"Analyze how fiscal deficits, unemployment, and inflation impact GDP growth in 5 EU countries (2014–2024), research for government spending."

Introduction:

This study analyzes the relationship between fiscal policy, labor markets, inflation, and GDP growth across five EU economies (Poland, Germany, France, Czech Republic, Lithuania) to inform evidence-based policy decisions. Using simple econometric techniques, this report seeks to provide an introductory understanding of these dynamics. My research identifies complex interactions based on the research of Furceri and Mourougane (2010) that fiscal policy shocks can have varying effects on output depending on the structural characteristics of the economy. Živković (2022) explored the relationship between unemployment and GDP growth in European countries, confirming the presence of the Okun's law dynamics.Together, these studies underline the importance of fiscal and labor market variables in determining growth outcomes.

The main question:

"Do government deficits, unemployment rates, and inflation levels significantly impact GDP growth in EU economies, and do these effects vary across countries?"

Data source: All statistics were taken from Eurostat

Mathematical model:

GDP_growth$_{it}=\alpha_i+\beta_1$Gov_deficit$_{it}+\beta_2$Unemp_rate$_{it}+\beta_3$Inf_rate$_{it}+\beta_4$Gov_exp$_{it}+\epsilon_{it}$

Data description:

GDP_growth - Annual real GDP growth rate

Gov_def - Government deficit/surplus

Unemp_rate - Unemployment rate

Inf_rate - Inflation rate (HICP) (annual)

Gov_exp - Government expenditure (health/education/public sectors)

Software Implementation:

Python (pandas, matplotlib) - for visualisation.
Excel - for initial data cleaning.
Gretl - for estimating regression models, conducting diagnostic tests.

References :

1. Furceri, D., & Mourougane, A. (2010). **The effects of fiscal policy on output: A DSGE analysis**. *OECD Economics Department Working Papers*, No. 770.
2. Živković, A. (2022). **Unemployment rate and GDP growth rate in selected European countries**. *Balkan Journal of Economic Studies*, 5(2), 81-92.
3. Dimovski, J., et al. (2023). **Inflation and unemployment interdependence: Evidence from the Western Balkan countries.** *Economic Themes*, 61(4), 459-476.

4. Afonso, O., Alves, P., & Fortuna, N. (2024). **The impact of fiscal policy on the economic growth of OECD members between 1985 and 2015**. *Panoeconomicus*.
5. Misztal, P. (2021). **Public debt and economic growth in the European Union**: Empirical investigation. *ResearchGate*.

Results for each Country:

1. Poland

	Mean	Median	Minimum	Maximum
Gov_exp	43.400	42.700	41.000	47.700
Unemp_rate	4.5364	3.4000	2.8000	9.0000
GDP_growth	3.6909	4.4000	-2.0000	6.9000
Gov_def	-3.1818	-2.6000	-6.9000	-0.20000
Inf_rate	3.7091	2.1000	-0.70000	13.200

	Std. Dev.	C.V.	Skewness	Ex. kurtosis
Gov_exp	2.6249	0.060481	0.69281	-1.1550
Unemp_rate	2.1271	0.46890	1.0802	-0.24118
GDP_growth	2.6174	0.70915	-0.99496	0.17925
Gov_def	2.2658	0.71209	-0.45545	-1.0042
Inf_rate	4.5287	1.2210	1.1386	0.044092

```
Model 1: OLS, using observations 1-11
Dependent variable: GDP_growth

             coefficient   std. error   t-ratio   p-value
  -------------------------------------------------------
  const        9.57848      37.5592      0.2550    0.8072
  Gov_def      0.892403      0.919458    0.9706    0.3692
  Gov_exp     -0.0946718     0.891340   -0.1062    0.9189
  Inf_rate     0.129801      0.184045    0.7053    0.5071
  Unemp_rate   0.127680      0.516277    0.2473    0.8129

Mean dependent var    3.690909   S.D. dependent var    2.617424
Sum squared resid     22.30813   S.E. of regression    1.928217
R-squared             0.674377   Adjusted R-squared    0.457295
F(4, 6)               3.106555   P-value(F)            0.104376
Log-likelihood       -19.49713   Akaike criterion     48.99426
Schwarz criterion     50.98374   Hannan-Quinn         47.74018

Excluding the constant, p-value was highest for variable 6 (Gov_exp)

RESET test for specification -
  Null hypothesis: specification is adequate
  Test statistic: F(2, 4) = 0.145839
  with p-value = P(F(2, 4) > 0.145839) = 0.868692

White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 9.73913
  with p-value = P(Chi-square(8) > 9.73913) = 0.283815

Test for normality of residual -
  Null hypothesis: error is normally distributed
  Test statistic: Chi-square(2) = 0.522426
  with p-value = 0.770117
```

