In [94]:

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LinearRegression
```

In [95]:

```
df_kse=pd.read_excel("kse100.xlsx")
df_kse.rename(columns={"CURRENCY":"Date"},inplace=True)
df_kse.set_index("Date",inplace=True)
print(df_kse.head())
```

```
                 PR
Date
1993-09-27  1340.18
1993-09-28  1342.91
1993-09-29  1342.91
1993-09-30  1339.91
1993-10-01  1342.31
```

In [96]:

```
df_kse["Index_months_resampled"]=df_kse["PR"].resample("M").mean()
```

In [97]:

```
df_kse.dropna(inplace=True)
df_kse.drop("PR",1,inplace=True)
print(df_kse.head())#resampled the data to months
df_kse["kse_returns_monthly"]=df_kse["Index_months_resampled"].pct_change()
df_kse.dropna(inplace=True)
print(df_kse.head())#resampled the data to months
```

```
            Index_months_resampled
Date
1993-09-30             1341.477500
1993-11-30             1672.244091
1993-12-31             1962.343043
1994-01-31             2317.896190
1994-02-28             2360.323500
            Index_months_resampled  kse_returns_monthly
Date
1993-11-30             1672.244091             0.246569
1993-12-31             1962.343043             0.173479
1994-01-31             2317.896190             0.181188
1994-02-28             2360.323500             0.018304
1994-03-31             2576.096957             0.091417
```

I have resampled data to months in order to conduct a sound comparative analysis with other financial instruments,I have resampled the data by months through calcualting means for all values of that specific month.

In [98]:

```
df_kse["kse_returns_monthly"].plot()
```

Out[98]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x27529b5e6d8>
```

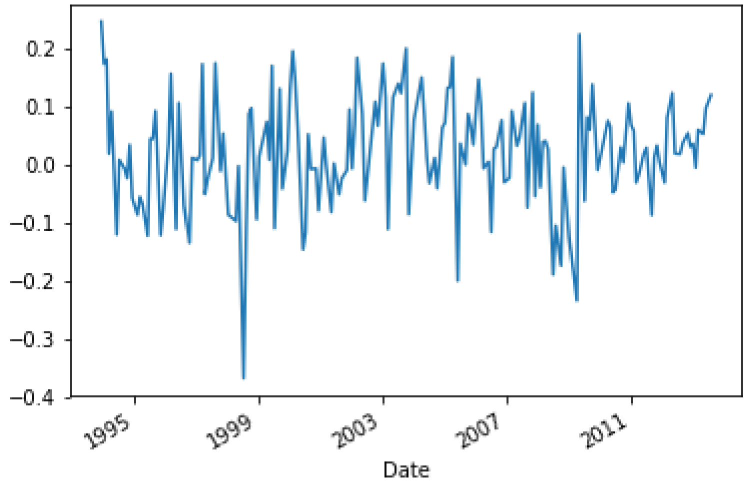


Fig.1-monthly returns KSE100

In [99]:

```
df_ex=pd.read_excel("exchange_rate_data.xlsx")
df_in=pd.read_excel("allindexes.xlsx")
df_ex.set_index("Year",inplace=True)
df_in.set_index("Date",inplace=True)
print(df_ex.head())

###Now in order to convert KSE100 data into dollar I will use the monthly averages from the
#### to convert KSE into common dollar and the compare the returns to all the other indexes
```

```
          JUL      AUG      SEP      OCT      NOV      DEC      JAN  \
Year
1994  30.6665  30.6665  30.7267  30.7287  30.7768  30.8770  30.9372
1995  31.2680  31.3983  31.6290  34.3357  34.3357  34.3357  34.3357
1996  35.4083  35.7091  37.0625  40.2203  40.2203  40.2203  40.2203
1997  40.6213  40.6213  40.6213  44.1602  44.1602  44.1602  44.1602
1998  46.1150  46.1150  46.1150  46.1150  46.1150  46.1150  46.1150

            FEB      MAR      APR        MAY        JUN  Average Yearly
Year
1994  30.957200  30.9572  30.9372  31.047500  31.087600       30.863842
1995  34.435928  34.6063  34.8370  34.917100  35.187800       33.801852
1996  40.220300  40.2203  40.3406  40.491000  40.561200       39.241208
1997  44.160200  44.2636  44.1482  44.339700  46.237608       43.471167
1998  46.115000  46.1150  46.1150  51.897712  51.560600       47.050693
```

```
Here I have the taken the monthly exchange rates,converted them to yearly averages
through calculating mean of all months
and I will be using these averages to convert KSE100 into dollars for further comparsion
```

In [100]:

```
import numpy as np
df_kse['year'] = df_kse.index.to_period('Y')
df_kse["Index_months_USD"]=np.nan
# print(df_kse)
i=-1
for year in df_kse["year"]:
    i+=1
    for years in df_ex.index.tolist():
        if str(year)==str(years):
#             print(year,years,i)
            df_kse.iloc[i,3]=df_kse.iloc[i,0]/df_ex.loc[years,"Average Yearly"]
```

