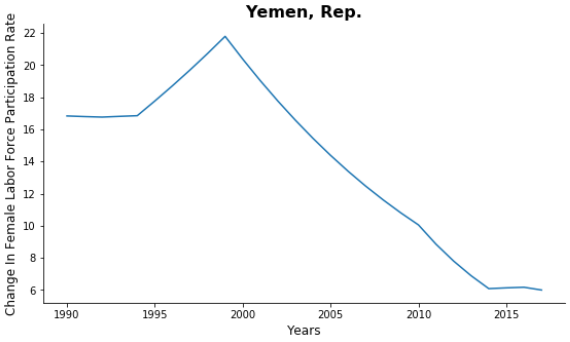


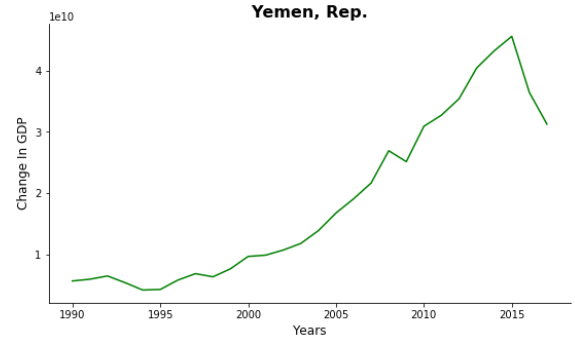
In [181]:
```
print(Fore.BLUE + Style.BRIGHT + "                Bottom Five Countries:
Growth in their Female Labor Force Participation Rate Over Time")

for country in bottom_5_lf:

    fig, (ax1, ax2) = plt.subplots(nrows = 1, ncols = 2, figsize= (20,5
))

    ax1.plot(lf_df_transposed.index, lf_df_transposed[country])

    ax1.set_xlabel("Years", fontsize = 12)
    ax1.set_ylabel("Change In Female Labor Force Participation Rate", fo
ntsize = 12)

    ax1.set_title(country, fontsize = 16, fontweight = "bold")

    ax1.spines["right"].set_visible(False)
    ax1.spines["top"].set_visible(False)

    ax2.plot(gdp_df_transposed.index, gdp_df_transposed[country], color
= 'green')

    ax2.set_xlabel("Years", fontsize = 12)
    ax2.set_ylabel("Change In GDP", fontsize = 12)

    ax2.set_title(country, fontsize = 16, fontweight = "bold")

    ax2.spines["right"].set_visible(False)
    ax2.spines["top"].set_visible(False)

    plt.savefig("bottom_5_labor_force.png", bbox_inches = "tight")

    plt.show()
```

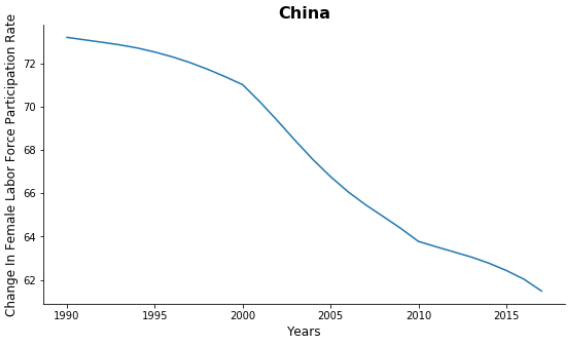
Bottom Five Countries: Growth in their Female Labor Force Participation Rate Over Time

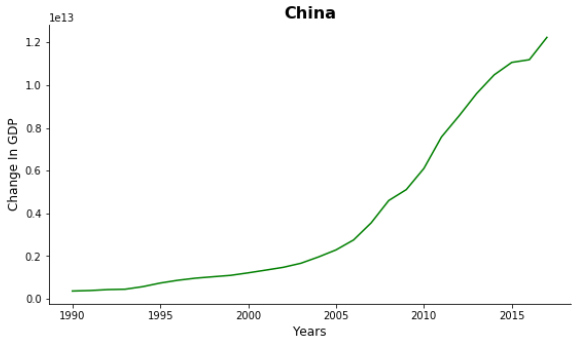


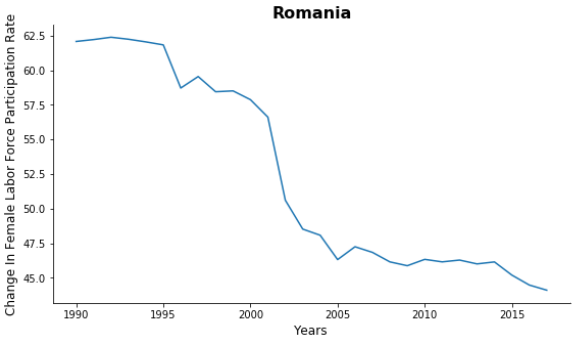


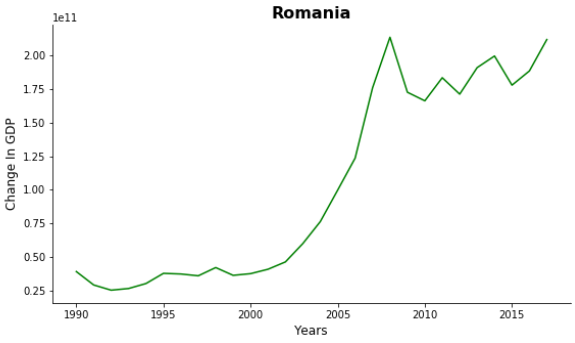


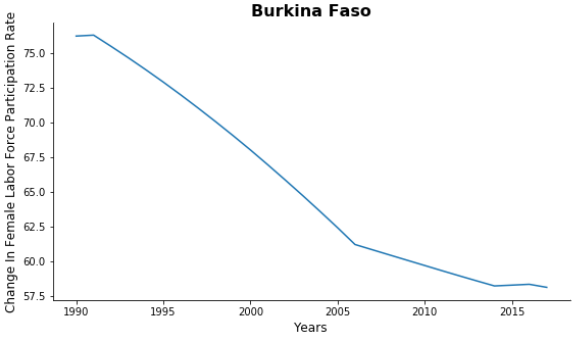


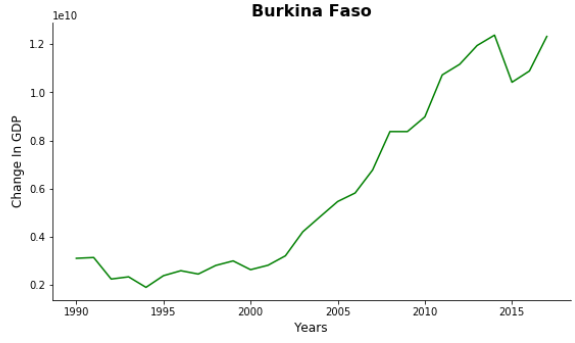






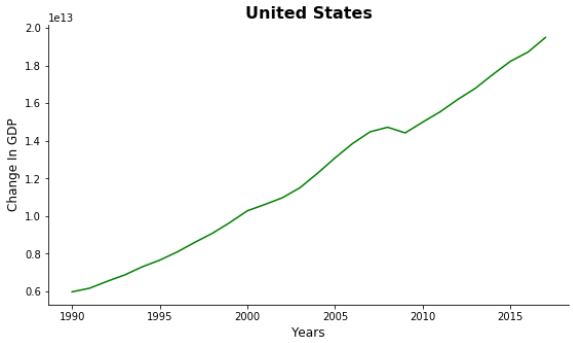


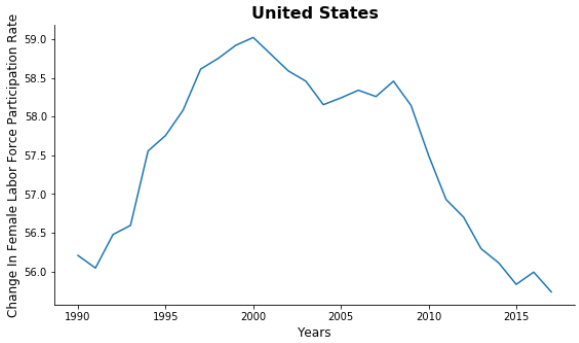


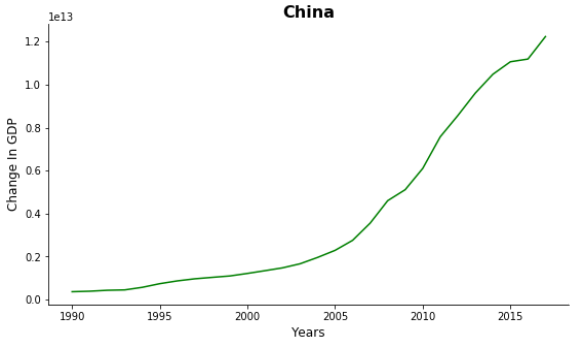


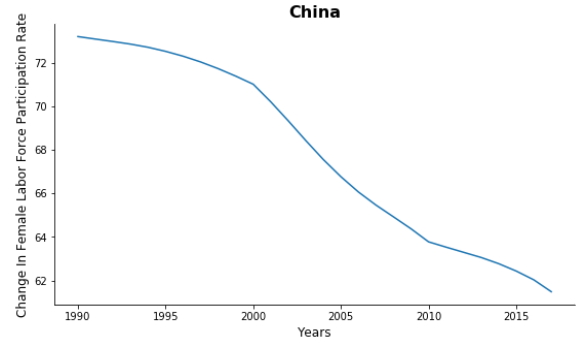
In [182]:
```
print(Fore.BLUE + Style.BRIGHT + "                                    Top F
ive Countries: Growth in their GDP Over Time")

for country in top_5_gdp:

    fig, (ax1, ax2) = plt.subplots(nrows = 1, ncols = 2, figsize= (20,5
))

    ax1.plot(gdp_df_transposed.index, gdp_df_transposed[country], color
= 'green')

    ax1.set_xlabel("Years", fontsize = 12)
    ax1.set_ylabel("Change In GDP", fontsize = 12)

    ax1.set_title(country, fontsize = 16, fontweight = "bold")

    ax1.spines["right"].set_visible(False)
    ax1.spines["top"].set_visible(False)

    ax2.plot(lf_df_transposed.index, lf_df_transposed[country])

    ax2.set_xlabel("Years", fontsize = 12)
    ax2.set_ylabel("Change In Female Labor Force Participation Rate", fo
ntsize = 12)

    ax2.set_title(country, fontsize = 16, fontweight = "bold")

    ax2.spines["right"].set_visible(False)
    ax2.spines["top"].set_visible(False)

    plt.savefig("top_5_gdp.png", bbox_inches = "tight")

    plt.show()
```

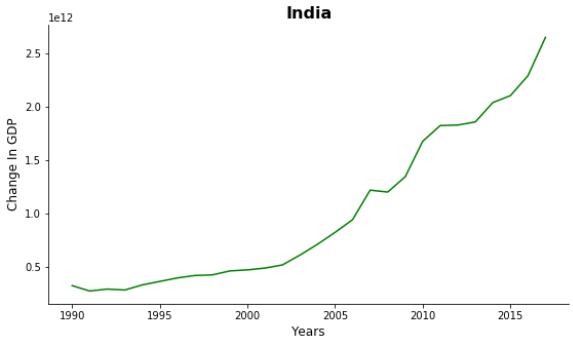
Top Five Countries: Growth in their GDP Over Time

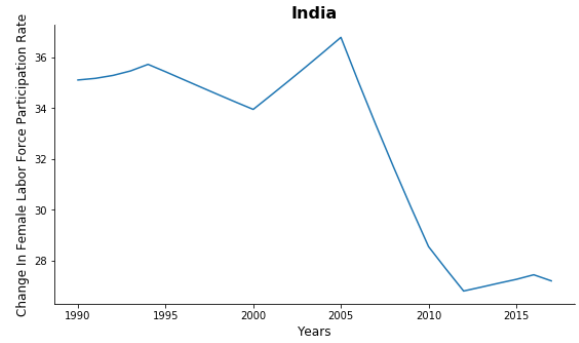


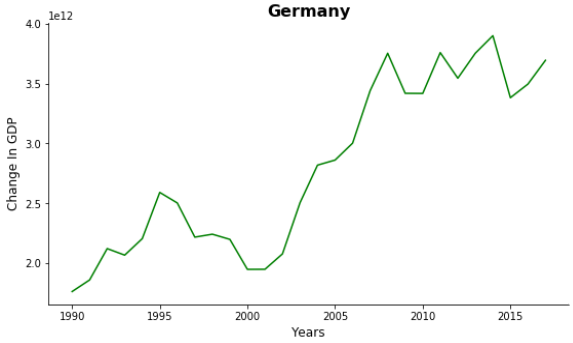


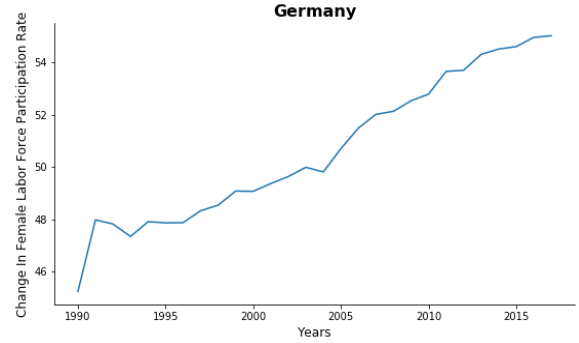


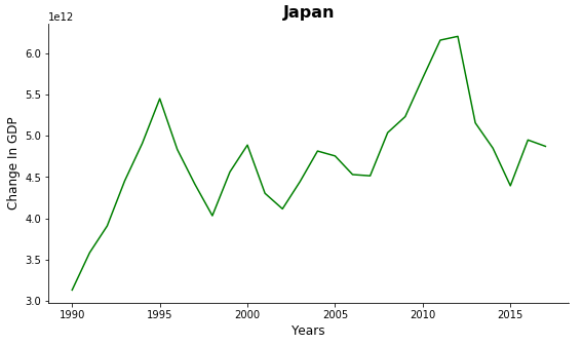


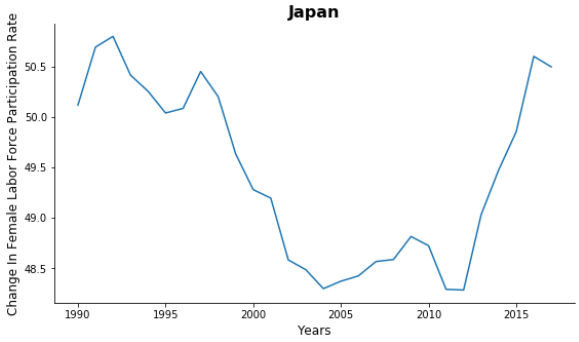






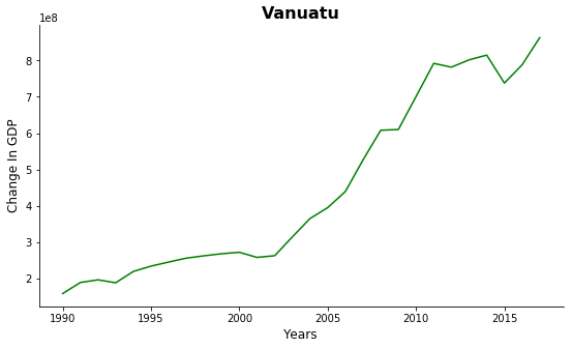


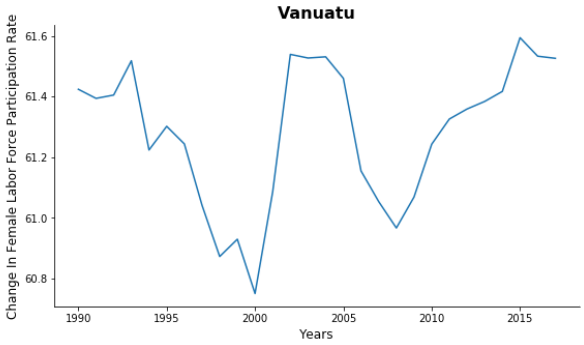


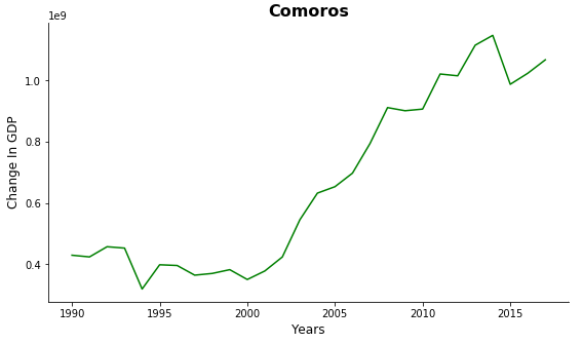


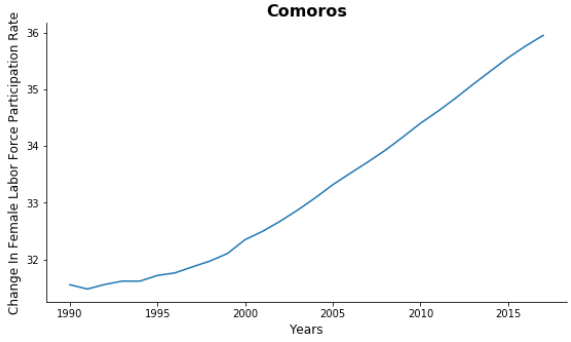
In [183]:
```
print(Fore.BLUE + Style.BRIGHT + "                                    Botto
m Five Countries: Growth in their GDP Over Time")

for country in bottom_5_gdp:

    fig, (ax1, ax2) = plt.subplots(nrows = 1, ncols = 2, figsize= (20,5
))

    ax1.plot(gdp_df_transposed.index, gdp_df_transposed[country], color
= 'green')

    ax1.set_xlabel("Years", fontsize = 12)
    ax1.set_ylabel("Change In GDP", fontsize = 12)

    ax1.set_title(country, fontsize = 16, fontweight = "bold")

    ax1.spines["right"].set_visible(False)
    ax1.spines["top"].set_visible(False)

    ax2.plot(lf_df_transposed.index, lf_df_transposed[country])

    ax2.set_xlabel("Years", fontsize = 12)
    ax2.set_ylabel("Change In Female Labor Force Participation Rate", fo
ntsize = 12)

    ax2.set_title(country, fontsize = 16, fontweight = "bold")

    ax2.spines["right"].set_visible(False)
    ax2.spines["top"].set_visible(False)

    plt.savefig("bottom_5_gdp.png", bbox_inches = "tight")

    plt.show()
```