Diagnostics:
- R^2: 67.4% of GDP growth variation is explained by the model.
- The model is almost significant at 10%.
- **Surplus**: deficits might correlate with growth
- No specification error (RESET p = 0.869).
- **Inf_rate**: Aligns with theory (mild inflation can signal demand growth)

2. Germany:

	Mean	Median	Minimum	Maximum
Gov_def	-0.70909	0.70000	-4.4000	1.9000
GDP_growth	1.0455	1.4000	-4.1000	3.7000
Unemp_rate	3.6818	3.7000	3.1000	4.6000
Gov_exp	46.973	45.600	44.500	51.100
Inf_rate	2.5182	1.7000	0.40000	8.7000

	Std. Dev.	C.V.	Skewness	Ex. kurtosis
Gov_def	2.2819	3.2180	-0.32173	-1.5495
GDP_growth	2.0757	1.9855	-1.3312	1.5519
Unemp_rate	0.49157	0.13351	0.39546	-0.90585
Gov_exp	2.6620	0.056671	0.39378	-1.5073
Inf_rate	2.6141	1.0381	1.4472	0.93285

```
Model 1: OLS, using observations 1-11
Dependent variable: GDP_growth

              coefficient   std. error   t-ratio   p-value
   ----------------------------------------------------------
   const       -62.8740      53.3637      -1.178    0.2833
   Gov_def       1.88839      1.21945      1.549    0.1725
   Unemp_rate    2.52525      1.77198      1.425    0.2040
   Gov_exp       1.16532      1.07252      1.087    0.3190
   Inf_rate      0.485629     0.305066     1.592    0.1625

Mean dependent var    1.045455   S.D. dependent var    2.075747
Sum squared resid    19.96552    S.E. of regression    1.824167
R-squared             0.536626   Adjusted R-squared    0.227710
F(4, 6)               1.737127   P-value(F)            0.259666
Log-likelihood      -18.88694    Akaike criterion     47.77387
Schwarz criterion    49.76335    Hannan-Quinn         46.51979

Excluding the constant, p-value was highest for variable 6 (Gov_exp)

RESET test for specification -
  Null hypothesis: specification is adequate
  Test statistic: F(2, 4) = 2.43258
  with p-value = P(F(2, 4) > 2.43258) = 0.203585

White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 10.8992
  with p-value = P(Chi-square(8) > 10.8992) = 0.207476

Test for normality of residual -
  Null hypothesis: error is normally distributed
  Test statistic: Chi-square(2) = 1.22891
  with p-value = 0.540937
```

Diagnostics:

- Moderate explanatory power, R^2: 53.7%
- **Unemployment Rate**: indicates structural labor market issues
- No heteroskedasticity (White test p = 0.207).
- **Inflation**: Positive effect (0.49) ranges with moderate inflation supporting growth
- Residuals are normally distributed (JB p = 0.541).

3. France:

```
                 Mean        Median      Minimum      Maximum
Gov_def        -4.7091       -4.6000     -8.9000      -2.3000
GDP_growth      1.1727        1.2000     -7.4000       6.9000
Unemp_rate      8.6636        8.4000      7.3000       10.400
Gov_exp         57.473        57.000      55.300       61.700
Inf_rate        2.0091        1.3000      0.10000       5.9000

               Std. Dev.       C.V.      Skewness    Ex. kurtosis
Gov_def         1.9274        0.40930    -0.76429      0.10119
GDP_growth      3.3203        2.8312     -1.2546       2.8672
Unemp_rate      1.1919        0.13757     0.23256     -1.4784
Gov_exp         1.8078        0.031455    1.2069       0.79441
Inf_rate        2.0211        1.0060      1.1451      -0.057203
```

```
Model 1: OLS, using observations 1-11
Dependent variable: GDP_growth

              coefficient   std. error    t-ratio    p-value
  -----------------------------------------------------------
  const         5.54313       98.3692      0.05635    0.9569
  Gov_def       0.842784       1.82758     0.4611     0.6609
  Unemp_rate   -0.122666       1.83947    -0.06669    0.9490
  Gov_exp      -0.00338392     1.83823    -0.001841   0.9986
  Inf_rate      0.425842       0.961378    0.4429     0.6733

Mean dependent var    1.172727   S.D. dependent var    3.320268
Sum squared resid     78.09629   S.E. of regression    3.607776
R-squared             0.291591   Adjusted R-squared   -0.180682
F(4, 6)               0.617421   P-value(F)            0.666501
Log-likelihood       -26.38858   Akaike criterion      62.77717
Schwarz criterion     64.76664   Hannan-Quinn          61.52308

Excluding the constant, p-value was highest for variable 6 (Gov_exp)

RESET test for specification -
  Null hypothesis: specification is adequate
  Test statistic: F(2, 4) = 15.644
  with p-value = P(F(2, 4) > 15.644) = 0.0128489

White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 8.97411
  with p-value = P(Chi-square(8) > 8.97411) = 0.344485

Test for normality of residual -
  Null hypothesis: error is normally distributed
  Test statistic: Chi-square(2) = 9.55969
  with p-value = 0.0083973
```