A piece of code which convert KSE values into dollar

In [101]:

```
df_kse.dropna(inplace=True)
df_kse["kse_returns_monthly_usd"]=df_kse["Index_months_resampled"].pct_change()
df_kse.dropna(inplace=True)
print(df_kse.head())#resampled the data to months
```

```
            Index_months_resampled  kse_returns_monthly year  \
Date
1994-02-28             2360.323500             0.018304 1994
1994-03-31             2576.096957             0.091417 1994
1994-05-31             2264.286364            -0.121040 1994
1994-06-30             2282.014091             0.007829 1994
1994-08-31             2266.300000            -0.006886 1994

            Index_months_USD  kse_returns_monthly_usd
Date
1994-02-28         76.475363                 0.018304
1994-03-31         83.466504                 0.091417
1994-05-31         73.363724                -0.121040
1994-06-30         73.938109                 0.007829
1994-08-31         73.428967                -0.006886
```

Now I have calculated KSE_100 montly returns in dollars.

In [102]:

```
df_kse["kse_returns_monthly_usd"].plot()
```

Out[102]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x275293547f0>
```

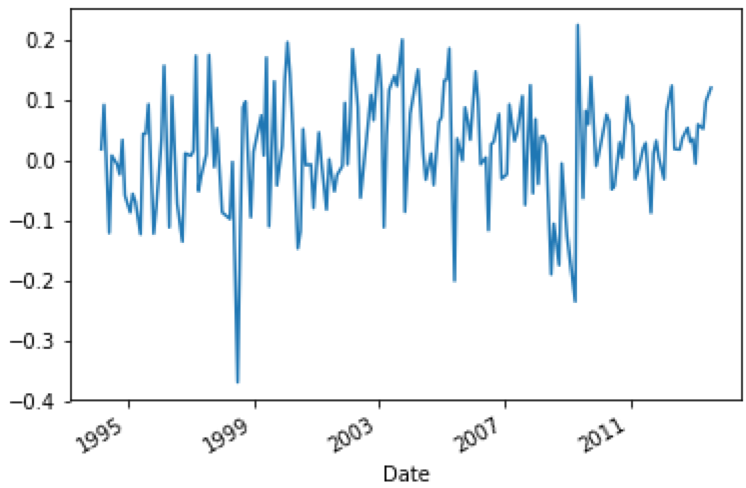


Fig.2 KSE100 monthly returns dollar

In [103]:

```
ax=plt.subplot(111)
ax.plot(df_kse["kse_returns_monthly_usd"])
ax.plot(df_kse["kse_returns_monthly"])
ax.set_xlabel("Date")
ax.set_ylabel("Returns")
plt.legend()
plt.show()
```

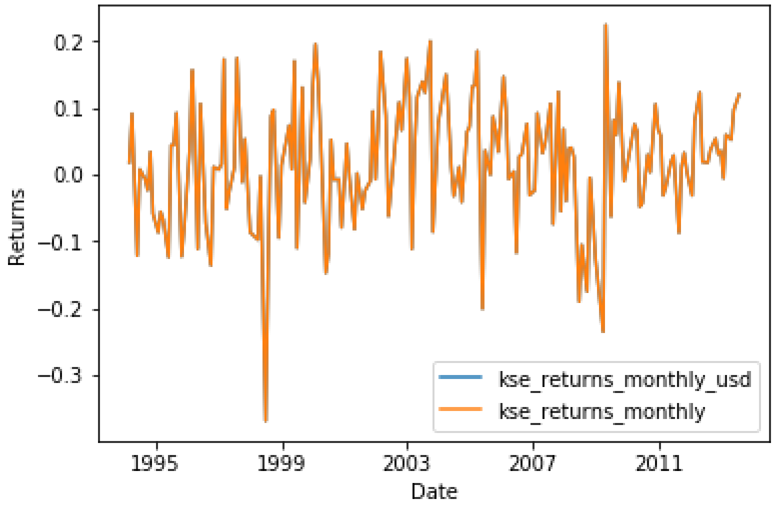


Fig.3 KSE_100 Comparsion

In [104]:

```
df_kse.to_excel("Table 1.xlsx")
df_kse.head()
```

Out[104]:

Date	Index_months_resampled	kse_returns_monthly	year	Index_months_USD	kse_returns_m
1994-02-28	2360.323500	0.018304	1994	76.475363	
1994-03-31	2576.096957	0.091417	1994	83.466504	
1994-05-31	2264.286364	-0.121040	1994	73.363724	
1994-06-30	2282.014091	0.007829	1994	73.938109	
1994-08-31	2266.300000	-0.006886	1994	73.428967	

Table 1 My Final Calculations For KSE100(for full calculated table see table 1 excel file)

In [105]:

```
df_ex.to_excel("Table 2.xlsx")
df_ex.head()
```

Out[105]:

Year	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	AP
1994	30.6665	30.6665	30.7267	30.7287	30.7768	30.8770	30.9372	30.957200	30.9572	30.937
1995	31.2680	31.3983	31.6290	34.3357	34.3357	34.3357	34.3357	34.435928	34.6063	34.837
1996	35.4083	35.7091	37.0625	40.2203	40.2203	40.2203	40.2203	40.220300	40.2203	40.340
1997	40.6213	40.6213	40.6213	44.1602	44.1602	44.1602	44.1602	44.160200	44.2636	44.148
1998	46.1150	46.1150	46.1150	46.1150	46.1150	46.1150	46.1150	46.115000	46.1150	46.115

Table 2 Exchange Rate Table With Calculated Yearly Averages(for full calculated table see table 2 excel file)

In [106]:

```
df_in.rename(columns={"EAFE $":"EAFE_DOLLAR","EM $":"EM_DOLLAR"},inplace=True)
df_in["S&P 500 Composite_monthly_return"]=df_in["S&P 500 Composite"].pct_change()
df_in["EAFE_monthly_return"]=df_in["EAFE"].pct_change()
df_in["EAFE_DOLLAR_montly_return"]=df_in["EAFE_DOLLAR"].pct_change()
df_in["EM_monthly_return"]=df_in["EM"].pct_change()
df_in["EM_DOLLAR_monthly_return"]=df_in["EM_DOLLAR"].pct_change()
df_in.dropna(inplace=True)
```

In [107]:

```
df_in.to_excel("Table3.xlsx")
df_in
```

Out[107]:

Date	S&P 500 Composite	EAFE	EAFE_DOLLAR	EM	EM_DOLLAR	S&P 500 Composite_monthly_return	EAFE_
1991-02-28	107.151459	112.259387	110.749287	116.651108	114.794094	0.071515	
1991-03-29	109.746065	113.667539	104.127485	125.720235	119.511879	0.024214	
1991-04-30	110.005943	114.184608	105.180275	128.754601	120.770581	0.002368	
1991-05-31	114.751513	116.039044	106.308803	140.860669	130.246338	0.043139	
1991-06-28	109.494529	109.803067	98.524942	139.776096	125.593742	-0.045812	

Table3 Calculated Montly Returns for SandP500,EAFE(Local and Foriegn currency), EM(Local and Foriegn currency)

PLEASE NOTE THAT DUE TO LESS SPACE I HAVE ONLY SHOWN THE RETURNS BUT INDEX VALUES HAVE ALSO BEEN CALUCLATED WHICH IS SELF EXPLANATIONARY(for full table see the excel file table 3).

In [108]:

```
df_in["KSE_returns_dollar"]=df_kse["kse_returns_monthly_usd"]
df_in["KSE_returns"]=df_kse["kse_returns_monthly"]
df_corr=df_in.corr()
df_corr.to_excel("Table 4.xlsx")
df_in.corr().head()
```

Out[108]:

	S&P 500 Composite	EAFE	EAFE_DOLLAR	EM	EM_DOLLAR	Composite_montl
S&P 500 Composite	1.000000	0.941076	0.909663	0.834513	0.744408	
EAFE	0.941076	1.000000	0.950812	0.813753	0.749239	
EAFE_DOLLAR	0.909663	0.950812	1.000000	0.931988	0.902008	
EM	0.834513	0.813753	0.931988	1.000000	0.981455	
EM_DOLLAR	0.744408	0.749239	0.902008	0.981455	1.000000	

Table 4 Correlation table for all financial instruments in both local and foreign currency(for full table see the

excel file table 4)

In [109]:

```
sns.heatmap(df_in.corr())
```

Out[109]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752998ff60>
```