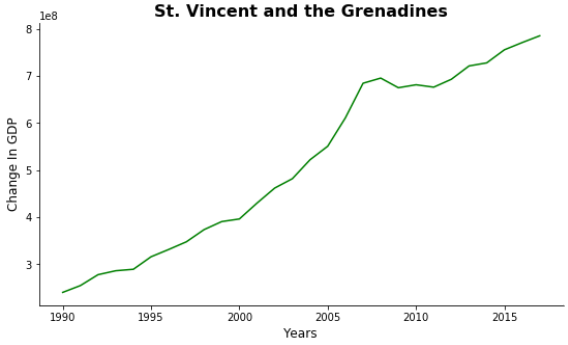
Bottom Five Countries: Growth in their GDP Over Time

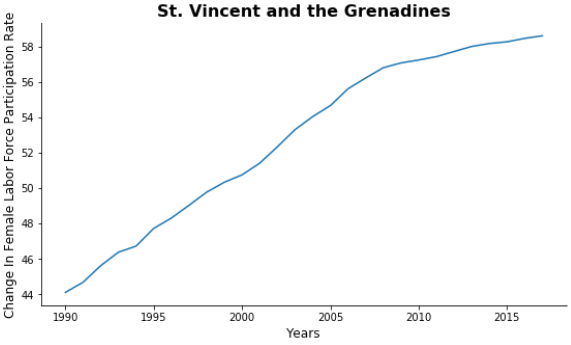


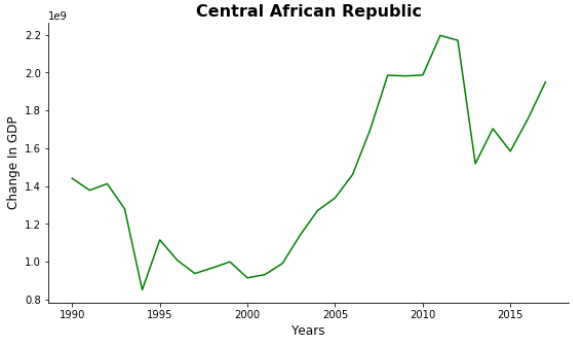


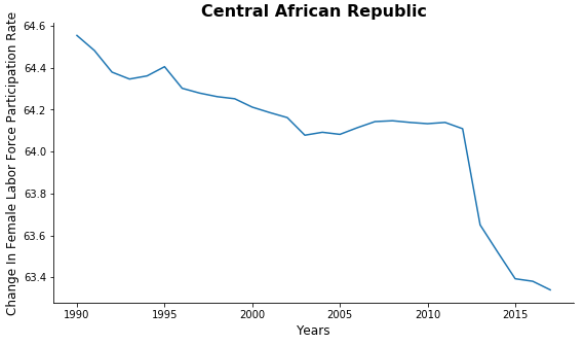


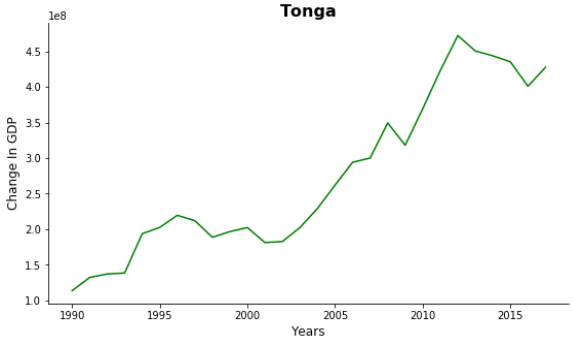


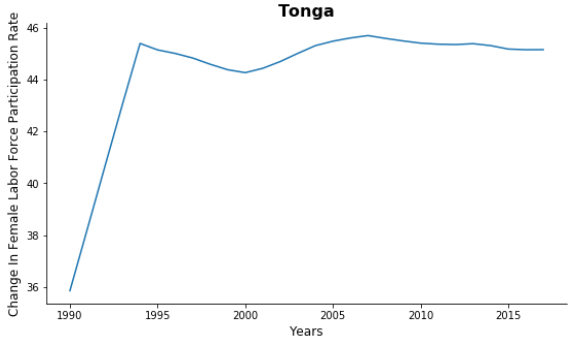












Mixed results here. I found when I was reviewing the graphs that the significance in the change in the country's GDP varied. This caused me to question how Female Labor Force Growth compared to the Percent Increase in GDP over time.

In [184]:
```
gdp_df["%increase"] = (((gdp_df[2017.0])-gdp_df[1990.0])/(gdp_df[1990.0
]))*(100)
```

In [185]:
```
gdp_df = gdp_df.sort_values(by= "%increase", ascending = False)
```

In [186]:
```
gdp_df
```

Out[186]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	199
Country Name						
Equatorial Guinea	1.121194e+08	1.109060e+08	1.347072e+08	1.360479e+08	1.008070e+08	1.418534e+
Vietnam	6.471741e+09	9.613370e+09	9.866990e+09	1.318095e+10	1.628643e+10	2.073616e+
China	3.608579e+11	3.833733e+11	4.269157e+11	4.447313e+11	5.643247e+11	7.345479e+
Qatar	7.360439e+09	6.883516e+09	7.646154e+09	7.156594e+09	7.374451e+09	8.137912e+
Maldives	2.150890e+08	2.444683e+08	2.848534e+08	3.223266e+08	3.558844e+08	3.989890e+
Lao PDR	8.655599e+08	1.028088e+09	1.127807e+09	1.327749e+09	1.543606e+09	1.763536e+
Lebanon	2.838485e+09	4.690415e+09	5.843579e+09	7.941744e+09	9.599127e+09	1.171880e+
Macao SAR, China	3.220920e+09	3.735117e+09	4.879019e+09	5.625533e+09	6.265844e+09	6.996034e+
Nicaragua	1.009455e+09	1.488804e+09	1.792800e+09	1.756454e+09	3.863185e+09	4.140470e+
Tanzania	4.258743e+09	4.956588e+09	4.601413e+09	4.257702e+09	4.510847e+09	5.255221e+
Turkmenistan	3.189540e+09	3.208099e+09	3.200540e+09	3.172880e+09	2.496503e+09	2.474614e+
Angola	1.122876e+10	1.060378e+10	8.307811e+09	5.768720e+09	4.438321e+09	5.538749e+
Sri Lanka	8.032551e+09	9.000363e+09	9.703012e+09	1.033868e+10	1.171760e+10	1.302970e+
Dominican Republic	7.073676e+09	9.734322e+09	1.135627e+10	1.308104e+10	1.466424e+10	1.659868e+
Costa Rica	5.711688e+09	7.169000e+09	8.528593e+09	9.537298e+09	1.043262e+10	1.151347e+
Ghana	5.889175e+09	6.596546e+09	6.413902e+09	5.966256e+09	5.444561e+09	6.465138e+
Guatemala	7.650125e+09	9.406098e+09	1.044084e+10	1.139994e+10	1.298324e+10	1.465540e+
Panama	6.433967e+09	7.074676e+09	8.042338e+09	8.782585e+09	9.365290e+09	9.573814e+
Jordan	4.160004e+09	4.344250e+09	5.311329e+09	5.605842e+09	6.237740e+09	6.727447e+
Indonesia	1.061407e+11	1.166220e+11	1.280270e+11	1.580067e+11	1.768921e+11	2.021320e+
Sudan	1.240865e+10	1.137922e+10	7.034220e+09	8.881786e+09	1.279419e+10	1.382974e+
Kenya	8.572359e+09	8.151479e+09	8.209129e+09	5.751790e+09	7.148145e+09	9.046326e+
Guyana	3.965823e+08	3.485331e+08	3.735731e+08	4.541014e+08	5.408749e+08	6.216268e+
Singapore	3.615203e+10	4.547444e+10	5.215641e+10	6.064457e+10	7.377779e+10	8.789001e+
Bhutan	2.997873e+08	2.500458e+08	2.507944e+08	2.352396e+08	2.708016e+08	3.030535e+
Bahrain	4.229787e+09	4.616223e+09	4.751064e+09	5.200266e+09	5.567553e+09	5.849468e+
Chile	3.311389e+10	3.783479e+10	4.596433e+10	4.929777e+10	5.700843e+10	7.344706e+
India	3.209790e+11	2.701053e+11	2.882084e+11	2.792960e+11	3.272756e+11	3.602820e+
Peru	2.641039e+10	3.467212e+10	3.613923e+10	3.515811e+10	4.488208e+10	5.331279e+
Poland	6.597775e+10	8.550094e+10	9.433705e+10	9.604565e+10	1.108034e+11	1.421373e+
...	...	...	...	...	...	

1 Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	199
Bulgaria	2.063209e+10	1.094355e+10	1.035052e+10	1.082971e+10	9.697417e+09	1.306342e+
Burundi	1.132101e+09	1.167398e+09	1.083038e+09	9.386326e+08	9.250306e+08	1.000428e+
Portugal	7.872161e+10	8.924238e+10	1.076027e+11	9.501910e+10	9.969845e+10	1.181336e+
Canada	5.939296e+11	6.103282e+11	5.923877e+11	5.771708e+11	5.781393e+11	6.040316e+
Tajikistan	2.629395e+09	2.534720e+09	1.909247e+09	1.630251e+09	1.522018e+09	1.231567e+
Haiti	3.096290e+09	3.473541e+09	2.257122e+09	1.878249e+09	2.167564e+09	2.813313e+
Algeria	6.204510e+10	4.571537e+10	4.800330e+10	4.994646e+10	4.254257e+10	4.176405e+
Netherlands	3.142677e+11	3.233204e+11	3.583304e+11	3.490378e+11	3.742914e+11	4.465290e+
Switzerland	2.580666e+11	2.611138e+11	2.718144e+11	2.643530e+11	2.926467e+11	3.426170e+
Gabon	5.952294e+09	5.402920e+09	5.592391e+09	4.378645e+09	4.190819e+09	4.958846e+
Belarus	2.165000e+10	1.800000e+10	1.703704e+10	1.628099e+10	1.493202e+10	1.397268e+
Zimbabwe	8.783817e+09	8.641482e+09	6.751472e+09	6.563813e+09	6.890675e+09	7.111271e+
Austria	1.664634e+11	1.737942e+11	1.950781e+11	1.903797e+11	2.035352e+11	2.410383e+
Comoros	4.296221e+08	4.241088e+08	4.573886e+08	4.528814e+08	3.191892e+08	3.984618e+
Spain	5.351012e+11	5.755985e+11	6.292024e+11	5.236495e+11	5.291216e+11	6.129397e+
United Kingdom	1.093169e+12	1.142797e+12	1.179660e+12	1.061389e+12	1.140490e+12	1.335219e+
Belgium	2.064308e+11	2.116378e+11	2.360384e+11	2.259247e+11	2.461949e+11	2.895673e+
Denmark	1.382473e+11	1.392247e+11	1.529156e+11	1.431956e+11	1.561623e+11	1.850070e+
Barbados	2.023318e+09	2.007110e+09	1.950900e+09	2.046189e+09	2.151295e+09	2.261970e+
Germany	1.764968e+12	1.861874e+12	2.123131e+12	2.068556e+12	2.205966e+12	2.591620e+
Sweden	2.581543e+11	2.703625e+11	2.803123e+11	2.099508e+11	2.260800e+11	2.640520e+
Greece	9.789109e+10	1.051432e+11	1.162247e+11	1.088091e+11	1.166018e+11	1.368784e+
France	1.269180e+12	1.269277e+12	1.401466e+12	1.322816e+12	1.393983e+12	1.601095e+
Georgia	7.753502e+09	6.357616e+09	3.690329e+09	2.701181e+09	2.513871e+09	2.693732e+
Finland	1.415176e+11	1.278665e+11	1.126254e+11	8.925575e+10	1.033216e+11	1.341993e+
Italy	1.177326e+12	1.242109e+12	1.315807e+12	1.061445e+12	1.095591e+12	1.170787e+
Japan	3.132818e+12	3.584420e+12	3.908809e+12	4.454144e+12	4.907039e+12	5.449116e+
Ukraine	8.145692e+10	7.746456e+10	7.394224e+10	6.564856e+10	5.254956e+10	4.821387e+
Central African Republic	1.440711e+09	1.377375e+09	1.411918e+09	1.278781e+09	8.511744e+08	1.115390e+
Libya	2.890184e+10	3.199501e+10	3.388139e+10	3.065703e+10	2.860792e+10	2.554413e+

157 rows × 30 columns

In [187]:
```
gdp_df.head(5)
```

Out[187]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0
Country Name						
Equatorial Guinea	1.121194e+08	1.109060e+08	1.347072e+08	1.360479e+08	1.008070e+08	1.418534e+08
Vietnam	6.471741e+09	9.613370e+09	9.866990e+09	1.318095e+10	1.628643e+10	2.073616e+10
China	3.608579e+11	3.833733e+11	4.269157e+11	4.447313e+11	5.643247e+11	7.345479e+11
Qatar	7.360439e+09	6.883516e+09	7.646154e+09	7.156594e+09	7.374451e+09	8.137912e+09
Maldives	2.150890e+08	2.444683e+08	2.848534e+08	3.223266e+08	3.558844e+08	3.989890e+08

5 rows × 30 columns

In [188]:
```
top_5_percent_change_gdp = ["Equatorial Guinea", "Vietnam", "China", "Qatar", "Maldives"]
```

In [189]:
```
gdp_df.tail(5)
```

Out[189]:

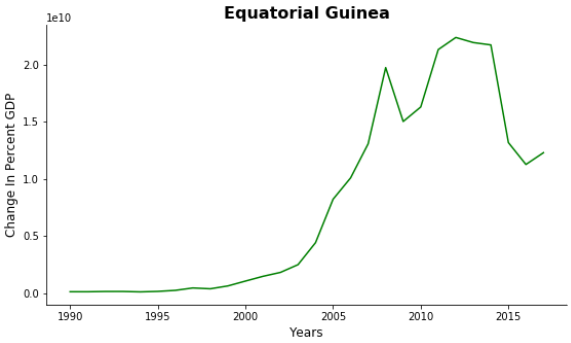
1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0
Country Name						
Italy	1.177326e+12	1.242109e+12	1.315807e+12	1.061445e+12	1.095591e+12	1.170787e+12
Japan	3.132818e+12	3.584420e+12	3.908809e+12	4.454144e+12	4.907039e+12	5.449116e+12
Ukraine	8.145692e+10	7.746456e+10	7.394224e+10	6.564856e+10	5.254956e+10	4.821387e+10
Central African Republic	1.440711e+09	1.377375e+09	1.411918e+09	1.278781e+09	8.511744e+08	1.115390e+09
Libya	2.890184e+10	3.199501e+10	3.388139e+10	3.065703e+10	2.860792e+10	2.554413e+10