Diagnostics:

- Budget shortfalls, averaging 4.71% of GDP. (2.3%-8.9%) with the most significant deficit occurring in 2020 (pandemic)
- Persistently high unemployment (mean=8.66%)
- Low explanatory power (R^2=0.292)
- Residuals are not normally distributed
- Gov_expenditure: Almost zero impact ($p \approx 1$). (Bad economical condition)

4. Czech Republic

	Mean	Median	Minimum	Maximum
Gov_def	-1.7364	-2.1000	-5.6000	1.5000
GDP_growth	2.1727	2.8000	-5.3000	5.2000
Unemp_rate	3.0909	2.6000	2.0000	5.1000
Gov_exp	42.127	42.300	38.500	46.300
Inf_rate	4.0364	2.6000	0.30000	14.800

	Std. Dev.	C.V.	Skewness	Ex. kurtosis
Gov_def	2.4622	1.4180	-0.19440	-1.2955
GDP_growth	2.9268	1.3471	-1.5492	1.9616
Unemp_rate	1.1013	0.35631	0.99870	-0.52370
Gov_exp	2.4067	0.057129	0.16051	-0.91409
Inf_rate	4.7961	1.1882	1.5137	0.73921

Model 1: OLS, using observations 1-11
Dependent variable: GDP_growth

	coefficient	std. error	t-ratio	p-value
const	75.4023	96.6397	0.7802	0.4649
Gov_def	-0.995365	2.39263	-0.4160	0.6919
Unemp_rate	0.517273	0.907630	0.5699	0.5894
Gov_exp	-1.82197	2.36238	-0.7712	0.4698
Inf_rate	0.0490067	0.252350	0.1942	0.8524

Mean dependent var	2.172727	S.D. dependent var	2.926804
Sum squared resid	42.29981	S.E. of regression	2.655178
R-squared	0.506200	Adjusted R-squared	0.177000
F(4, 6)	1.537667	P-value(F)	0.303258
Log-likelihood	-23.01620	Akaike criterion	56.03241
Schwarz criterion	58.02188	Hannan-Quinn	54.77832

Excluding the constant, p-value was highest for variable 7 (Inf_rate)

RESET test for specification -
  Null hypothesis: specification is adequate
  Test statistic: F(2, 4) = 2.03212
  with p-value = P(F(2, 4) > 2.03212) = 0.246032

White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 9.61027
  with p-value = P(Chi-square(8) > 9.61027) = 0.293452

Test for normality of residual -
  Null hypothesis: error is normally distributed
  Test statistic: Chi-square(2) = 1.78457
  with p-value = 0.409718

Diagnostics:

- Moderate explanatory power (R^2=0.506)
- Normal residuals (J-B p=0.410)
- Exceptionally low unemployment (mean=3.09%). Steady improvement from 5.1% -> to 2.0%
- Average 4.04% inflation, with extreme 14.8% spike (2022)
- Gov_expenditure: Negative effect

5. Lithuania

	Mean	Median	Minimum	Maximum
Gov_def	-1.0545	-0.70000	-6.4000	0.50000
GDP_growth	3.2273	2.8000	0.00000	6.4000
Unemp_rate	7.3818	7.1000	6.0000	9.1000
Gov_exp	36.045	35.200	33.400	42.300
Inf_rate	3.8909	2.2000	-0.70000	18.900