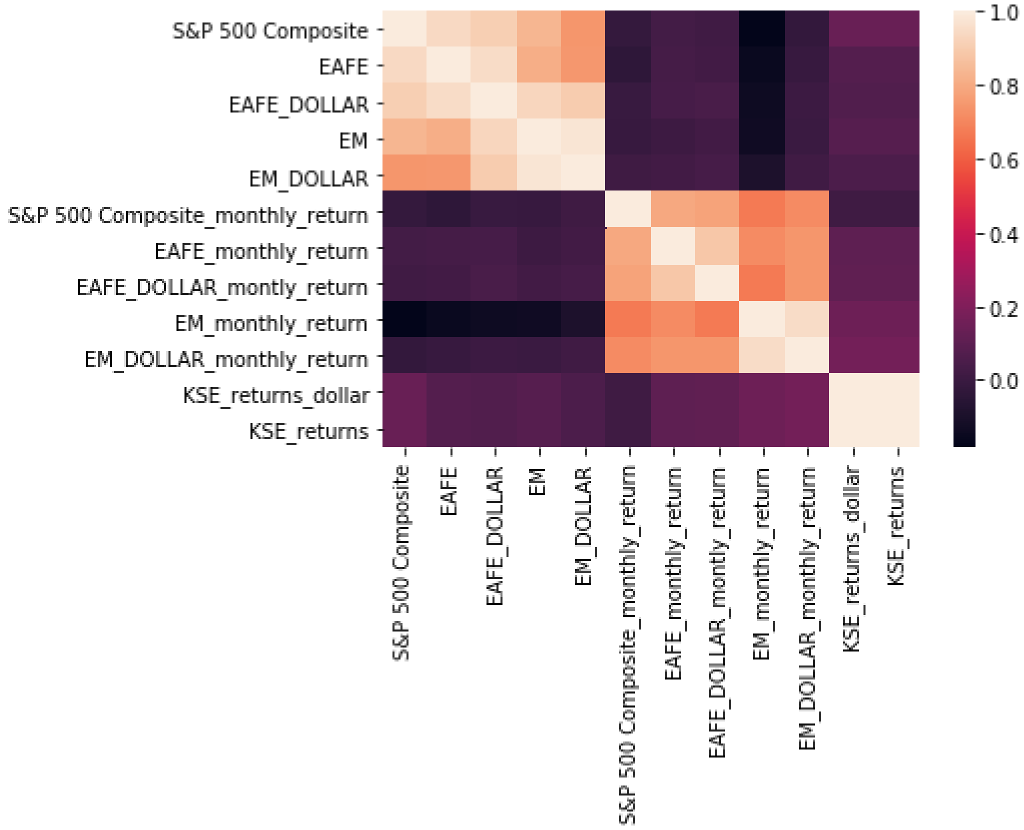


Fig4 Heatmap for the associated corr table for better visualization

In [128]:

```
df_factors=pd.read_excel("Factors_2.xlsx")
df_factors.set_index("Date",inplace=True)
df_factors["Mkt_Rf"]=df_factors["Mkt_Rf"].resample("M").mean()
df_factors["SMB"]=df_factors["SMB"].resample("M").mean()
df_factors["HML"]=df_factors["HML"].resample("M").mean()
df_factors["RF"]=df_factors["RF"].resample("M").mean()
df_factors.dropna(inplace=True)
# df_factors.to_excel("f.xlsx")
df_factors.head()
```

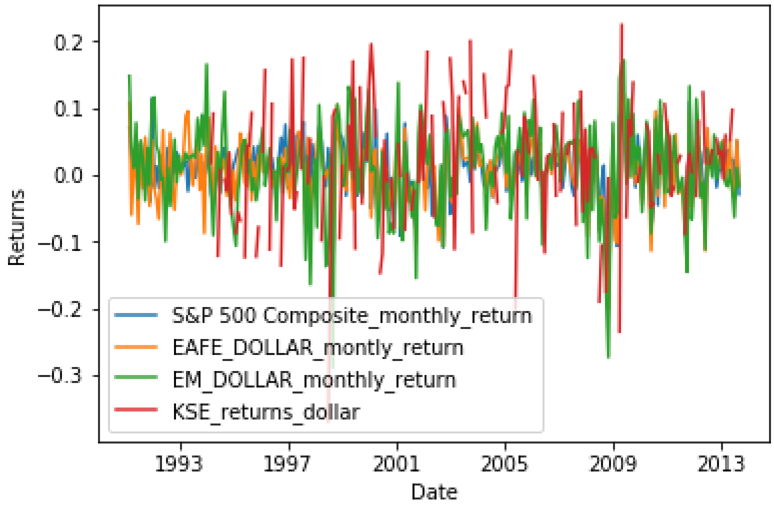
Out[128]:

	Mkt_Rf	SMB	HML	RF
Date				
1926-07-31	0.114800	-0.087200	-0.110400	0.009
1926-08-31	0.103077	-0.052308	0.156923	0.010
1926-09-30	0.016667	-0.053750	-0.002083	0.009
1926-11-30	0.107083	-0.006667	-0.016667	0.013
1926-12-31	0.100769	-0.002308	0.005000	0.011

Table 5 Factors

In [111]:

```
ax=plt.subplot(111)
ax.plot(df_in["S&P 500 Composite_monthly_return"])
ax.plot(df_in["EAFE_DOLLAR_montly_return"])
ax.plot(df_in["EM_DOLLAR_monthly_return"])
ax.plot(df_in["KSE_returns_dollar"])
ax.set_xlabel("Date")
ax.set_ylabel("Returns")
plt.legend()
plt.show()
df_in["S&P 500 Composite_monthly_return"].plot()
```