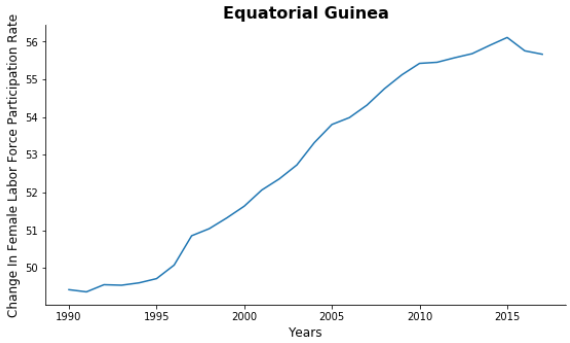
5 rows × 30 columns

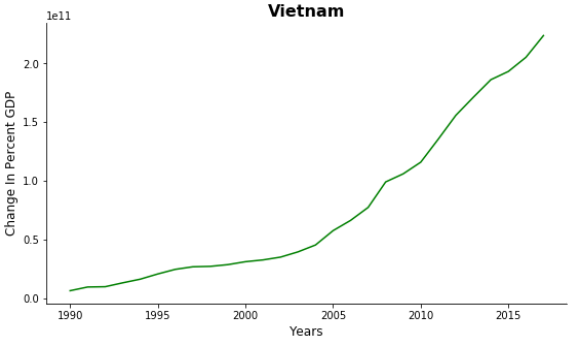
In [190]:
```
bottom_5_percent_change_gdp = ["Italy", "Japan", "Ukraine", "Central African Republic", "Libya"]
```

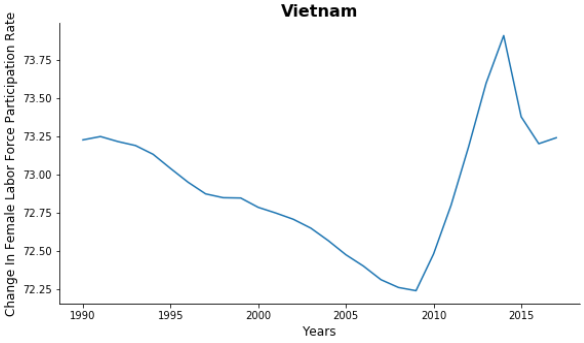
In [191]:
```
print(Fore.BLUE + Style.BRIGHT + "                                    Top F
ive Countries: Growth in Percent GDP Over Time")

for country in top_5_percent_change_gdp:

    fig, (ax1, ax2) = plt.subplots(nrows = 1, ncols = 2, figsize= (20,5
))

    ax1.plot(gdp_df_transposed.index, gdp_df_transposed[country], color
= "green")

    ax1.set_xlabel("Years", fontsize = 12)
    ax1.set_ylabel("Change In Percent GDP", fontsize = 12)

    ax1.set_title(country, fontsize = 16, fontweight = "bold")

    ax1.spines["right"].set_visible(False)
    ax1.spines["top"].set_visible(False)

    ax2.plot(lf_df_transposed.index, lf_df_transposed[country])

    ax2.set_xlabel("Years", fontsize = 12)
    ax2.set_ylabel("Change In Female Labor Force Participation Rate", fo
ntsize = 12)

    ax2.set_title(country, fontsize = 16, fontweight = "bold")

    ax2.spines["right"].set_visible(False)
    ax2.spines["top"].set_visible(False)

    plt.savefig("top_5_percent_gdp_change.png", bbox_inches = "tight")

    plt.show()
```

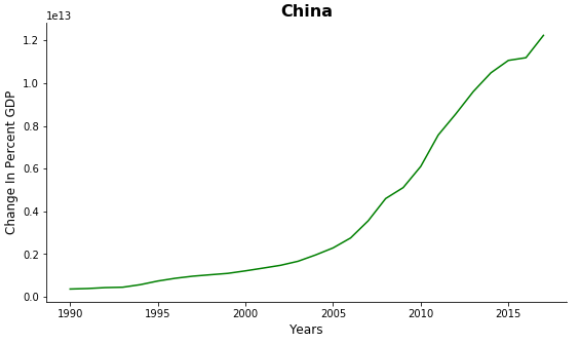
Top Five Countries: Growth in Percent GDP Over Time

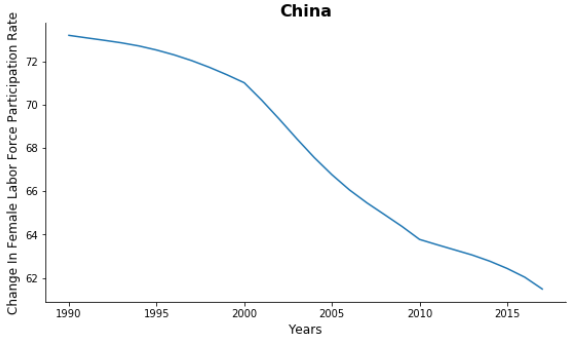


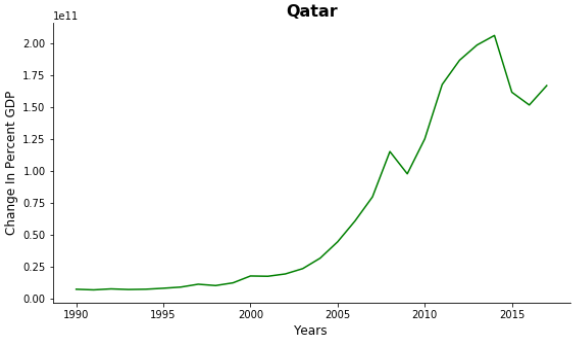


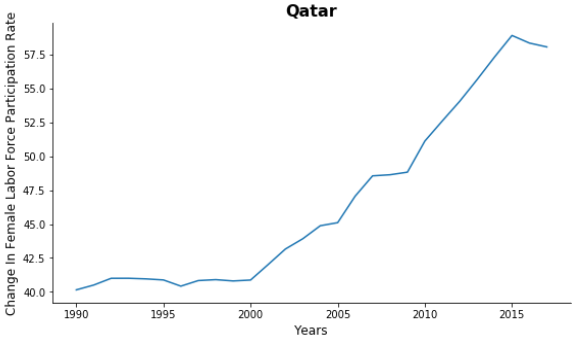


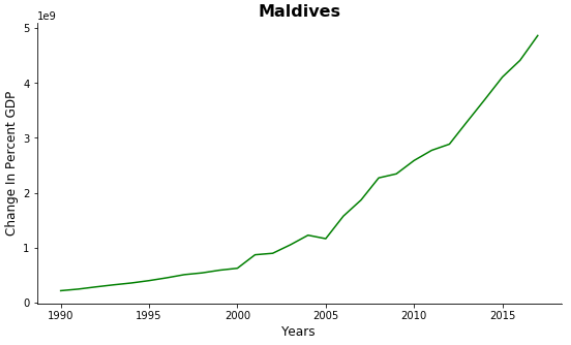


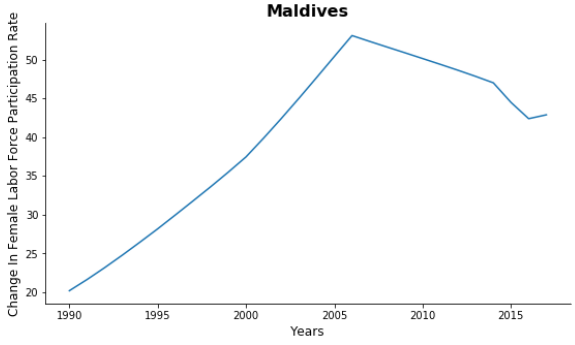






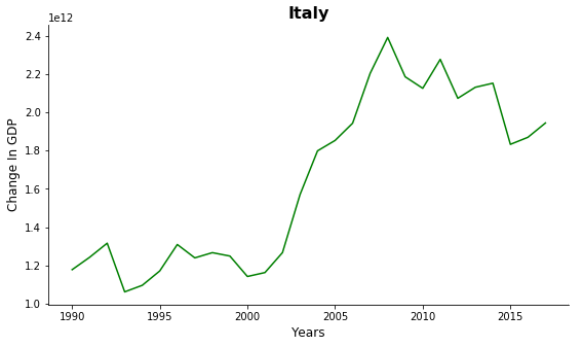


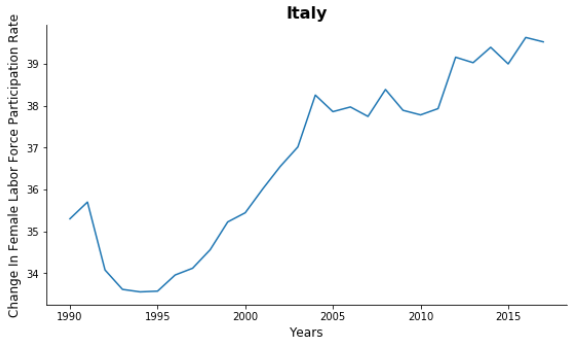


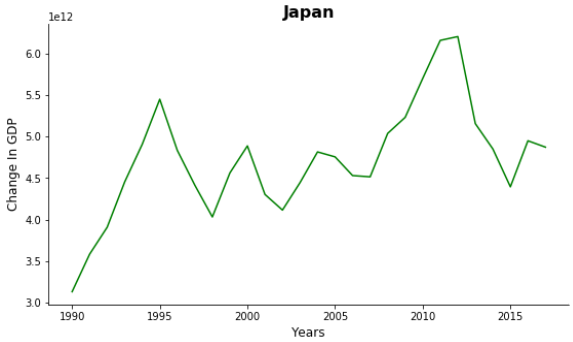


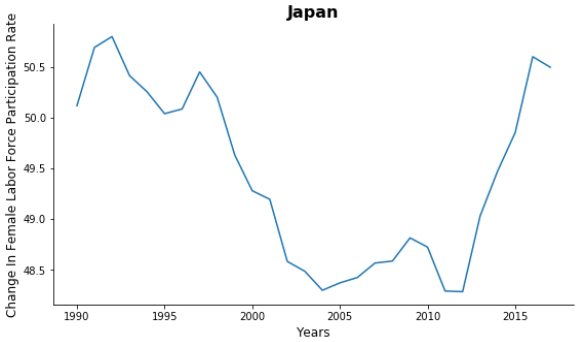
In [192]:
```
print(Fore.BLUE + Style.BRIGHT + "                                    Botto
m Five Countries: Growth in their GDP Over Time")

for country in bottom_5_percent_change_gdp:

    fig, (ax1, ax2) = plt.subplots(nrows = 1, ncols = 2, figsize= (20,5
))

    ax1.plot(gdp_df_transposed.index, gdp_df_transposed[country], color
= "green")

    ax1.set_xlabel("Years", fontsize = 12)
    ax1.set_ylabel("Change In GDP", fontsize = 12)

    ax1.set_title(country, fontsize = 16, fontweight = "bold")

    ax1.spines["right"].set_visible(False)
    ax1.spines["top"].set_visible(False)

    ax2.plot(lf_df_transposed.index, lf_df_transposed[country])

    ax2.set_xlabel("Years", fontsize = 12)
    ax2.set_ylabel("Change In Female Labor Force Participation Rate", fo
ntsize = 12)

    ax2.set_title(country, fontsize = 16, fontweight = "bold")

    ax2.spines["right"].set_visible(False)
    ax2.spines["top"].set_visible(False)

    plt.savefig("bottom_five_percent_change_gdp.png", bbox_inches = "tig
ht")

    plt.show()
```

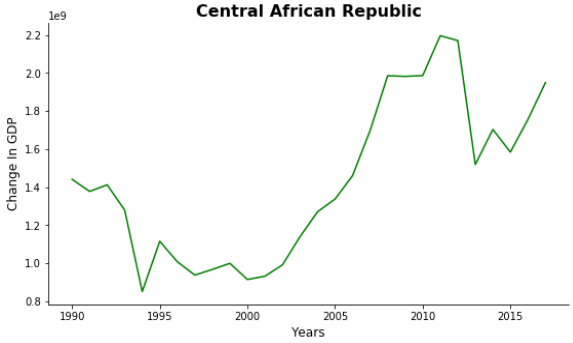
Bottom Five Countries: Growth in their GDP Over Time

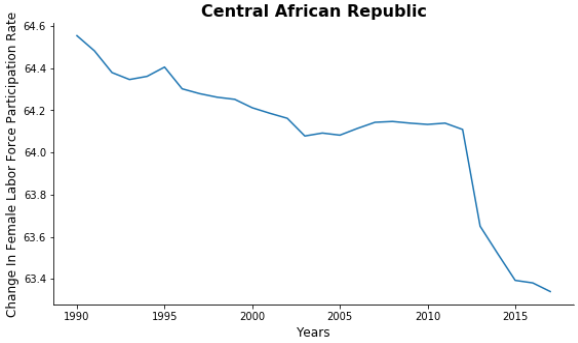


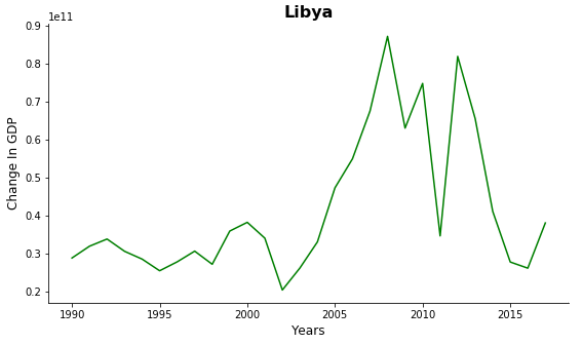


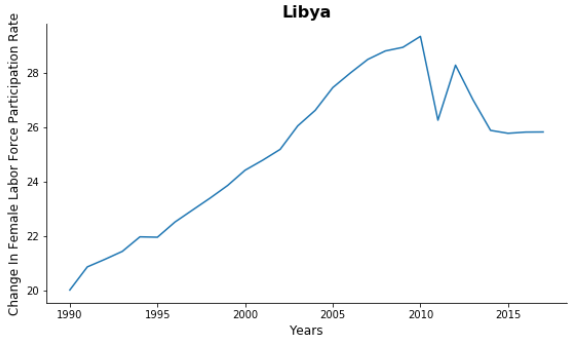












With the exception of China, most of these graphs support or somewhat support a positive association between the Female Labor Force Participation and GDP. Let's scale our graphs up and look at what is happening on a worldwide basis.

For these graphs, I took the top 5%, the 5-10% and the bottom 10-99% groups of countries that experienced the highest increase in female labor force participation and compared their average rate of labor force change, their relative contribution to the global female labor force participation rate, their average growth in GDP and their average growth in percent GDP.

In [193]:
```
lf_df.shape
```

Out[193]:
```
(157, 29)
```

In [194]:
```
157*.05
```

Out[194]:
```
7.8500000000000005
```

round up to eight

In [195]:
```
lf_df = lf_df.sort_values(by="Δlf", ascending = False)
```

In [196]:
```
lf_df
```

Out[196]:

1 Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Colombia	29.856001	30.379999	30.976000	31.450001	32.861000	34.294998	35.751999	37.22
Peru	43.134998	43.500999	44.584000	45.688999	46.824001	50.083000	52.778000	55.53
Mali	35.404999	35.433998	35.373001	35.367001	35.382999	35.400002	35.452000	35.51
Maldives	20.212999	21.652000	23.184999	24.799999	26.475000	28.186001	29.974001	31.77
Macao SAR, China	44.164001	44.419998	45.953999	46.387001	47.289001	48.328999	55.490002	55.11
Belize	34.488998	35.054001	35.686001	35.883999	35.634998	35.783001	36.131001	37.12
Chile	32.075001	31.854000	33.848000	35.484001	35.490002	34.356998	34.692001	35.54
Spain	33.840000	34.020000	34.590000	35.099998	36.278000	36.685001	37.214001	37.99
Luxembourg	34.120998	35.930000	38.105000	36.944000	37.706001	35.283001	36.363998	37.39
Qatar	40.143002	40.498001	40.997002	40.999001	40.953999	40.875000	40.417000	40.82
Botswana	47.747002	47.951000	48.105000	48.261002	48.469002	48.754002	48.926998	49.16
Ireland	35.770000	36.509998	36.661999	38.250000	39.338001	39.937000	41.501999	42.48
Bahrain	28.851000	28.938000	29.514000	30.180000	30.917000	31.672001	32.202999	32.73
Netherlands	43.049000	43.825001	45.110001	45.584999	46.689999	47.307999	48.340000	49.72
Panama	38.247002	39.056000	39.736000	40.451000	41.415001	42.793999	43.244999	43.68
St. Vincent and the Grenadines	44.111000	44.682999	45.620998	46.383999	46.729000	47.731998	48.318001	49.04
Malta	27.927999	28.059999	28.322001	28.514999	28.472000	28.271999	28.545000	28.75
St. Lucia	47.300999	47.778000	48.425999	49.084000	49.713001	50.285000	50.844002	51.34
Nicaragua	36.522999	36.368999	35.612000	34.873001	34.287998	33.831001	34.215000	35.13
Brunei Darussalam	45.779999	46.209000	47.146000	48.143002	49.214001	50.362000	51.299000	52.33
Israel	46.266998	46.724998	47.994999	49.021000	50.505001	51.287998	51.118999	51.01
Singapore	47.618000	48.160000	48.680000	49.465000	50.188999	50.771999	51.110001	51.42
Trinidad and Tobago	38.578999	44.006001	43.550999	43.188999	44.044998	44.813999	46.883999	46.84
Costa Rica	32.903000	33.799999	33.145000	34.053001	35.089001	36.122002	34.564999	37.66
Senegal	33.375000	33.366001	33.353001	33.348999	33.349998	33.410999	33.415001	33.44
Cyprus	46.162998	46.752998	47.341000	46.750999	48.191002	47.124001	47.644001	49.34
United Arab Emirates	29.180000	29.421000	29.815001	30.214001	30.754999	31.257999	31.556999	31.96
Austria	43.432999	43.786999	44.990002	45.569000	47.956001	48.807999	48.341000	48.29
Benin	57.348999	57.362000	57.366001	58.222000	59.073002	59.917999	60.741001	61.55

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Belgium	36.557999	37.946999	38.737999	39.446999	40.054001	40.477001	40.529999	40.96
...	...	...	...	...	...	...	...	
Turkey	34.034000	33.939999	32.514000	26.603001	31.070000	30.753000	30.382000	28.60
Denmark	61.050999	61.441002	61.594002	61.035000	57.912998	57.952000	58.222000	58.70
Papua New Guinea	70.958000	70.654999	70.170998	69.502998	69.364998	69.675003	69.464996	69.80
Jamaica	59.500000	60.263000	60.944000	61.825001	62.452999	61.452000	60.109001	58.50
Sweden	63.136002	62.473999	61.109001	59.460999	58.623001	59.084999	59.259998	58.68
Kyrgyz Republic	50.764999	51.360001	52.389000	53.549999	55.138000	55.713001	55.477001	55.10
Tanzania	82.100998	82.070999	82.023003	81.972000	81.917000	81.863998	81.843002	81.80
Russian Federation	59.285000	59.007000	58.709000	56.895000	55.057999	54.539001	53.731998	52.70
Lao PDR	79.904999	79.945000	79.970001	79.990997	79.960999	79.945999	79.793999	79.63
Zambia	73.833000	73.783997	73.711998	73.685997	73.559998	73.514999	73.511002	73.49
Malawi	76.107002	76.107002	75.999001	75.983002	75.866997	75.921997	75.964996	75.99
Finland	58.976002	57.722000	56.324001	55.487000	54.780998	54.755001	54.645000	54.77
Mozambique	87.232002	87.054001	86.897003	86.833000	86.803001	86.779999	86.885002	86.92
Togo	80.843002	80.806999	80.737000	80.587997	80.582001	80.538002	80.499001	80.49
Poland	53.874001	53.759998	53.679001	53.178001	52.423000	51.151001	50.556000	49.36
Albania	53.590000	55.780998	56.097000	55.280998	54.535000	53.501999	52.907001	53.56
Bulgaria	54.445000	54.396000	54.374001	53.258999	52.094002	50.872002	49.673000	48.43
Thailand	67.171997	66.754997	66.367996	65.984001	65.622002	66.425003	67.348999	67.63
Sierra Leone	63.894001	63.841000	63.646999	63.657001	63.668999	63.653000	63.647999	63.59
Slovak Republic	59.783001	59.723000	57.602001	55.187000	51.445000	51.568001	52.304001	51.80
Ukraine	54.748001	54.443001	54.137001	53.875000	53.891998	54.018002	53.162998	52.22
Kenya	70.324997	70.275002	70.206001	70.147003	70.113998	70.103996	70.053001	69.99
India	35.106998	35.172001	35.286999	35.463001	35.722000	35.431000	35.130001	34.83
Lesotho	68.709999	68.748001	68.789001	68.817001	68.882004	68.941002	68.981003	69.00
Sri Lanka	45.514999	41.646999	38.049999	37.891998	38.530998	36.330002	35.808998	35.48
Burundi	90.783997	90.345001	89.845001	89.282997	88.665001	87.992996	87.262001	86.46
Yemen, Rep.	16.832001	16.792999	16.761000	16.806999	16.848000	17.761999	18.707001	19.69
China	73.197998	73.083000	72.971001	72.851997	72.707001	72.519997	72.296997	72.03
Romania	62.076000	62.212002	62.381001	62.236000	62.043999	61.828999	58.709999	59.54

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Burkina Faso	76.218002	76.285004	75.478996	74.650002	73.792000	72.907997	71.987999	71.03

157 rows × 29 columns

In [197]:
```
top_5 = lf_df.head(8)
```

In [198]:
```
top_5
```

Out[198]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	1997.
Country Name								
Colombia	29.856001	30.379999	30.976000	31.450001	32.861000	34.294998	35.751999	37.22300
Peru	43.134998	43.500999	44.584000	45.688999	46.824001	50.083000	52.778000	55.53200
Mali	35.404999	35.433998	35.373001	35.367001	35.382999	35.400002	35.452000	35.51699
Maldives	20.212999	21.652000	23.184999	24.799999	26.475000	28.186001	29.974001	31.77899
Macao SAR, China	44.164001	44.419998	45.953999	46.387001	47.289001	48.328999	55.490002	55.11200
Belize	34.488998	35.054001	35.686001	35.883999	35.634998	35.783001	36.131001	37.12799
Chile	32.075001	31.854000	33.848000	35.484001	35.490002	34.356998	34.692001	35.54600
Spain	33.840000	34.020000	34.590000	35.099998	36.278000	36.685001	37.214001	37.99300

8 rows × 29 columns

In [199]:
```
five_to_ten = lf_df.head(-141)
```

In [200]:
```
five_to_ten = five_to_ten.tail(-8)
```

In [201]:
```
five_to_ten
```

Out[201]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Luxembourg	34.120998	35.930000	38.105000	36.944000	37.706001	35.283001	36.363998	37.394
Qatar	40.143002	40.498001	40.997002	40.999001	40.953999	40.875000	40.417000	40.828
Botswana	47.747002	47.951000	48.105000	48.261002	48.469002	48.754002	48.926998	49.160
Ireland	35.770000	36.509998	36.661999	38.250000	39.338001	39.937000	41.501999	42.488
Bahrain	28.851000	28.938000	29.514000	30.180000	30.917000	31.672001	32.202999	32.730
Netherlands	43.049000	43.825001	45.110001	45.584999	46.689999	47.307999	48.340000	49.727
Panama	38.247002	39.056000	39.736000	40.451000	41.415001	42.793999	43.244999	43.688
St. Vincent and the Grenadines	44.111000	44.682999	45.620998	46.383999	46.729000	47.731998	48.318001	49.042

8 rows × 29 columns

In [202]:
```
ninetynine = lf_df.tail(-16)
```

In [203]:
```
ninetynine
```

Out[203]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Malta	27.927999	28.059999	28.322001	28.514999	28.472000	28.271999	28.545000	28.75
St. Lucia	47.300999	47.778000	48.425999	49.084000	49.713001	50.285000	50.844002	51.34
Nicaragua	36.522999	36.368999	35.612000	34.873001	34.287998	33.831001	34.215000	35.13
Brunei Darussalam	45.779999	46.209000	47.146000	48.143002	49.214001	50.362000	51.299000	52.33
Israel	46.266998	46.724998	47.994999	49.021000	50.505001	51.287998	51.118999	51.01
Singapore	47.618000	48.160000	48.680000	49.465000	50.188999	50.771999	51.110001	51.42
Trinidad and Tobago	38.578999	44.006001	43.550999	43.188999	44.044998	44.813999	46.883999	46.84
Costa Rica	32.903000	33.799999	33.145000	34.053001	35.089001	36.122002	34.564999	37.66
Senegal	33.375000	33.366001	33.353001	33.348999	33.349998	33.410999	33.415001	33.44
Cyprus	46.162998	46.752998	47.341000	46.750999	48.191002	47.124001	47.644001	49.34
United Arab Emirates	29.180000	29.421000	29.815001	30.214001	30.754999	31.257999	31.556999	31.96
Austria	43.432999	43.786999	44.990002	45.569000	47.956001	48.807999	48.341000	48.29
Benin	57.348999	57.362000	57.366001	58.222000	59.073002	59.917999	60.741001	61.55
Belgium	36.557999	37.946999	38.737999	39.446999	40.054001	40.477001	40.529999	40.96
Brazil	41.974998	42.890999	43.806000	44.722000	45.639000	46.558998	47.462002	48.36
Pakistan	14.014000	13.833000	13.822000	14.188000	14.571000	12.505000	13.610000	14.83
Zimbabwe	67.761002	67.762001	67.653999	67.605003	67.602997	67.547997	67.515999	67.43
Azerbaijan	52.127998	52.263000	53.179001	54.300999	55.395000	56.148998	56.278000	56.22
Dominican Republic	43.597000	43.591999	44.300999	44.741001	44.805000	45.139999	45.632000	46.21
Ethiopia	66.494003	66.421997	66.346001	66.400002	66.402000	67.542000	68.598000	69.59
Mexico	33.457001	34.005001	34.876999	35.855000	36.374001	37.618999	37.541000	39.59
New Zealand	53.299000	53.630001	53.396999	53.306999	54.410000	55.112999	56.416000	56.30
Uruguay	45.609001	45.783001	47.529999	46.945000	48.198002	49.284000	49.765999	50.28
Oman	20.077000	20.424999	20.712999	20.922001	21.105000	21.344000	21.575001	22.01
Bangladesh	23.111000	23.193001	23.357000	23.601000	23.921000	24.315001	24.702999	25.17
Germany	45.227001	47.972000	47.813999	47.334999	47.902000	47.858002	47.866001	48.32
Ecuador	45.680000	46.285999	46.801998	47.333000	48.006001	48.553001	49.027000	49.48
Namibia	48.779999	48.969002	49.175999	49.333000	49.542000	48.915001	48.306000	47.77
Greece	36.058998	34.113998	35.397999	35.456001	36.195999	36.938999	38.231998	38.29
Tonga	35.866001	38.257000	40.662998	43.049999	45.388000	45.139999	45.004002	44.82

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
...	...	...	...	...	...	...	...	
Turkey	34.034000	33.939999	32.514000	26.603001	31.070000	30.753000	30.382000	28.60
Denmark	61.050999	61.441002	61.594002	61.035000	57.912998	57.952000	58.222000	58.70
Papua New Guinea	70.958000	70.654999	70.170998	69.502998	69.364998	69.675003	69.464996	69.80
Jamaica	59.500000	60.263000	60.944000	61.825001	62.452999	61.452000	60.109001	58.50
Sweden	63.136002	62.473999	61.109001	59.460999	58.623001	59.084999	59.259998	58.68
Kyrgyz Republic	50.764999	51.360001	52.389000	53.549999	55.138000	55.713001	55.477001	55.10
Tanzania	82.100998	82.070999	82.023003	81.972000	81.917000	81.863998	81.843002	81.80
Russian Federation	59.285000	59.007000	58.709000	56.895000	55.057999	54.539001	53.731998	52.70
Lao PDR	79.904999	79.945000	79.970001	79.990997	79.960999	79.945999	79.793999	79.63
Zambia	73.833000	73.783997	73.711998	73.685997	73.559998	73.514999	73.511002	73.49
Malawi	76.107002	76.107002	75.999001	75.983002	75.866997	75.921997	75.964996	75.99
Finland	58.976002	57.722000	56.324001	55.487000	54.780998	54.755001	54.645000	54.77
Mozambique	87.232002	87.054001	86.897003	86.833000	86.803001	86.779999	86.885002	86.92
Togo	80.843002	80.806999	80.737000	80.587997	80.582001	80.538002	80.499001	80.49
Poland	53.874001	53.759998	53.679001	53.178001	52.423000	51.151001	50.556000	49.36
Albania	53.590000	55.780998	56.097000	55.280998	54.535000	53.501999	52.907001	53.56
Bulgaria	54.445000	54.396000	54.374001	53.258999	52.094002	50.872002	49.673000	48.43
Thailand	67.171997	66.754997	66.367996	65.984001	65.622002	66.425003	67.348999	67.63
Sierra Leone	63.894001	63.841000	63.646999	63.657001	63.668999	63.653000	63.647999	63.59
Slovak Republic	59.783001	59.723000	57.602001	55.187000	51.445000	51.568001	52.304001	51.80
Ukraine	54.748001	54.443001	54.137001	53.875000	53.891998	54.018002	53.162998	52.22
Kenya	70.324997	70.275002	70.206001	70.147003	70.113998	70.103996	70.053001	69.99
India	35.106998	35.172001	35.286999	35.463001	35.722000	35.431000	35.130001	34.83
Lesotho	68.709999	68.748001	68.789001	68.817001	68.882004	68.941002	68.981003	69.00
Sri Lanka	45.514999	41.646999	38.049999	37.891998	38.530998	36.330002	35.808998	35.48
Burundi	90.783997	90.345001	89.845001	89.282997	88.665001	87.992996	87.262001	86.46
Yemen, Rep.	16.832001	16.792999	16.761000	16.806999	16.848000	17.761999	18.707001	19.69
China	73.197998	73.083000	72.971001	72.851997	72.707001	72.519997	72.296997	72.03
Romania	62.076000	62.212002	62.381001	62.236000	62.043999	61.828999	58.709999	59.54

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Burkina Faso	76.218002	76.285004	75.478996	74.650002	73.792000	72.907997	71.987999	71.03

141 rows × 29 columns

In [204]:
```
avg_rate_change_top_5 = (sum(top_5["Δlf"]))/(8)
```

In [205]:
```
avg_rate_change_top_5
```

Out[205]:
```
22.538249969482397
```

In [206]:
```
avg_rate_change_five_to_ten = (sum(five_to_ten["Δlf"]))/(8)
```

In [207]:
```
avg_rate_change_five_to_ten
```

Out[207]:
```
16.2931249141693
```

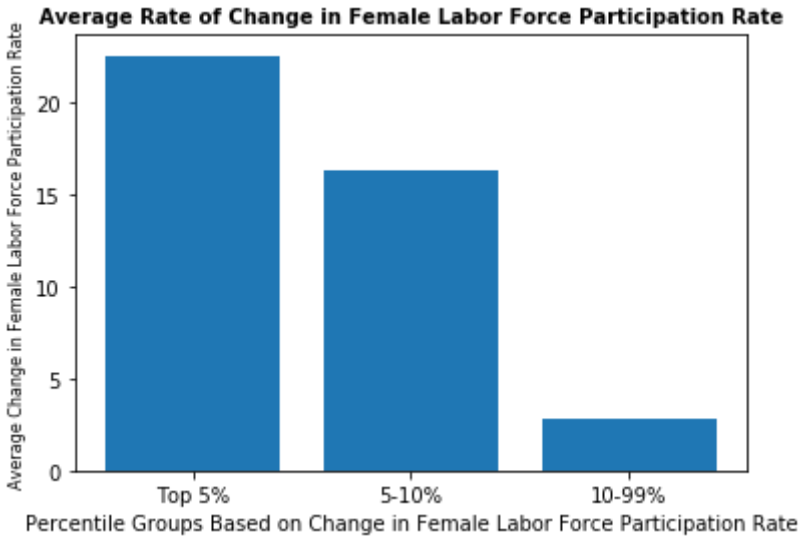
In [208]:
```
avg_rate_change_ninetynine = (sum(ninetynine["Δlf"]))/(141)
```

In [209]:
```
avg_rate_change_ninetynine
```

Out[209]:
```
2.852029767647471
```

In [210]:
```
avg_change_lf_df = pd.DataFrame(columns=['Average Rate of Change in Labo
r Force'], index=['Top 5%','5-10%','10-99%'])
avg_change_lf_df.loc['Top 5%'] = pd.Series({'Average Rate of Change in L
abor Force' : 22.538249969482397})
avg_change_lf_df.loc['5-10%'] = pd.Series({'Average Rate of Change in La
bor Force' : 16.2931249141693})
avg_change_lf_df.loc['10-99%'] = pd.Series({'Average Rate of Change in L
abor Force' : 2.852029767647471})
```

In [211]:
```
fig, ax = plt.subplots()

ax.bar(avg_change_lf_df.index, avg_change_lf_df["Average Rate of Change
 in Labor Force"])

ax.set_xlabel("Percentile Groups Based on Change in Female Labor Force P
articipation Rate", fontsize = 10)

ax.set_ylabel("Average Change in Female Labor Force Participation Rate",
fontsize = 8)

ax.set_title("Average Rate of Change in Female Labor Force Participation
Rate", fontsize = 10, fontweight = "bold")

plt.savefig("average_rate_of_change_Δlf_bar.png", bbox_inches = "tight")

plt.show()
```



In [212]:
```
sum(lf_df["Δlf"])
```

Out[212]: 712.7871963075073

In [213]:
```
total_rep_top_5 =  (sum(top_5["Δlf"]))/(sum(lf_df["Δlf"]))*(100)
```

In [214]:
```
total_rep_top_5
```

Out[214]: 25.295908889765244

In [215]:
```
total_rep_five_to_ten = (sum(five_to_ten["Δlf"])) /(sum(lf_df["Δlf"]))*(
100)
```

In [216]:
```
total_rep_five_to_ten
```

Out[216]: 18.286663956449857

In [217]:
```
total_rep_ninetynine =  (sum(ninetynine["Δlf"]))/(sum(lf_df["Δlf"]))*(10
0)
```

In [218]:
```
total_rep_ninetynine
```

Out[218]:
```
56.41742715378486
```

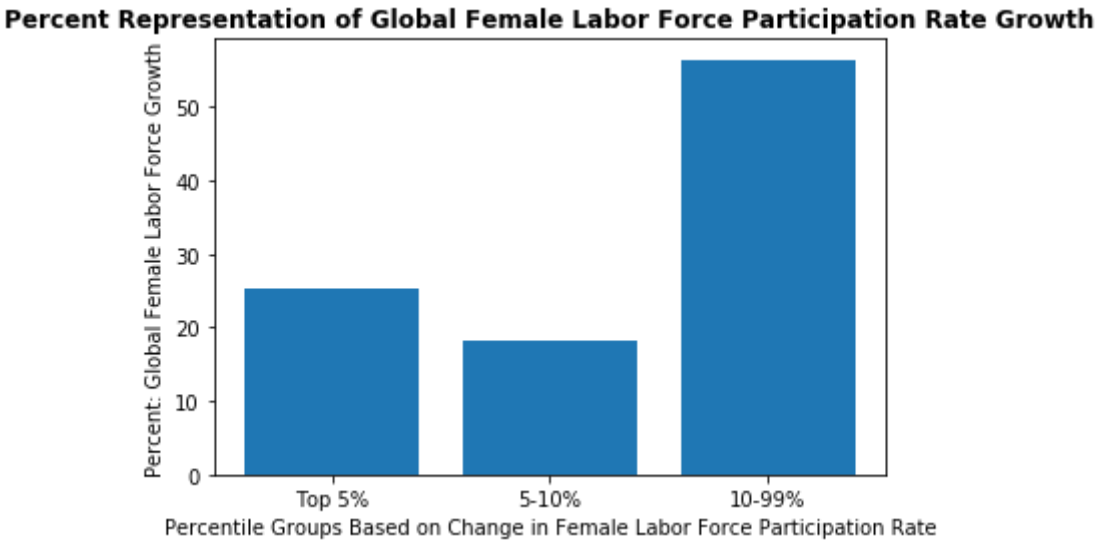
In [219]:
```
total_rep_df = pd.DataFrame(columns=['Percent Representation of Global Labor Force Growth for Women'], index=['Top 5%','5-10%','10-99%'])
total_rep_df.loc['Top 5%'] = pd.Series({'Percent Representation of Global Labor Force Growth for Women' : 25.295908889765244})
total_rep_df.loc['5-10%'] = pd.Series({'Percent Representation of Global Labor Force Growth for Women' : 18.286663956449857})
total_rep_df.loc['10-99%'] = pd.Series({'Percent Representation of Global Labor Force Growth for Women' : 56.41742715378486})
```

In [220]:
```
total_rep_df
```

Out[220]:

	Percent Representation of Global Labor Force Growth for Women
Top 5%	25.2959
5-10%	18.2867
10-99%	56.4174

In [221]:
```
fig, ax = plt.subplots()

ax.bar(total_rep_df.index, total_rep_df["Percent Representation of Globa
l Labor Force Growth for Women"])

ax.set_xlabel("Percentile Groups Based on Change in Female Labor Force P
articipation Rate", fontsize = 10)

ax.set_ylabel("Percent: Global Female Labor Force Growth", fontsize = 10
)

ax.set_title("Percent Representation of Global Female Labor Force Partic
ipation Rate Growth", fontsize = 12, fontweight = "bold")

plt.savefig("percent_global_flfpr_growth.png", bbox_inches = "tight")

plt.show()
```



In [222]:
```
top_5
```

Out[222]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	1997.
Country Name								
Colombia	29.856001	30.379999	30.976000	31.450001	32.861000	34.294998	35.751999	37.22300
Peru	43.134998	43.500999	44.584000	45.688999	46.824001	50.083000	52.778000	55.53200
Mali	35.404999	35.433998	35.373001	35.367001	35.382999	35.400002	35.452000	35.51699
Maldives	20.212999	21.652000	23.184999	24.799999	26.475000	28.186001	29.974001	31.77899
Macao SAR, China	44.164001	44.419998	45.953999	46.387001	47.289001	48.328999	55.490002	55.11200
Belize	34.488998	35.054001	35.686001	35.883999	35.634998	35.783001	36.131001	37.12799
Chile	32.075001	31.854000	33.848000	35.484001	35.490002	34.356998	34.692001	35.54600
Spain	33.840000	34.020000	34.590000	35.099998	36.278000	36.685001	37.214001	37.99300

8 rows × 29 columns

In [223]:
```
top_5_gdp = gdp_df[(gdp_df.index.isin((top_5.index)))]
```

In [224]:
```
top_5_gdp
```

Out[224]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0
Country Name						
Maldives	2.150890e+08	2.444683e+08	2.848534e+08	3.223266e+08	3.558844e+08	3.989890e+08
Macao SAR, China	3.220920e+09	3.735117e+09	4.879019e+09	5.625533e+09	6.265844e+09	6.996034e+09
Chile	3.311389e+10	3.783479e+10	4.596433e+10	4.929777e+10	5.700843e+10	7.344706e+10
Peru	2.641039e+10	3.467212e+10	3.613923e+10	3.515811e+10	4.488208e+10	5.331279e+10
Colombia	4.784409e+10	4.917557e+10	5.841899e+10	6.644680e+10	8.170350e+10	9.250728e+10
Mali	2.681912e+09	2.724132e+09	2.830673e+09	2.818281e+09	2.081846e+09	2.706425e+09
Belize	4.120864e+08	4.447208e+08	5.182391e+08	5.598582e+08	5.808637e+08	6.201404e+08
Spain	5.351012e+11	5.755985e+11	6.292024e+11	5.236495e+11	5.291216e+11	6.129397e+11

8 rows × 30 columns

In [225]:
```
five_to_ten_gdp = gdp_df[(gdp_df.index.isin((five_to_ten.index)))]
```

In [226]:
```
ninetynine_gdp = gdp_df[(gdp_df.index.isin((ninetynine.index)))]
```

In [227]:
```
top_5_gdp_avg_change = sum(top_5_gdp["Δgdp"])/8
```

In [228]:
```
top_5_gdp_avg_change
```

Out[228]:
```
192582632429.23517
```

In [229]:
```
five_to_ten_avg_change = sum(five_to_ten_gdp["Δgdp"])/8
```

In [230]:
```
five_to_ten_avg_change
```

Out[230]:
```
138529884042.79422
```

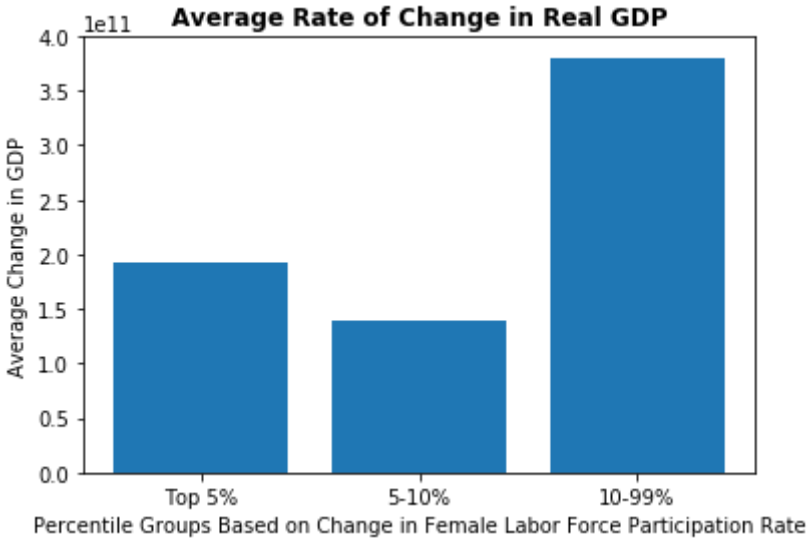
In [231]:
```
ninetynine_avg_change = sum(ninetynine_gdp["Δgdp"])/141
```

In [232]:
```
ninetynine_avg_change
```

Out[232]:
```
380383848507.6408
```

In [233]:
```
avg_change_gdp_df = pd.DataFrame(columns=['Average Change in GDP'], inde
x=['Top 5%','5-10%','10-99%'])
avg_change_gdp_df.loc['Top 5%'] = pd.Series({'Average Change in GDP' : 1
92582632429.23517})
avg_change_gdp_df.loc['5-10%'] = pd.Series({'Average Change in GDP' : 13
8529884042.79422})
avg_change_gdp_df.loc['10-99%'] = pd.Series({'Average Change in GDP' : 3
80383848507.6408})
```

In [234]:
```
fig, ax = plt.subplots()

ax.bar(avg_change_gdp_df.index, avg_change_gdp_df["Average Change in GD
P"])

ax.set_xlabel("Percentile Groups Based on Change in Female Labor Force P
articipation Rate")

ax.set_ylabel("Average Change in GDP")

ax.set_title("Average Rate of Change in Real GDP", fontsize = 12, fontwe
ight = "bold")

plt.savefig("avg_rate_of_change_real_gdp.png", bbox_inches = "tight")

plt.show()
```



In [235]:
```
top_5_gdp_avg_percentage_change = sum(top_5_gdp["%increase"])/8
```

In [236]:
```
top_5_gdp_avg_percentage_change
```

Out[236]: 823.6814722366782

In [237]:
```
five_to_ten_avg_percentage_change = sum(five_to_ten_gdp["%increase"])/8
```

In [238]:
```
five_to_ten_avg_percentage_change
```

Out[238]: 683.2839417325531

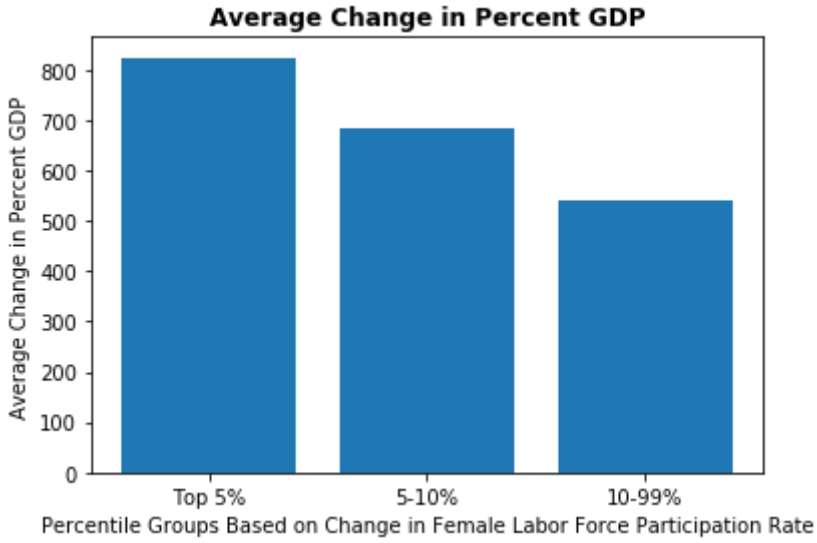
In [239]:
```
ninetynine_avg_percentage_change = sum(ninetynine_gdp["%increase"])/141
```

In [240]:
```
ninetynine_avg_percentage_change
```

Out[240]: 541.9012117053653

In [241]:
```
avg_percent_change_gdp_df = pd.DataFrame(columns=['Average Percent Chang
e in GDP'], index=['Top 5%','5-10%','10-99%'])
avg_percent_change_gdp_df.loc['Top 5%'] = pd.Series({'Average Percent Ch
ange in GDP' : 823.6814722366782})
avg_percent_change_gdp_df.loc['5-10%'] = pd.Series({'Average Percent Cha
nge in GDP' : 683.2839417325531})
avg_percent_change_gdp_df.loc['10-99%'] = pd.Series({'Average Percent Ch
ange in GDP' : 541.9012117053653})
```

In [243]:
```
fig, ax = plt.subplots()

ax.bar(avg_percent_change_gdp_df.index, avg_percent_change_gdp_df["Avera
ge Percent Change in GDP"])

ax.set_xlabel("Percentile Groups Based on Change in Female Labor Force P
articipation Rate")

ax.set_ylabel("Average Change in Percent GDP")

ax.set_title("Average Change in Percent GDP", fontsize = 12, fontweight
= "bold")

plt.savefig("avg_change_in_percent_gdp.png", bbox_inches = "tight")

plt.show()
```



Lastly, I created a scatterplot to show that the association exists by taking the difference in the log of labor force over time against the logs of gdp over time and the logs of percent gdp over time. The last two graphs show the association with the dot size equivalent to the country's gdp per capita.

In [244]:
```
pop_df["Δpop"] = pop_df[2017.0] - pop_df[1990.0]
```

In [245]:
```
lf_df
```

Out[245]:

1 Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Colombia	29.856001	30.379999	30.976000	31.450001	32.861000	34.294998	35.751999	37.22
Peru	43.134998	43.500999	44.584000	45.688999	46.824001	50.083000	52.778000	55.53
Mali	35.404999	35.433998	35.373001	35.367001	35.382999	35.400002	35.452000	35.51
Maldives	20.212999	21.652000	23.184999	24.799999	26.475000	28.186001	29.974001	31.77
Macao SAR, China	44.164001	44.419998	45.953999	46.387001	47.289001	48.328999	55.490002	55.11
Belize	34.488998	35.054001	35.686001	35.883999	35.634998	35.783001	36.131001	37.12
Chile	32.075001	31.854000	33.848000	35.484001	35.490002	34.356998	34.692001	35.54
Spain	33.840000	34.020000	34.590000	35.099998	36.278000	36.685001	37.214001	37.99
Luxembourg	34.120998	35.930000	38.105000	36.944000	37.706001	35.283001	36.363998	37.39
Qatar	40.143002	40.498001	40.997002	40.999001	40.953999	40.875000	40.417000	40.82
Botswana	47.747002	47.951000	48.105000	48.261002	48.469002	48.754002	48.926998	49.16
Ireland	35.770000	36.509998	36.661999	38.250000	39.338001	39.937000	41.501999	42.48
Bahrain	28.851000	28.938000	29.514000	30.180000	30.917000	31.672001	32.202999	32.73
Netherlands	43.049000	43.825001	45.110001	45.584999	46.689999	47.307999	48.340000	49.72
Panama	38.247002	39.056000	39.736000	40.451000	41.415001	42.793999	43.244999	43.68
St. Vincent and the Grenadines	44.111000	44.682999	45.620998	46.383999	46.729000	47.731998	48.318001	49.04
Malta	27.927999	28.059999	28.322001	28.514999	28.472000	28.271999	28.545000	28.75
St. Lucia	47.300999	47.778000	48.425999	49.084000	49.713001	50.285000	50.844002	51.34
Nicaragua	36.522999	36.368999	35.612000	34.873001	34.287998	33.831001	34.215000	35.13
Brunei Darussalam	45.779999	46.209000	47.146000	48.143002	49.214001	50.362000	51.299000	52.33
Israel	46.266998	46.724998	47.994999	49.021000	50.505001	51.287998	51.118999	51.01
Singapore	47.618000	48.160000	48.680000	49.465000	50.188999	50.771999	51.110001	51.42
Trinidad and Tobago	38.578999	44.006001	43.550999	43.188999	44.044998	44.813999	46.883999	46.84
Costa Rica	32.903000	33.799999	33.145000	34.053001	35.089001	36.122002	34.564999	37.66
Senegal	33.375000	33.366001	33.353001	33.348999	33.349998	33.410999	33.415001	33.44
Cyprus	46.162998	46.752998	47.341000	46.750999	48.191002	47.124001	47.644001	49.34
United Arab Emirates	29.180000	29.421000	29.815001	30.214001	30.754999	31.257999	31.556999	31.96
Austria	43.432999	43.786999	44.990002	45.569000	47.956001	48.807999	48.341000	48.29
Benin	57.348999	57.362000	57.366001	58.222000	59.073002	59.917999	60.741001	61.55

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Belgium	36.557999	37.946999	38.737999	39.446999	40.054001	40.477001	40.529999	40.96
...	...	...	...	...	...	...	...	
Turkey	34.034000	33.939999	32.514000	26.603001	31.070000	30.753000	30.382000	28.60
Denmark	61.050999	61.441002	61.594002	61.035000	57.912998	57.952000	58.222000	58.70
Papua New Guinea	70.958000	70.654999	70.170998	69.502998	69.364998	69.675003	69.464996	69.80
Jamaica	59.500000	60.263000	60.944000	61.825001	62.452999	61.452000	60.109001	58.50
Sweden	63.136002	62.473999	61.109001	59.460999	58.623001	59.084999	59.259998	58.68
Kyrgyz Republic	50.764999	51.360001	52.389000	53.549999	55.138000	55.713001	55.477001	55.10
Tanzania	82.100998	82.070999	82.023003	81.972000	81.917000	81.863998	81.843002	81.80
Russian Federation	59.285000	59.007000	58.709000	56.895000	55.057999	54.539001	53.731998	52.70
Lao PDR	79.904999	79.945000	79.970001	79.990997	79.960999	79.945999	79.793999	79.63
Zambia	73.833000	73.783997	73.711998	73.685997	73.559998	73.514999	73.511002	73.49
Malawi	76.107002	76.107002	75.999001	75.983002	75.866997	75.921997	75.964996	75.99
Finland	58.976002	57.722000	56.324001	55.487000	54.780998	54.755001	54.645000	54.77
Mozambique	87.232002	87.054001	86.897003	86.833000	86.803001	86.779999	86.885002	86.92
Togo	80.843002	80.806999	80.737000	80.587997	80.582001	80.538002	80.499001	80.49
Poland	53.874001	53.759998	53.679001	53.178001	52.423000	51.151001	50.556000	49.36
Albania	53.590000	55.780998	56.097000	55.280998	54.535000	53.501999	52.907001	53.56
Bulgaria	54.445000	54.396000	54.374001	53.258999	52.094002	50.872002	49.673000	48.43
Thailand	67.171997	66.754997	66.367996	65.984001	65.622002	66.425003	67.348999	67.63
Sierra Leone	63.894001	63.841000	63.646999	63.657001	63.668999	63.653000	63.647999	63.59
Slovak Republic	59.783001	59.723000	57.602001	55.187000	51.445000	51.568001	52.304001	51.80
Ukraine	54.748001	54.443001	54.137001	53.875000	53.891998	54.018002	53.162998	52.22
Kenya	70.324997	70.275002	70.206001	70.147003	70.113998	70.103996	70.053001	69.99
India	35.106998	35.172001	35.286999	35.463001	35.722000	35.431000	35.130001	34.83
Lesotho	68.709999	68.748001	68.789001	68.817001	68.882004	68.941002	68.981003	69.00
Sri Lanka	45.514999	41.646999	38.049999	37.891998	38.530998	36.330002	35.808998	35.48
Burundi	90.783997	90.345001	89.845001	89.282997	88.665001	87.992996	87.262001	86.46
Yemen, Rep.	16.832001	16.792999	16.761000	16.806999	16.848000	17.761999	18.707001	19.69
China	73.197998	73.083000	72.971001	72.851997	72.707001	72.519997	72.296997	72.03
Romania	62.076000	62.212002	62.381001	62.236000	62.043999	61.828999	58.709999	59.54

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Burkina Faso	76.218002	76.285004	75.478996	74.650002	73.792000	72.907997	71.987999	71.03

157 rows × 29 columns

In [246]:
```
lf_df["log_2017"] = np.log(lf_df[2017.0])
```

In [247]:
```
lf_df["log_1990"] = np.log(lf_df[1990.0])
```

In [248]:
```
lf_df["Δlogs"] = lf_df["log_2017"] - lf_df["log_1990"]
```

In [249]:
```
lf_df_all["log_2017"] = np.log(lf_df_all[2017.0])
```

In [250]:
```
lf_df_all["log_1990"] = np.log(lf_df_all[1990.0])
```

In [251]:
```
lf_df_all["Δlogs"] = lf_df_all["log_2017"] - lf_df_all["log_1990"]
```

In [282]:
```
gdp_df["log_2017"] = np.log(gdp_df[2017.0])
```

In [283]:
```
gdp_df["log_1990"] = np.log(gdp_df[1990.0])
```

In [284]:
```
gdp_df["Δlogs"] = gdp_df["log_2017"] - gdp_df["log_1990"]
```

In [252]:
```
gdp_df_all["log_2017"] = np.log(gdp_df_all[2017.0])
```

In [253]:
```
gdp_df_all["log_1990"] = np.log(gdp_df_all[1990.0])
```

In [254]:
```
gdp_df_all["Δlogs"] = gdp_df_all["log_2017"] - gdp_df_all["log_1990"]
```

In [279]:
```
lf_df.sort_values(by = "Δlogs")
```

Out[279]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
Yemen, Rep.	16.832001	16.792999	16.761000	16.806999	16.848000	17.761999	18.707001	19.69
Romania	62.076000	62.212002	62.381001	62.236000	62.043999	61.828999	58.709999	59.54
Burkina Faso	76.218002	76.285004	75.478996	74.650002	73.792000	72.907997	71.987999	71.03
Sri Lanka	45.514999	41.646999	38.049999	37.891998	38.530998	36.330002	35.808998	35.48
India	35.106998	35.172001	35.286999	35.463001	35.722000	35.431000	35.130001	34.83
China	73.197998	73.083000	72.971001	72.851997	72.707001	72.519997	72.296997	72.03
Ukraine	54.748001	54.443001	54.137001	53.875000	53.891998	54.018002	53.162998	52.22
Lesotho	68.709999	68.748001	68.789001	68.817001	68.882004	68.941002	68.981003	69.00
Slovak Republic	59.783001	59.723000	57.602001	55.187000	51.445000	51.568001	52.304001	51.80
Bulgaria	54.445000	54.396000	54.374001	53.258999	52.094002	50.872002	49.673000	48.43
Albania	53.590000	55.780998	56.097000	55.280998	54.535000	53.501999	52.907001	53.56
Burundi	90.783997	90.345001	89.845001	89.282997	88.665001	87.992996	87.262001	86.46
Kenya	70.324997	70.275002	70.206001	70.147003	70.113998	70.103996	70.053001	69.99
Sierra Leone	63.894001	63.841000	63.646999	63.657001	63.668999	63.653000	63.647999	63.59
Thailand	67.171997	66.754997	66.367996	65.984001	65.622002	66.425003	67.348999	67.63
Poland	53.874001	53.759998	53.679001	53.178001	52.423000	51.151001	50.556000	49.36
Finland	58.976002	57.722000	56.324001	55.487000	54.780998	54.755001	54.645000	54.77
Togo	80.843002	80.806999	80.737000	80.587997	80.582001	80.538002	80.499001	80.49
Mozambique	87.232002	87.054001	86.897003	86.833000	86.803001	86.779999	86.885002	86.92
Kyrgyz Republic	50.764999	51.360001	52.389000	53.549999	55.138000	55.713001	55.477001	55.10
Zambia	73.833000	73.783997	73.711998	73.685997	73.559998	73.514999	73.511002	73.49
Samoa	24.993999	25.254999	25.441000	25.440001	25.569000	25.346001	25.225000	25.27
Malawi	76.107002	76.107002	75.999001	75.983002	75.866997	75.921997	75.964996	75.99
Turkey	34.034000	33.939999	32.514000	26.603001	31.070000	30.753000	30.382000	28.60
Russian Federation	59.285000	59.007000	58.709000	56.895000	55.057999	54.539001	53.731998	52.70
Lao PDR	79.904999	79.945000	79.970001	79.990997	79.960999	79.945999	79.793999	79.63
Sweden	63.136002	62.473999	61.109001	59.460999	58.623001	59.084999	59.259998	58.68
Jamaica	59.500000	60.263000	60.944000	61.825001	62.452999	61.452000	60.109001	58.50
Tanzania	82.100998	82.070999	82.023003	81.972000	81.917000	81.863998	81.843002	81.80
Denmark	61.050999	61.441002	61.594002	61.035000	57.912998	57.952000	58.222000	58.70

1	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Country Name								
...	...	...	...	...	...	...	...	
Belgium	36.557999	37.946999	38.737999	39.446999	40.054001	40.477001	40.529999	40.96
Jordan	10.587000	10.930000	11.305000	11.641000	11.983000	12.336000	12.397000	12.46
Mexico	33.457001	34.005001	34.876999	35.855000	36.374001	37.618999	37.541000	39.59
Trinidad and Tobago	38.578999	44.006001	43.550999	43.188999	44.044998	44.813999	46.883999	46.84
Algeria	11.496000	11.535000	11.581000	11.647000	11.724000	11.804000	11.867000	11.81
St. Vincent and the Grenadines	44.111000	44.682999	45.620998	46.383999	46.729000	47.731998	48.318001	49.04
Netherlands	43.049000	43.825001	45.110001	45.584999	46.689999	47.307999	48.340000	49.72
Senegal	33.375000	33.366001	33.353001	33.348999	33.349998	33.410999	33.415001	33.44
Botswana	47.747002	47.951000	48.105000	48.261002	48.469002	48.754002	48.926998	49.16
Costa Rica	32.903000	33.799999	33.145000	34.053001	35.089001	36.122002	34.564999	37.66
Nicaragua	36.522999	36.368999	35.612000	34.873001	34.287998	33.831001	34.215000	35.13
Panama	38.247002	39.056000	39.736000	40.451000	41.415001	42.793999	43.244999	43.68
United Arab Emirates	29.180000	29.421000	29.815001	30.214001	30.754999	31.257999	31.556999	31.96
Bangladesh	23.111000	23.193001	23.357000	23.601000	23.921000	24.315001	24.702999	25.17
Qatar	40.143002	40.498001	40.997002	40.999001	40.953999	40.875000	40.417000	40.82
Ireland	35.770000	36.509998	36.661999	38.250000	39.338001	39.937000	41.501999	42.48
Macao SAR, China	44.164001	44.419998	45.953999	46.387001	47.289001	48.328999	55.490002	55.11
Oman	20.077000	20.424999	20.712999	20.922001	21.105000	21.344000	21.575001	22.01
Malta	27.927999	28.059999	28.322001	28.514999	28.472000	28.271999	28.545000	28.75
Bahrain	28.851000	28.938000	29.514000	30.180000	30.917000	31.672001	32.202999	32.73
Luxembourg	34.120998	35.930000	38.105000	36.944000	37.706001	35.283001	36.363998	37.39
Spain	33.840000	34.020000	34.590000	35.099998	36.278000	36.685001	37.214001	37.99
Belize	34.488998	35.054001	35.686001	35.883999	35.634998	35.783001	36.131001	37.12
Saudi Arabia	14.154000	14.220000	14.217000	14.482000	14.698000	14.870000	15.104000	15.42
Chile	32.075001	31.854000	33.848000	35.484001	35.490002	34.356998	34.692001	35.54
Peru	43.134998	43.500999	44.584000	45.688999	46.824001	50.083000	52.778000	55.53
Mali	35.404999	35.433998	35.373001	35.367001	35.382999	35.400002	35.452000	35.51
Pakistan	14.014000	13.833000	13.822000	14.188000	14.571000	12.505000	13.610000	14.83
Colombia	29.856001	30.379999	30.976000	31.450001	32.861000	34.294998	35.751999	37.22

Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	1995.0	1996.0	19
Maldives	20.212999	21.652000	23.184999	24.799999	26.475000	28.186001	29.974001	31.77

157 rows × 32 columns

In [267]:
```
lf_df_all[1990.0].loc["World"]
```

Out[267]:
```
51.379113765679
```

In [268]:
```
lf_df_all[2017.0].loc["World"]
```

Out[268]:
```
48.68722180239935
```

In [269]:
```
lf_df_all["Δlf"].loc["World"] = (lf_df_all[2017.0].loc["World"] ) - (lf_
df_all[1990.0].loc["World"])
```

In [270]:
```
lf_df_all["Δlf"].loc["World"]
```

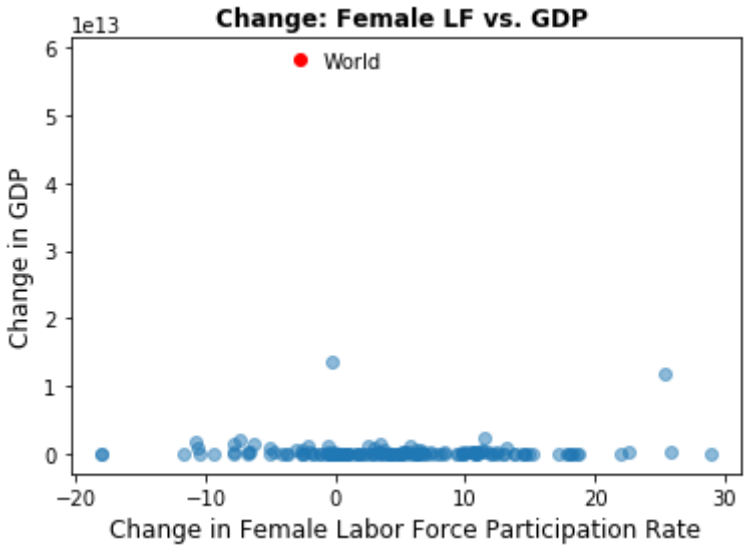
Out[270]:
```
-2.6918919632796516
```

In [273]:
```
gdp_df_all["Δgdp"].loc["World"] = (gdp_df_all[2017.0].loc["World"] ) - (
gdp_df_all[1990.0].loc["World"])
```

In [274]:
```
gdp_df_all["Δgdp"].loc["World"]
```

Out[274]:
```
58323339995218.2
```

In [311]:
```
fix, ax = plt.subplots()

ax.scatter(lf_df["Δlf"], gdp_df["Δgdp"],
           alpha= 0.50)

ax.scatter(lf_df_all["Δlf"].loc["World"], gdp_df_all["Δgdp"].loc["World"
], alpha = 1, color = "red")

ax.set_title('Change: Female LF vs. GDP ', loc='center', fontsize=12, fo
ntweight = "bold")

ax.annotate(
   "World",
    xy = (lf_df_all["Δlf"].loc["World"], gdp_df_all["Δgdp"].loc["World"
]),
    xytext=(-1, 57000000000000),
    fontsize=10,
)

ax.set_xlabel("Change in Female Labor Force Participation Rate", fontsiz
e=12)
ax.set_ylabel("Change in GDP", fontsize=12)
plt.savefig("change_lf_gdp.png", bbox_inches = "tight")
plt.show()
```



In [276]:
```
lf_df_all["Δlogs"].loc["World"]
```

Out[276]:
```
-0.05381513323696607
```

In [285]:
```
gdp_df
```

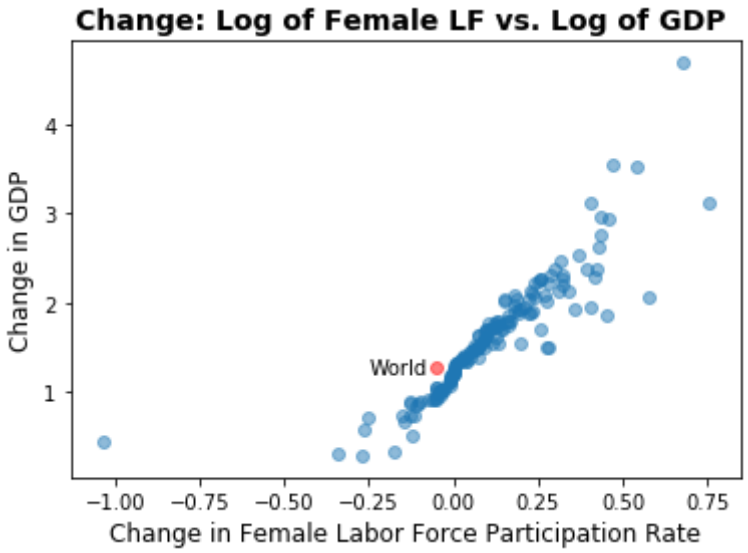
Out[285]:

1	1990.0	1991.0	1992.0	1993.0	1994.0	199
Country Name						
Equatorial Guinea	1.121194e+08	1.109060e+08	1.347072e+08	1.360479e+08	1.008070e+08	1.418534e+
Vietnam	6.471741e+09	9.613370e+09	9.866990e+09	1.318095e+10	1.628643e+10	2.073616e+
China	3.608579e+11	3.833733e+11	4.269157e+11	4.447313e+11	5.643247e+11	7.345479e+
Qatar	7.360439e+09	6.883516e+09	7.646154e+09	7.156594e+09	7.374451e+09	8.137912e+
Maldives	2.150890e+08	2.444683e+08	2.848534e+08	3.223266e+08	3.558844e+08	3.989890e+
Lao PDR	8.655599e+08	1.028088e+09	1.127807e+09	1.327749e+09	1.543606e+09	1.763536e+
Lebanon	2.838485e+09	4.690415e+09	5.843579e+09	7.941744e+09	9.599127e+09	1.171880e+
Macao SAR, China	3.220920e+09	3.735117e+09	4.879019e+09	5.625533e+09	6.265844e+09	6.996034e+
Nicaragua	1.009455e+09	1.488804e+09	1.792800e+09	1.756454e+09	3.863185e+09	4.140470e+
Tanzania	4.258743e+09	4.956588e+09	4.601413e+09	4.257702e+09	4.510847e+09	5.255221e+
Turkmenistan	3.189540e+09	3.208099e+09	3.200540e+09	3.172880e+09	2.496503e+09	2.474614e+
Angola	1.122876e+10	1.060378e+10	8.307811e+09	5.768720e+09	4.438321e+09	5.538749e+
Sri Lanka	8.032551e+09	9.000363e+09	9.703012e+09	1.033868e+10	1.171760e+10	1.302970e+
Dominican Republic	7.073676e+09	9.734322e+09	1.135627e+10	1.308104e+10	1.466424e+10	1.659868e+
Costa Rica	5.711688e+09	7.169000e+09	8.528593e+09	9.537298e+09	1.043262e+10	1.151347e+
Ghana	5.889175e+09	6.596546e+09	6.413902e+09	5.966256e+09	5.444561e+09	6.465138e+
Guatemala	7.650125e+09	9.406098e+09	1.044084e+10	1.139994e+10	1.298324e+10	1.465540e+
Panama	6.433967e+09	7.074676e+09	8.042338e+09	8.782585e+09	9.365290e+09	9.573814e+
Jordan	4.160004e+09	4.344250e+09	5.311329e+09	5.605842e+09	6.237740e+09	6.727447e+
Indonesia	1.061407e+11	1.166220e+11	1.280270e+11	1.580067e+11	1.768921e+11	2.021320e+
Sudan	1.240865e+10	1.137922e+10	7.034220e+09	8.881786e+09	1.279419e+10	1.382974e+
Kenya	8.572359e+09	8.151479e+09	8.209129e+09	5.751790e+09	7.148145e+09	9.046326e+
Guyana	3.965823e+08	3.485331e+08	3.735731e+08	4.541014e+08	5.408749e+08	6.216268e+
Singapore	3.615203e+10	4.547444e+10	5.215641e+10	6.064457e+10	7.377779e+10	8.789001e+
Bhutan	2.997873e+08	2.500458e+08	2.507944e+08	2.352396e+08	2.708016e+08	3.030535e+
Bahrain	4.229787e+09	4.616223e+09	4.751064e+09	5.200266e+09	5.567553e+09	5.849468e+
Chile	3.311389e+10	3.783479e+10	4.596433e+10	4.929777e+10	5.700843e+10	7.344706e+
India	3.209790e+11	2.701053e+11	2.882084e+11	2.792960e+11	3.272756e+11	3.602820e+
Peru	2.641039e+10	3.467212e+10	3.613923e+10	3.515811e+10	4.488208e+10	5.331279e+
Poland	6.597775e+10	8.550094e+10	9.433705e+10	9.604565e+10	1.108034e+11	1.421373e+
...	...	...	...	...	...	

1	1990.0	1991.0	1992.0	1993.0	1994.0	199
Country Name						
Bulgaria	2.063209e+10	1.094355e+10	1.035052e+10	1.082971e+10	9.697417e+09	1.306342e+
Burundi	1.132101e+09	1.167398e+09	1.083038e+09	9.386326e+08	9.250306e+08	1.000428e+
Portugal	7.872161e+10	8.924238e+10	1.076027e+11	9.501910e+10	9.969845e+10	1.181336e+
Canada	5.939296e+11	6.103282e+11	5.923877e+11	5.771708e+11	5.781393e+11	6.040316e+
Tajikistan	2.629395e+09	2.534720e+09	1.909247e+09	1.630251e+09	1.522018e+09	1.231567e+
Haiti	3.096290e+09	3.473541e+09	2.257122e+09	1.878249e+09	2.167564e+09	2.813313e+
Algeria	6.204510e+10	4.571537e+10	4.800330e+10	4.994646e+10	4.254257e+10	4.176405e+
Netherlands	3.142677e+11	3.233204e+11	3.583304e+11	3.490378e+11	3.742914e+11	4.465290e+
Switzerland	2.580666e+11	2.611138e+11	2.718144e+11	2.643530e+11	2.926467e+11	3.426170e+
Gabon	5.952294e+09	5.402920e+09	5.592391e+09	4.378645e+09	4.190819e+09	4.958846e+
Belarus	2.165000e+10	1.800000e+10	1.703704e+10	1.628099e+10	1.493202e+10	1.397268e+
Zimbabwe	8.783817e+09	8.641482e+09	6.751472e+09	6.563813e+09	6.890675e+09	7.111271e+
Austria	1.664634e+11	1.737942e+11	1.950781e+11	1.903797e+11	2.035352e+11	2.410383e+
Comoros	4.296221e+08	4.241088e+08	4.573886e+08	4.528814e+08	3.191892e+08	3.984618e+
Spain	5.351012e+11	5.755985e+11	6.292024e+11	5.236495e+11	5.291216e+11	6.129397e+
United Kingdom	1.093169e+12	1.142797e+12	1.179660e+12	1.061389e+12	1.140490e+12	1.335219e+
Belgium	2.064308e+11	2.116378e+11	2.360384e+11	2.259247e+11	2.461949e+11	2.895673e+
Denmark	1.382473e+11	1.392247e+11	1.529156e+11	1.431956e+11	1.561623e+11	1.850070e+
Barbados	2.023318e+09	2.007110e+09	1.950900e+09	2.046189e+09	2.151295e+09	2.261970e+
Germany	1.764968e+12	1.861874e+12	2.123131e+12	2.068556e+12	2.205966e+12	2.591620e+
Sweden	2.581543e+11	2.703625e+11	2.803123e+11	2.099508e+11	2.260800e+11	2.640520e+
Greece	9.789109e+10	1.051432e+11	1.162247e+11	1.088091e+11	1.166018e+11	1.368784e+
France	1.269180e+12	1.269277e+12	1.401466e+12	1.322816e+12	1.393983e+12	1.601095e+
Georgia	7.753502e+09	6.357616e+09	3.690329e+09	2.701181e+09	2.513871e+09	2.693732e+
Finland	1.415176e+11	1.278665e+11	1.126254e+11	8.925575e+10	1.033216e+11	1.341993e+
Italy	1.177326e+12	1.242109e+12	1.315807e+12	1.061445e+12	1.095591e+12	1.170787e+
Japan	3.132818e+12	3.584420e+12	3.908809e+12	4.454144e+12	4.907039e+12	5.449116e+
Ukraine	8.145692e+10	7.746456e+10	7.394224e+10	6.564856e+10	5.254956e+10	4.821387e+
Central African Republic	1.440711e+09	1.377375e+09	1.411918e+09	1.278781e+09	8.511744e+08	1.115390e+
Libya	2.890184e+10	3.199501e+10	3.388139e+10	3.065703e+10	2.860792e+10	2.554413e+

157 rows × 33 columns

In [306]:
```
fix, ax = plt.subplots()

ax.scatter(lf_df["Δlogs"], gdp_df["Δlogs"],
           alpha= 0.50)

ax.scatter(lf_df_all["Δlogs"].loc["World"], gdp_df_all["Δlogs"].loc["Wor
ld"],
           alpha= 0.50, color = "red")

ax.set_title('Change: Log of Female LF vs. Log of GDP ', loc='center', f
ontsize=14, fontweight = "bold")

ax.set_xlabel("Change in Female Labor Force Participation Rate", fontsiz
e=12)
ax.set_ylabel("Change in GDP", fontsize=12)

ax.annotate(
   "World",
    xy = (lf_df_all["Δlogs"].loc["World"], gdp_df_all["Δlogs"].loc["Worl
d"]),
    xytext=(-0.25, 1.2),
    fontsize=10,
)

plt.savefig("change_log_lf_gdp.png", bbox_inches = "tight")
plt.show()
```



In [366]:
```
gdp_df
```

Out[366]:

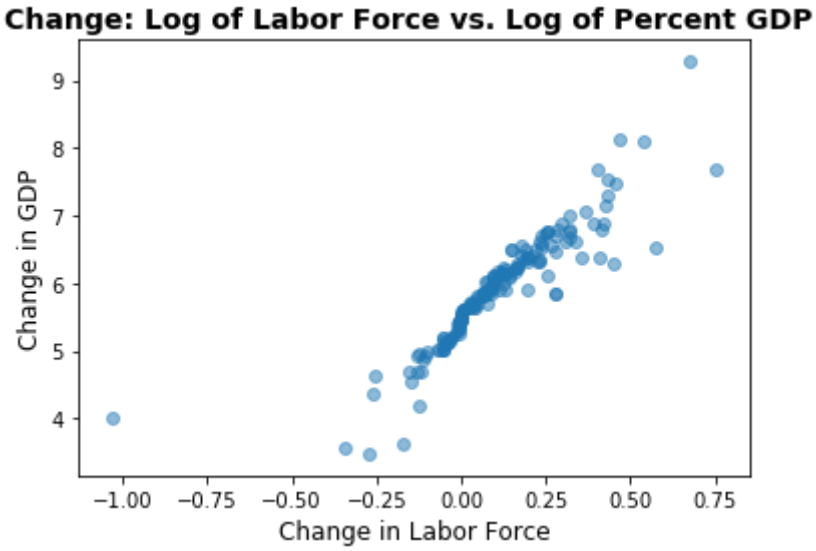
1 Country Name	1990.0	1991.0	1992.0	1993.0	1994.0	199
Equatorial Guinea	1.121194e+08	1.109060e+08	1.347072e+08	1.360479e+08	1.008070e+08	1.418534e+
Vietnam	6.471741e+09	9.613370e+09	9.866990e+09	1.318095e+10	1.628643e+10	2.073616e+
China	3.608579e+11	3.833733e+11	4.269157e+11	4.447313e+11	5.643247e+11	7.345479e+
Qatar	7.360439e+09	6.883516e+09	7.646154e+09	7.156594e+09	7.374451e+09	8.137912e+
Maldives	2.150890e+08	2.444683e+08	2.848534e+08	3.223266e+08	3.558844e+08	3.989890e+
Lao PDR	8.655599e+08	1.028088e+09	1.127807e+09	1.327749e+09	1.543606e+09	1.763536e+
Lebanon	2.838485e+09	4.690415e+09	5.843579e+09	7.941744e+09	9.599127e+09	1.171880e+
Macao SAR, China	3.220920e+09	3.735117e+09	4.879019e+09	5.625533e+09	6.265844e+09	6.996034e+
Nicaragua	1.009455e+09	1.488804e+09	1.792800e+09	1.756454e+09	3.863185e+09	4.140470e+
Tanzania	4.258743e+09	4.956588e+09	4.601413e+09	4.257702e+09	4.510847e+09	5.255221e+
Turkmenistan	3.189540e+09	3.208099e+09	3.200540e+09	3.172880e+09	2.496503e+09	2.474614e+
Angola	1.122876e+10	1.060378e+10	8.307811e+09	5.768720e+09	4.438321e+09	5.538749e+
Sri Lanka	8.032551e+09	9.000363e+09	9.703012e+09	1.033868e+10	1.171760e+10	1.302970e+
Dominican Republic	7.073676e+09	9.734322e+09	1.135627e+10	1.308104e+10	1.466424e+10	1.659868e+
Costa Rica	5.711688e+09	7.169000e+09	8.528593e+09	9.537298e+09	1.043262e+10	1.151347e+
Ghana	5.889175e+09	6.596546e+09	6.413902e+09	5.966256e+09	5.444561e+09	6.465138e+
Guatemala	7.650125e+09	9.406098e+09	1.044084e+10	1.139994e+10	1.298324e+10	1.465540e+
Panama	6.433967e+09	7.074676e+09	8.042338e+09	8.782585e+09	9.365290e+09	9.573814e+
Jordan	4.160004e+09	4.344250e+09	5.311329e+09	5.605842e+09	6.237740e+09	6.727447e+
Indonesia	1.061407e+11	1.166220e+11	1.280270e+11	1.580067e+11	1.768921e+11	2.021320e+
Sudan	1.240865e+10	1.137922e+10	7.034220e+09	8.881786e+09	1.279419e+10	1.382974e+
Kenya	8.572359e+09	8.151479e+09	8.209129e+09	5.751790e+09	7.148145e+09	9.046326e+
Guyana	3.965823e+08	3.485331e+08	3.735731e+08	4.541014e+08	5.408749e+08	6.216268e+
Singapore	3.615203e+10	4.547444e+10	5.215641e+10	6.064457e+10	7.377779e+10	8.789001e+
Bhutan	2.997873e+08	2.500458e+08	2.507944e+08	2.352396e+08	2.708016e+08	3.030535e+
Bahrain	4.229787e+09	4.616223e+09	4.751064e+09	5.200266e+09	5.567553e+09	5.849468e+
Chile	3.311389e+10	3.783479e+10	4.596433e+10	4.929777e+10	5.700843e+10	7.344706e+
India	3.209790e+11	2.701053e+11	2.882084e+11	2.792960e+11	3.272756e+11	3.602820e+
Peru	2.641039e+10	3.467212e+10	3.613923e+10	3.515811e+10	4.488208e+10	5.331279e+
Poland	6.597775e+10	8.550094e+10	9.433705e+10	9.604565e+10	1.108034e+11	1.421373e+
...	...	...	...	...	...	

1	1990.0	1991.0	1992.0	1993.0	1994.0	199
Country Name						
Bulgaria	2.063209e+10	1.094355e+10	1.035052e+10	1.082971e+10	9.697417e+09	1.306342e+
Burundi	1.132101e+09	1.167398e+09	1.083038e+09	9.386326e+08	9.250306e+08	1.000428e+
Portugal	7.872161e+10	8.924238e+10	1.076027e+11	9.501910e+10	9.969845e+10	1.181336e+
Canada	5.939296e+11	6.103282e+11	5.923877e+11	5.771708e+11	5.781393e+11	6.040316e+
Tajikistan	2.629395e+09	2.534720e+09	1.909247e+09	1.630251e+09	1.522018e+09	1.231567e+
Haiti	3.096290e+09	3.473541e+09	2.257122e+09	1.878249e+09	2.167564e+09	2.813313e+
Algeria	6.204510e+10	4.571537e+10	4.800330e+10	4.994646e+10	4.254257e+10	4.176405e+
Netherlands	3.142677e+11	3.233204e+11	3.583304e+11	3.490378e+11	3.742914e+11	4.465290e+
Switzerland	2.580666e+11	2.611138e+11	2.718144e+11	2.643530e+11	2.926467e+11	3.426170e+
Gabon	5.952294e+09	5.402920e+09	5.592391e+09	4.378645e+09	4.190819e+09	4.958846e+
Belarus	2.165000e+10	1.800000e+10	1.703704e+10	1.628099e+10	1.493202e+10	1.397268e+
Zimbabwe	8.783817e+09	8.641482e+09	6.751472e+09	6.563813e+09	6.890675e+09	7.111271e+
Austria	1.664634e+11	1.737942e+11	1.950781e+11	1.903797e+11	2.035352e+11	2.410383e+
Comoros	4.296221e+08	4.241088e+08	4.573886e+08	4.528814e+08	3.191892e+08	3.984618e+
Spain	5.351012e+11	5.755985e+11	6.292024e+11	5.236495e+11	5.291216e+11	6.129397e+
United Kingdom	1.093169e+12	1.142797e+12	1.179660e+12	1.061389e+12	1.140490e+12	1.335219e+
Belgium	2.064308e+11	2.116378e+11	2.360384e+11	2.259247e+11	2.461949e+11	2.895673e+
Denmark	1.382473e+11	1.392247e+11	1.529156e+11	1.431956e+11	1.561623e+11	1.850070e+
Barbados	2.023318e+09	2.007110e+09	1.950900e+09	2.046189e+09	2.151295e+09	2.261970e+
Germany	1.764968e+12	1.861874e+12	2.123131e+12	2.068556e+12	2.205966e+12	2.591620e+
Sweden	2.581543e+11	2.703625e+11	2.803123e+11	2.099508e+11	2.260800e+11	2.640520e+
Greece	9.789109e+10	1.051432e+11	1.162247e+11	1.088091e+11	1.166018e+11	1.368784e+
France	1.269180e+12	1.269277e+12	1.401466e+12	1.322816e+12	1.393983e+12	1.601095e+
Georgia	7.753502e+09	6.357616e+09	3.690329e+09	2.701181e+09	2.513871e+09	2.693732e+
Finland	1.415176e+11	1.278665e+11	1.126254e+11	8.925575e+10	1.033216e+11	1.341993e+
Italy	1.177326e+12	1.242109e+12	1.315807e+12	1.061445e+12	1.095591e+12	1.170787e+
Japan	3.132818e+12	3.584420e+12	3.908809e+12	4.454144e+12	4.907039e+12	5.449116e+
Ukraine	8.145692e+10	7.746456e+10	7.394224e+10	6.564856e+10	5.254956e+10	4.821387e+
Central African Republic	1.440711e+09	1.377375e+09	1.411918e+09	1.278781e+09	8.511744e+08	1.115390e+
Libya	2.890184e+10	3.199501e+10	3.388139e+10	3.065703e+10	2.860792e+10	2.554413e+

157 rows × 33 columns

In [369]:
```
gdp_df["logs%"] = np.log(gdp_df["%increase"])
```

In [334]:
```
fix, ax = plt.subplots()

ax.scatter(lf_df["Δlogs"], gdp_df["logs%"],
           alpha= 0.50)

ax.set_title('Change: Log of Labor Force vs. Log of Percent GDP ', loc=
'center', fontsize=14, fontweight = "bold")

ax.set_xlabel("Change in Labor Force", fontsize=12)
ax.set_ylabel("Change in GDP", fontsize=12)

plt.savefig("change_log_lf_percent_gdp.png", bbox_inches = "tight")
plt.show()
```



^without sizing

with sizing

In [386]:
```
merging_pop_df = pop_df.drop(columns = [
 1990.0,
 1991.0,
 1992.0,
 1993.0,
 1994.0,
 1995.0,
 1996.0,
 1997.0,
 1998.0,
 1999.0,
 2000.0,
 2001.0,
 2002.0,
 2003.0,
 2004.0,
 2005.0,
 2006.0,
 2007.0,
 2008.0,
 2009.0,
 2010.0,
 2011.0,
 2012.0,
 2013.0,
 2014.0,
 2015.0,
 2016.0])
```

In [387]:
```
merging_pop_df.rename(columns={2017.0:'pop_in_2017'}, inplace=True)
```

In [388]:
```
merging_gdp_df = gdp_df.drop(columns = [
 1990.0,
 1991.0,
 1992.0,
 1993.0,
 1994.0,
 1995.0,
 1996.0,
 1997.0,
 1998.0,
 1999.0,
 2000.0,
 2001.0,
 2002.0,
 2003.0,
 2004.0,
 2005.0,
 2006.0,
 2007.0,
 2008.0,
 2009.0,
 2010.0,
 2011.0,
 2012.0,
 2013.0,
 2014.0,
 2015.0,
 2016.0])
```

In [389]:
```
merging_gdp_df.rename(columns={2017.0:'gdp_in_2017'}, inplace=True)
```

In [390]:
```
both_df = pd.merge(merging_pop_df, merging_gdp_df, on='Country Name', ho
w='left')
```

In [422]:
```
both_df
```

Out[422]:

1	Country Name	pop_in_2017	Δpop	gdp_in_2017	Δgdp	%increase	log_201
0	Angola	2.978419e+09	17612752.0	1.221238e+11	1.108951e+11	987.597993	25.52830
1	Albania	2.873457e+08	-413085.0	1.303854e+10	1.100998e+10	542.750447	23.29117
2	United Arab Emirates	9.400145e+08	7539971.0	3.825751e+11	3.318736e+11	654.564479	26.67019
3	Argentina	4.427104e+09	11541302.0	6.374303e+11	4.960780e+11	350.951291	27.18071
4	Armenia	2.930450e+08	-607715.0	1.153659e+10	9.279752e+09	411.183623	23.16879
5	Australia	2.460186e+09	7536760.0	1.323421e+12	1.012583e+12	325.759080	27.91124
6	Austria	8.797566e+08	1119716.0	4.168360e+11	2.503726e+11	150.407002	26.75595
7	Azerbaijan	9.854033e+08	2695033.0	4.074779e+10	3.168435e+10	349.583975	24.43066
8	Burundi	1.086424e+09	5448830.0	3.172416e+09	2.040315e+09	180.223711	21.87775
9	Belgium	1.138239e+09	1415014.0	4.947636e+11	2.883327e+11	139.675210	26.92734
10	Benin	1.117569e+09	6197196.0	9.246697e+09	7.286732e+09	371.778617	22.94753
11	Burkina Faso	1.919338e+09	10382348.0	1.232286e+10	9.221562e+09	297.344893	23.23472
12	Bangladesh	1.646698e+10	58481109.0	2.497239e+11	2.181255e+11	690.306873	26.24362
13	Bulgaria	7.075947e+08	-1642342.0	5.822097e+10	3.758888e+10	182.186493	24.78751
14	Bahrain	1.492584e+08	996653.0	3.543269e+10	3.120290e+10	737.694291	24.29090
15	Bahamas, The	3.953610e+07	139025.0	1.216210e+10	8.996100e+09	284.147189	23.22159
16	Belarus	9.498264e+08	-690736.0	5.445647e+10	3.280647e+10	151.531018	24.72066
17	Belize	3.746810e+07	187129.0	1.862615e+09	1.450528e+09	351.996133	21.34524
18	Bolivia	1.105160e+09	4195356.0	3.750864e+10	3.264106e+10	670.580492	24.34783
19	Brazil	2.092883e+10	59936133.0	2.053595e+12	1.591643e+12	344.547452	28.35061
20	Barbados	2.857190e+07	25345.0	4.673500e+09	2.650182e+09	130.981952	22.26517
21	Brunei Darussalam	4.286970e+07	169912.0	1.212809e+10	8.607537e+09	244.493987	23.21879
22	Bhutan	8.076100e+07	270330.0	2.528008e+09	2.228221e+09	743.267248	21.65069
23	Botswana	2.291661e+08	913749.0	1.740657e+10	1.361600e+10	359.207437	23.58011
24	Central African Republic	4.659080e+08	1719300.0	1.949412e+09	5.087003e+08	35.308964	21.39079
25	Canada	3.670808e+09	8917083.0	1.647120e+12	1.053191e+12	177.325850	28.13005
26	Switzerland	8.450851e+08	1735332.0	6.789654e+11	4.208989e+11	163.097025	27.24383
27	Chile	1.805473e+09	4812594.0	2.770759e+11	2.439621e+11	736.736375	26.34755
28	China	1.386395e+11	251210000.0	1.223770e+13	1.187684e+13	3291.279518	30.13554
29	Cote d'Ivoire	2.429475e+09	12026996.0	3.735328e+10	2.655743e+10	245.996616	24.34368
...	...	...	...	...	...	...	

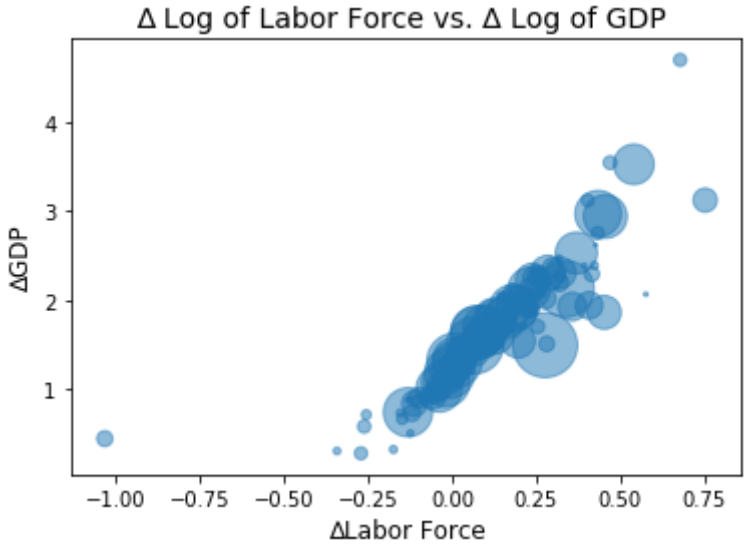
1	Country Name	pop_in_2017	Δpop	gdp_in_2017	Δgdp	%increase	log_201
126	Solomon Islands	6.113430e+07	299503.0	1.303454e+09	1.000939e+09	330.872356	20.98828
127	Sierra Leone	7.557212e+08	3244966.0	3.775047e+09	3.125403e+09	481.094034	22.05167
128	El Salvador	6.377853e+08	1122869.0	2.480544e+10	1.998790e+10	414.898231	23.93432
129	Suriname	5.634020e+07	155930.0	2.995828e+09	2.607428e+09	671.325412	21.82048
130	Slovak Republic	5.439232e+08	140045.0	9.561767e+10	8.292313e+10	653.218588	25.28362
131	Sweden	1.005770e+09	1498863.0	5.356074e+11	2.774531e+11	107.475691	27.00666
132	Eswatini	1.367254e+08	505881.0	4.433664e+09	3.318961e+09	297.743974	22.21249
133	Chad	1.489999e+09	8943135.0	9.871248e+09	8.132642e+09	467.768099	23.01289
134	Togo	7.797694e+08	4010754.0	4.757776e+09	3.129349e+09	192.169989	22.28304
135	Thailand	6.903751e+09	12454692.0	4.553027e+11	3.699596e+11	433.496997	26.84422
136	Tajikistan	8.921343e+08	3637615.0	7.146450e+09	4.517055e+09	171.790636	22.68988
137	Turkmenistan	5.758075e+08	2074109.0	3.792629e+10	3.473675e+10	1089.083378	24.35891
138	Tonga	1.080200e+07	12867.0	4.276598e+08	3.140960e+08	276.581018	19.87383
139	Trinidad and Tobago	1.369125e+08	147225.0	2.207902e+10	1.701102e+10	335.655439	23.81789
140	Tunisia	1.153213e+09	3299330.0	3.995210e+10	2.766153e+10	225.063048	24.41094
141	Turkey	8.074502e+09	26823321.0	8.515493e+11	7.008730e+11	465.151487	27.47032
142	Tanzania	5.731002e+09	31850415.0	5.332063e+10	4.906188e+10	1152.027245	24.69958
143	Uganda	4.286296e+09	25424051.0	2.599503e+10	2.169063e+10	503.917821	23.98117
144	Ukraine	4.483114e+09	-7060865.0	1.121542e+11	3.069727e+10	37.685278	25.44314
145	Uruguay	3.456750e+08	346761.0	5.615697e+10	4.685813e+10	503.913760	24.75141
146	United States	3.251471e+10	75524121.0	1.948539e+13	1.350580e+13	225.865105	30.60068
147	Uzbekistan	3.238720e+09	11877200.0	4.967717e+10	3.631656e+10	271.818206	24.62881
148	St. Vincent and the Grenadines	1.098970e+07	2392.0	7.852225e+08	5.448572e+08	226.678864	20.48147
149	Vietnam	9.554080e+09	27331195.0	2.237799e+11	2.173081e+11	3357.800189	26.13392
150	Vanuatu	2.762440e+07	129610.0	8.628798e+08	7.044824e+08	444.756273	20.57578
151	Samoa	1.964400e+07	33574.0	8.409280e+08	7.151617e+08	568.643507	20.55001
152	Yemen, Rep.	2.825042e+09	16193381.0	3.126768e+10	2.562056e+10	453.692493	24.16585
153	South Africa	5.671716e+09	19156631.0	3.488716e+11	2.333184e+11	201.914104	26.57797
154	Zambia	1.709413e+09	9066877.0	2.586814e+10	2.258292e+10	687.410360	23.97627
155	Zimbabwe	1.652990e+09	6346791.0	2.204090e+10	1.325709e+10	150.926255	23.81616

156 rows × 11 columns

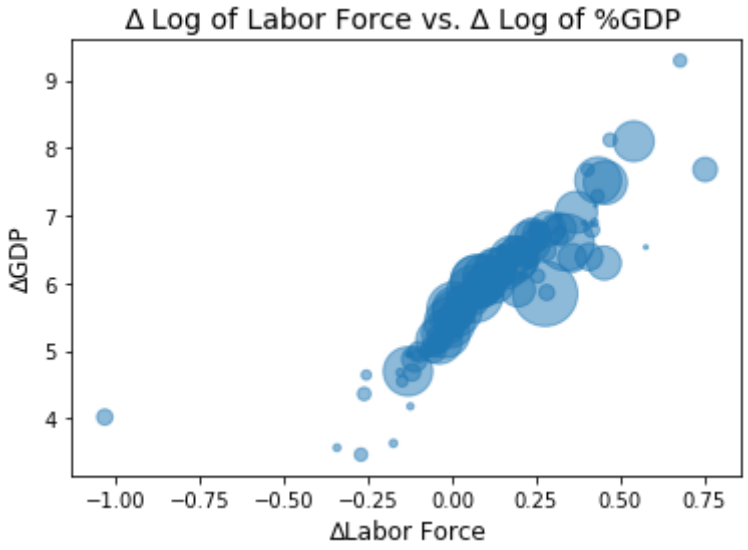
In [418]:
```
both_df["pop_in_2017"] = both_df["pop_in_2017"]*(5000000)
```

In [419]:
```
both_df["gdp_per_capita_in_2017"] = (both_df["gdp_in_2017"])/(both_df["pop_in_2017"])
```

In [423]:
```
fix, ax = plt.subplots()

ax.scatter(lf_df["Δlogs"], gdp_df["Δlogs"],s=both_df["gdp_per_capita_in_2017"],
           alpha= 0.50)

ax.set_title('Δ Log of Labor Force vs. Δ Log of GDP ', loc='center', fontsize=14)

ax.set_xlabel("ΔLabor Force", fontsize=12)
ax.set_ylabel("ΔGDP", fontsize=12)
plt.show()
```



In [424]:
```
fix, ax = plt.subplots()

ax.scatter(lf_df["Δlogs"], gdp_df["logs%"],s=both_df["gdp_per_capita_in_
2017"],
            alpha= 0.50)

ax.set_title('Δ Log of Labor Force vs. Δ Log of %GDP ', loc='center', fo
ntsize=14)

ax.set_xlabel("ΔLabor Force", fontsize=12)
ax.set_ylabel("ΔGDP", fontsize=12)
plt.show()
```



The log graphs above prove a positive association between Female Labor Force Participation Rate and GDP exists!