	Std. Dev.	C.V.	Skewness	Ex. kurtosis
Gov_def	1.9310	1.8311	-2.0682	3.5892
GDP_growth	1.9340	0.59925	-0.24356	-0.64219
Unemp_rate	1.0971	0.14862	0.40606	-1.1590
Gov_exp	2.5009	0.069383	1.4044	1.5813
Inf_rate	5.6156	1.4433	1.9291	2.7706

```
Model 1: OLS, using observations 1-11
Dependent variable: GDP_growth

              coefficient   std. error   t-ratio   p-value
   ---------------------------------------------------------
   const        31.3233      27.8261       1.126    0.3033
   Gov_def      -0.334676     1.01649     -0.3292   0.7532
   Unemp_rate   -0.799997     0.851888    -0.9391   0.3839
   Gov_exp      -0.613263     0.710110    -0.8636   0.4210
   Inf_rate     -0.112618     0.133721    -0.8422   0.4320

Mean dependent var    3.227273    S.D. dependent var    1.933955
Sum squared resid    19.54281     S.E. of regression    1.804753
R-squared             0.477490    Adjusted R-squared    0.129151
F(4, 6)               1.370761    P-value(F)            0.347001
Log-likelihood      -18.76924     Akaike criterion     47.53848
Schwarz criterion    49.52796     Hannan-Quinn         46.28439

Excluding the constant, p-value was highest for variable 3 (Gov_def)

RESET test for specification -
  Null hypothesis: specification is adequate
  Test statistic: F(2, 4) = 0.63447
  with p-value = P(F(2, 4) > 0.63447) = 0.576333

White's test for heteroskedasticity -
  Null hypothesis: heteroskedasticity not present
  Test statistic: LM = 5.62568
  with p-value = P(Chi-square(8) > 5.62568) = 0.68908

Test for normality of residual -
  Null hypothesis: error is normally distributed
  Test statistic: Chi-square(2) = 8.56768
  with p-value = 0.0137896
```

Diagnostics:

- Average Deficit: -1.05% of GDP
- Economic Growth: 3.23% (highest among analyzed countries)
- Minimal COVID contraction (0% in 2020) and rapid 6.4% rebound (2021)
- The highest inflation level (2022)

Overall diagnoses and the major findings:

1. **Fiscal Deficits**:
   - Positive growth effects in Germany (β=1.89, p=0.17) and France (β=0.84, p=0.66), Poland (β=0.89, p=0.37) suggesting funding in productive investments.
   - Negative/nonsignificant in Czech Republic (β=-1.00) and Lithuania (β=-0.33).
2. **Unemployment**:
   - Germany (β=2.53) and Czechia (β=0.52) showed paradoxical positive links to growth.
   - France (β=-0.12) and Lithuania (β=-0.80) unemployment behaved naturally
   - Živković (2022) finds Polish wages grew 8% yearly post-2015 due to shortages
3. **Inflation**:
   - Positive effects in Germany (β=0.49) and France (β=0.43).
   - Czechia (β=0.05) and Lithuania (β=-0.11), Poland (β=0.13, p=0.51)showed minimum negative impacts. Dimovski(2023) suggested a wage indexation cushioned demand shocks.
4. **Model Performance and fit**:
   - Best fit: Poland (R^2=0.67), worst: France (R^2=0.29).
   - No specification errors except France (RESET p=0.013).

Visualization of Inflation and GDP growth parts

```python
plt.figure(figsize=(12, 6))
sns.lineplot(data=df, x='Year', y='Inf_rate', hue='Country',
             style='Country', markers=True, dashes=False)
plt.title('Inflation Rates in EU Countries (2014-2024)', fontsize=14)
plt.ylabel('Inflation Rate (%)')
plt.axhline(y=0, color='gray', linestyle='--')  # Highlight 0% inflation
plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left')
plt.tight_layout()

plt.show()
```
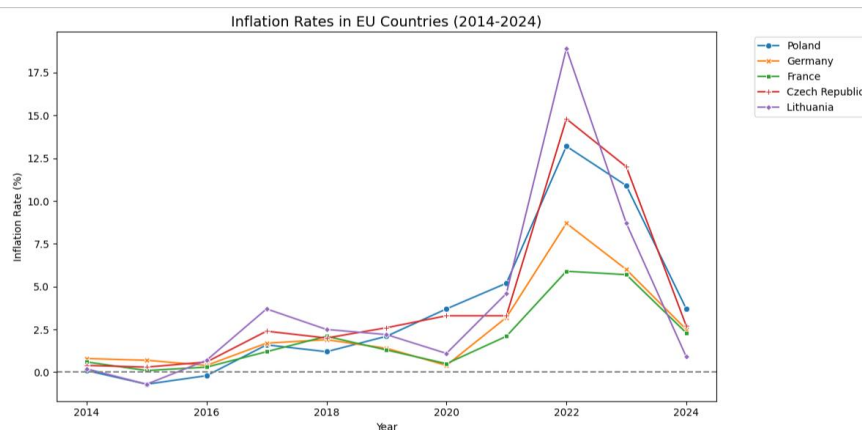
```
[15]:  plt.figure(figsize=(10, 5))

       # Plot each country's GDP growth
       countries = df['Country'].unique()
       for country in countries:
           country_data = df[df['Country'] == country]
           plt.plot(country_data['Year'],
                    country_data['GDP_growth'],
                    label=country,
                    marker='o')

       plt.title("GDP Growth by Country (2014-2024)")
       plt.xlabel("Year")
       plt.ylabel("GDP Growth (%)")
       plt.legend()
       plt.grid(True, linestyle='--', alpha=0.6)
       plt.axhline(y=0, color='black', linestyle=':', linewidth=0.8)

       plt.show()
```


GDP Growth by Country (2014-2024)
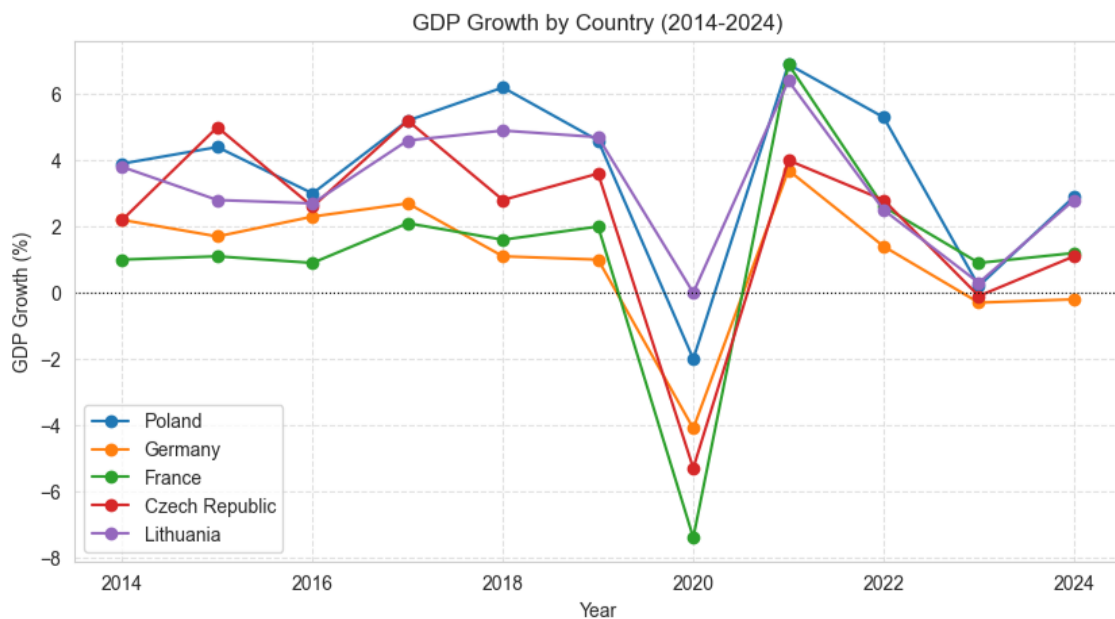
Conclusion

This empirical study looks at macroeconomic dynamics in Germany, France, Poland, Czech Republic, and Lithuania between 2014 and 2024. The findings show important differences across countries and question whether a single policy approach can work for all EU members.

First, fiscal policy effects appear mixed. Germany and France show the expected positive link between deficits and growth, though insignificantly, while Poland's stronger positive effect could reflect Furceri & Mourougane (2010) idea that public investment boosts private activity in transition economies. In contrast, Czechia and Lithuania's negative results fit with Misztal's (2021) debt overhang theory for small open economies.

Second, labor markets behave unexpectedly. In Germany and Czechia, unemployment correlates positively with growth, contradicting Okun's Law. Poland's success in lowering unemployment without major inflation supports Živković's (2022) findings on structural labor shortages, but more factors likely matter.

Third, inflation impacts differ greatly. Germany benefits from moderate inflation (consistent with Phillips Curve logic), while Lithuania shows significant negative effects, especially

during the 2022 energy crisis (Dimovski et al., 2023). Poland's almost neutral result may reflect wage indexation, as Afonso et al. (2024) suggest.

Finally, although model fit is moderate (R^2 between 0.29–0.67), many coefficients lack significance. The RESET test for France ($p=0.013$) points to missing variables, such as EU cohesion funds, echoing the European Commission's (2023) concerns about standard models underestimating regional policy impacts.