Out[111]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752946fd68>
```

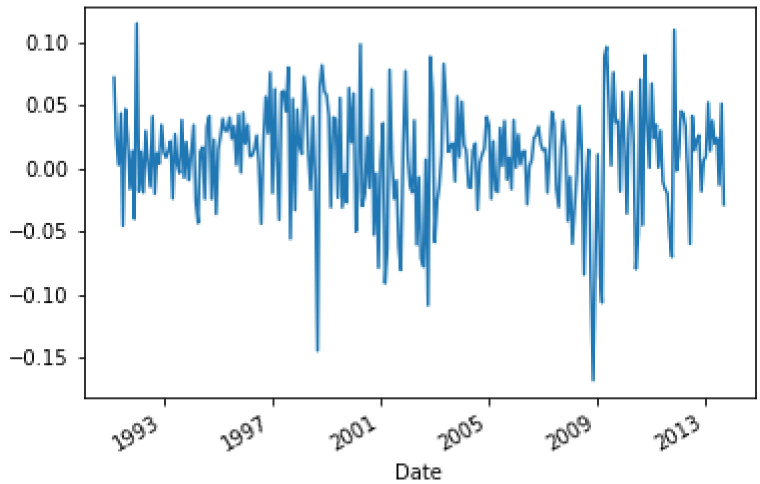


Fig 5(a)-Monthly returns for over the time horizion comparsion for all instruments

Fig5(b)(Below)-S and P 500 returns

In [112]:

```
df_in["EAFE_DOLLAR_montly_return"].plot()
```

Out[112]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752951fcc0>
```

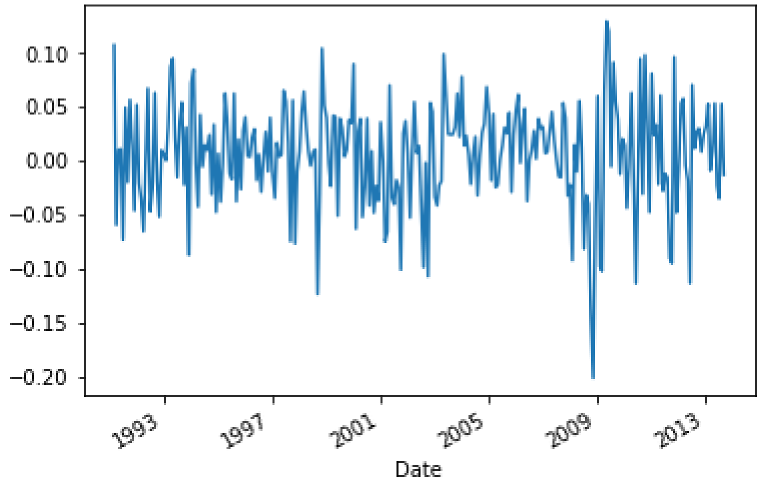


Fig6 EAFE DOLLAR Returns

In [113]:

```
df_in["EM_DOLLAR_monthly_return"].plot()
```

Out[113]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752b436828>
```

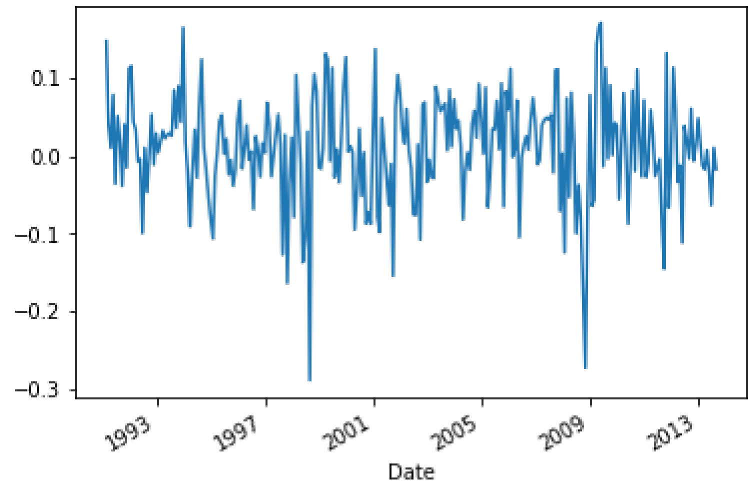


Fig7 EM DOLLAR Returns

In [114]:

```
df_in["Mkt_Rf"]=df_factors["Mkt_Rf"]
df_in["RF"]=df_factors["RF"]
df_in_copy=df_in.copy()
df_in_copy.dropna(inplace=True)
###the data used for regression
df_in_copy.to_excel("Table 6.xlsx")
df_in_copy
```

Out[114]:

	S&P 500 Composite	EAFE	EAFE_DOLLAR	EM	EM_DOLLAR	S&P 500 Composite_monthly_return	EAFE_r
Date							
1994-02-28	148.986034	137.178319	138.138113	1019.645377	288.191248	-0.027141	
1994-03-31	142.490655	129.729646	132.217738	986.944618	262.113046	-0.043597	
1994-05-31	146.686234	134.460754	137.094993	1080.959213	265.661432	0.016411	
1994-06-30	143.090694	131.151296	139.063100	1101.589476	258.338729	-0.024512	
1994-08-31	153.848640	136.250783	143.786770	1294.623083	308.458616	0.041000	

Table 6 Combined all of the returns with Factor table for CAPM model-adjusted for missing values(for complete calculated table see table 6 excel file)

In [115]:

```
##The regressions result are not accurate as of right now need some changes as the date tim
##for predicting accurate beta,need to reduce the lag
import numpy as np
X=np.array(df_in_copy["Mkt_Rf"]).reshape(-1,1)
y=np.array(df_in_copy["S&P 500 Composite_monthly_return"]-df_in_copy["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_sp500=clf.coef_
print("The estimate beta for sandp 500 under CAPM MODEL with given data is:",beta_sp500)
```

```
The estimate beta for sandp 500 under CAPM MODEL with given data is: [0.2051
2881]
```

In [116]:

```
import numpy as np
X=np.array(df_in_copy["Mkt_Rf"]).reshape(-1,1)
y=np.array(df_in_copy["EAFE_DOLLAR_montly_return"]-df_in_copy["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_eafe=clf.coef_
print("The estimate beta for eafe under CAPM MODEL with given data is:",beta_eafe)
```

```
The estimate beta for eafe under CAPM MODEL with given data is: [0.18522279]
```

In [117]:

```
import numpy as np
X=np.array(df_in_copy["Mkt_Rf"]).reshape(-1,1)
y=np.array(df_in_copy["EM_DOLLAR_monthly_return"]-df_in_copy["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_em=clf.coef_
print("The estimate beta for em under CAPM MODEL with given data is:",beta_em)
```

```
The estimate beta for em under CAPM MODEL with given data is: [0.25544116]
```

In [118]:

```
import numpy as np
X=np.array(df_in_copy["Mkt_Rf"]).reshape(-1,1)
y=np.array(df_in_copy["KSE_returns_dollar"]-df_in_copy["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_kse=clf.coef_
print("The estimate beta for kse under CAPM MODEL with given data is:",beta_kse)
```

```
The estimate beta for kse under CAPM MODEL with given data is: [0.01692614]
```

Please note that for both CAPM model and Fama-French Factor Regression I have used dollar adjusted returns as it accounts for a more a sound comparsion with S and P 500.

In [119]:

```
df_in["Mkt_Rf"]=df_factors["Mkt_Rf"]
df_in["RF"]=df_factors["RF"]
df_in["SMB"]=df_factors["SMB"]
df_in["HML"]=df_factors["HML"]
df_in_copy1=df_in.copy()
df_in_copy1.dropna(inplace=True)
df_in_copy1.to_excel("Table7.xlsx")
df_in_copy1###the data used for multiple regression to calculate all the betas
```

Out[119]:

Date	S&P 500 Composite	EAFE	EAFE_DOLLAR	EM	EM_DOLLAR	S&P 500 Composite_monthly_return	EAFE_
1994-02-28	148.986034	137.178319	138.138113	1019.645377	288.191248	-0.027141	
1994-03-31	142.490655	129.729646	132.217738	986.944618	262.113046	-0.043597	
1994-05-31	146.686234	134.460754	137.094993	1080.959213	265.661432	0.016411	
1994-06-30	143.090694	131.151296	139.063100	1101.589476	258.338729	-0.024512	
1994-08-31	153.848640	136.250783	143.786770	1294.623083	308.458616	0.041000	

Table 7 Combined all of the returns with Factor table for Fama-French Factor Regression -adjusted for missing values (for complete calculated table see table 7 excel file)

In [120]:

```
import numpy as np
X=np.array(df_in_copy1[["Mkt_Rf","SMB","HML"]])
y=np.array(df_in_copy1["S&P 500 Composite_monthly_return"]-df_in_copy1["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_sandp500=clf.coef_
print("The estimate betas for sandp 500 under Fama-French Factor Regression with given data
```

```
The estimate betas for sandp 500 under Fama-French Factor Regression with gi
ven data is: [ 0.21696953 -0.03494916  0.0222487 ]
```

In [121]:

```
import numpy as np
X=np.array(df_in_copy1[["Mkt_Rf","SMB","HML"]])
y=np.array(df_in_copy1["EAFE_DOLLAR_montly_return"]-df_in_copy1["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_eafe=clf.coef_
print("The estimate betas for eafe with under Fama-French Factor Regression given data is:"
```

```
The estimate betas for eafe with under Fama-French Factor Regression given d
ata is: [0.19146941 0.03330851 0.05306955]
```

In [122]:

```
import numpy as np
X=np.array(df_in_copy1[["Mkt_Rf","SMB","HML"]])
y=np.array(df_in_copy1["EM_DOLLAR_monthly_return"]-df_in_copy1["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_em=clf.coef_
print("The estimate betas for em under Fama-French Factor Regression with given data is:",b
```

```
The estimate betas for em under Fama-French Factor Regression with given dat
a is: [0.24779432 0.0940093  0.04269328]
```

In [123]:

```
import numpy as np
X=np.array(df_in_copy1[["Mkt_Rf","SMB","HML"]])
y=np.array(df_in_copy1["KSE_returns_dollar"]-df_in_copy1["RF"])
clf=LinearRegression()
clf.fit(X,y)
beta_kse=clf.coef_
print("The estimate betas for kse under Fama-French Factor Regression with given data is:",
```

```
The estimate betas for kse under Fama-French Factor Regression with given da
ta is: [0.01720959 0.10544822 0.08542755]
```

In [124]:

```
#Now caculating the expected return on each of the individual expected returns:
from statistics import mean,stdev
SandP500return=mean(df_in_copy1["S&P 500 Composite_monthly_return"])
SandPstandarddev=stdev(df_in_copy1["S&P 500 Composite_monthly_return"])
print("The mean of SANDP500 returns is about:",SandP500return,"and the standard dev is:",Sa
sns.distplot(df_in_copy1["S&P 500 Composite_monthly_return"])
```

```
The mean of SANDP500 returns is about: 0.008605939185586789 and the standard
dev is: 0.04522865752412346
```

```
C:\Users\MMOHTASHIM\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: F
utureWarning: Using a non-tuple sequence for multidimensional indexing is de
precated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the future this wi
ll be interpreted as an array index, `arr[np.array(seq)]`, which will result
either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
```

Out[124]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752b2aae48>
```

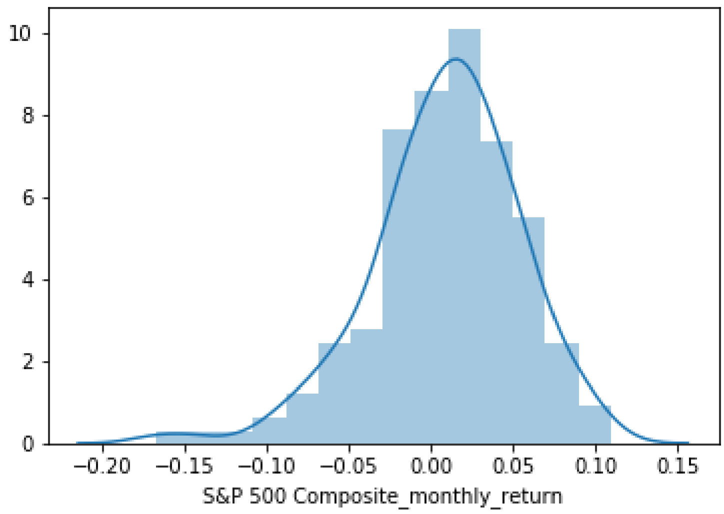


Fig.8 SandP500 returns distribution

In [125]:

```
from statistics import mean,stdev
SandP500return=mean(df_in_copy1["EAFE_DOLLAR_montly_return"])
SandPstandarddev=stdev(df_in_copy1["EAFE_DOLLAR_montly_return"])
print("The mean of EAFE returns is about:",SandP500return,"and the standard dev is:",SandPs
sns.distplot(df_in_copy1["EAFE_DOLLAR_montly_return"])
```

```
The mean of EAFE returns is about: 0.0048759306389617495 and the standard de
v is: 0.048495643914728624
```

```
C:\Users\MMOHTASHIM\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: F
utureWarning: Using a non-tuple sequence for multidimensional indexing is de
precated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the future this wi
ll be interpreted as an array index, `arr[np.array(seq)]`, which will result
either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
```

Out[125]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752b256198>
```

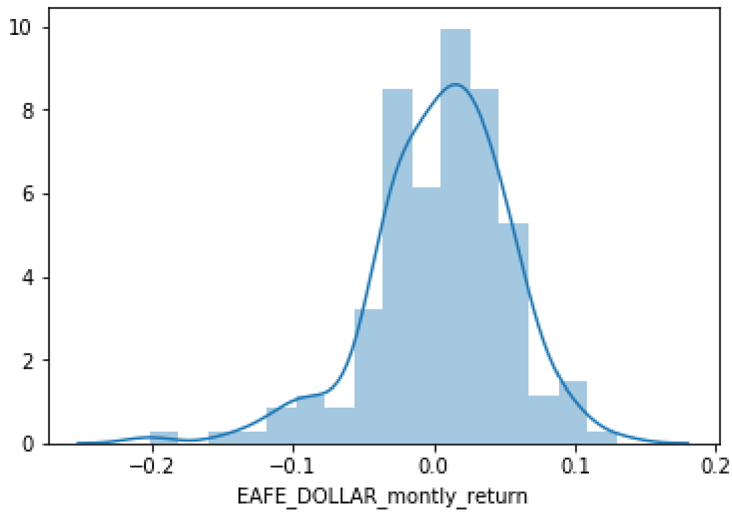


Fig.9 EAFE Dollar Adjusted returns distribution

In [126]:

```
from statistics import mean,stdev
SandP500return=mean(df_in_copy1["EM_DOLLAR_monthly_return"])
SandPstandarddev=stdev(df_in_copy1["EM_DOLLAR_monthly_return"])
print("The mean of EM returns is about:",SandP500return,"and the standard dev is:",SandPsta
sns.distplot(df_in_copy1["EM_DOLLAR_monthly_return"])
```

```
The mean of EM returns is about: 0.009036531076885757 and the standard dev i
s: 0.07180198162901183
```

```
C:\Users\MMOHTASHIM\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: F
utureWarning: Using a non-tuple sequence for multidimensional indexing is de
precated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the future this wi
ll be interpreted as an array index, `arr[np.array(seq)]`, which will result
either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
```

Out[126]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752b75e4e0>
```

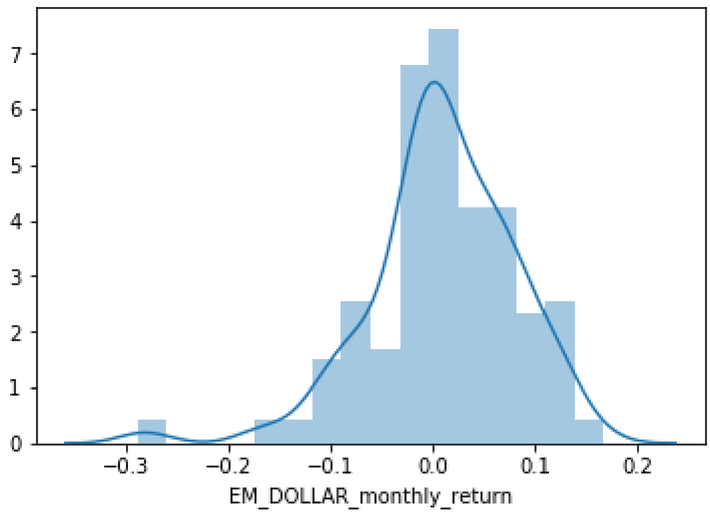


Fig.10 EM Dollar djusted returns distribution

In [127]:

```
from statistics import mean,stdev
SandP500return=mean(df_in_copy1["KSE_returns_dollar"])
SandPstandarddev=stdev(df_in_copy1["KSE_returns_dollar"])
print("The mean of KSE returns is about:",SandP500return,"and the standard dev is:",SandPst
sns.distplot(df_in_copy1["KSE_returns_dollar"])
```

```
The mean of KSE returns is about: 0.01762482422919961 and the standard dev i
s: 0.09221655449181404
```

```
C:\Users\MMOHTASHIM\Anaconda3\lib\site-packages\scipy\stats\stats.py:1713: F
utureWarning: Using a non-tuple sequence for multidimensional indexing is de
precated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the future this wi
ll be interpreted as an array index, `arr[np.array(seq)]`, which will result
either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
```

Out[127]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2752b188f98>
```

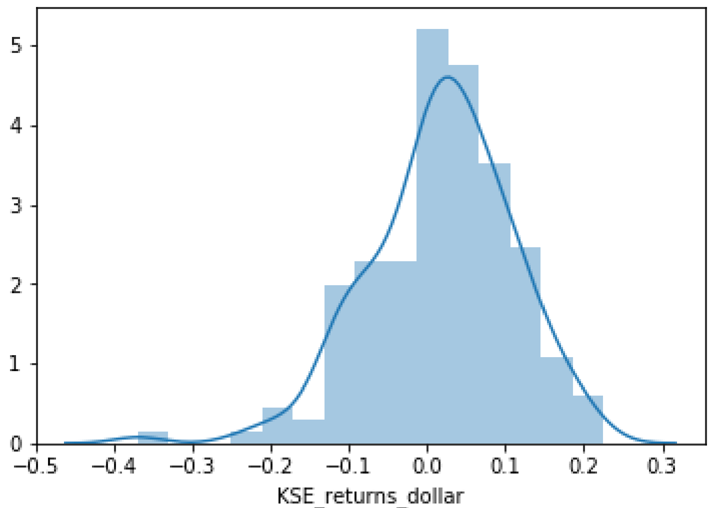


Fig.11 KSE 100 Dolaar Adjusted Returns distribution

In [ ]: