Unemployment Trends Over Time: A Comparative Analysis and Forecasting of Gender-specific Unemployment Rates in Italy and the United States, Utilizing GDP and CPI

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Abstract

- Examining the relationship between unemployment, GDP, and CPI in the US and Italy using a ARMA and VAR models facilitate a comprehensive understanding of economic dynamics, aids in policy evaluation, and offers insights into the interconnectedness of key economic indicators in these two nations. The comparison sheds light on how global economic trends and events affect economies with different structures and sizes. Understanding how these two nations respond to global shock provides a broader perspective on the impact of global forces on diverse economies.
- The data is hand collected from the Federal Reserve of St. Louis, Missouri, and the OECD; compiled into one dataset from 1999 to 2019. Information included are the respective GDP, CPI, and Unemployment Rate Across Genders for U.S. and Italy.
- This paper will investigate and evaluate the unemployment trend for men and women between the two countries, while controlling for the GDP and CPI. Additionally, we forecast unemployment trend for each group using VAR and ARMA model and choose the most robust.

Conceptual Framework

- Gender Disparities in Unemployment Rates Over Time
  - The first hypothesis states that there are significant differences in the gender-specific unemployment rates over time between Italy and the United States.
- Influence of GDP and CPI on Gender-Specific Unemployment
  - The second states that Industrial Production and CPI significantly influence gender-specific unemployment rates in Italy and the United States.
- ARIMA and VAR Models Effectively Forecast Gender-Specific Unemployment Trends
  - The third hypothesis purports that ARIMA and VAR models, when applied to gender-specific unemployment data, offer effective forecasts for future trends in Italy and the United States.

ARMA Forecasts

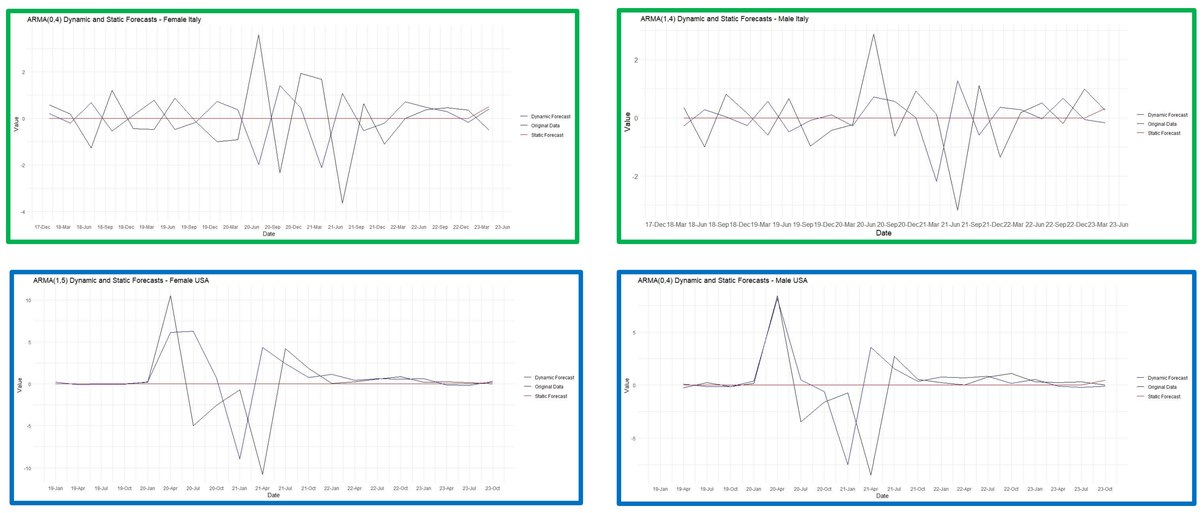

Chart 1. ARMA forecast for Italy and USA across genders

ARMA Model

Italy
ARMA(0,4) female

$$Y_t = \beta + \varepsilon_t + \emptyset_1\varepsilon_{t-1} + \emptyset_2\varepsilon_{t-2} + \emptyset_3\varepsilon_{t-3} + \emptyset_4\varepsilon_{t-4}$$

ARMA(1,4) male

$$yt = \beta + \emptyset_1 y_{t-1} + \varepsilon_t + \theta_1\varepsilon_{t-1} + \theta_2\varepsilon_{t-2} + \theta_3\varepsilon_{t-3} + \theta_4\varepsilon_{t-4}$$

USA
ARMA(1,5) female

$$yt = \beta + \emptyset_1 y_{t-1} + \varepsilon_t + \theta_1\varepsilon_{t-1} + \theta_2\varepsilon_{t-2} + \theta_3\varepsilon_{t-3} + \theta_4\varepsilon_{t-4} + \theta_5\varepsilon_{t-5}$$

ARMA(0,4) male

$$yt = \beta + \varepsilon_t + \emptyset_1\varepsilon_{t-1} + \emptyset_2\varepsilon_{t-2} + \emptyset_3\varepsilon_{t-3} + \emptyset_4\varepsilon_{t-4}$$

- Female unemployment in Italy: ARMA(0,4) model suggests no direct dependence on past unemployment rates, with 4 moving average terms indicating a linear combination of the past four error terms.
- Male unemployment in Italy: ARMA(1,4) model shows direct influence from the previous period's unemployment rate with 4 moving average terms representing a linear combination of the past four error terms.
- Female unemployment in the United States: ARMA(1,5) model indicates influence from the previous period's unemployment rate, with 5 moving average terms representing a linear combination of the past five error terms.
- Male unemployment in the United States: ARMA(0,4) model suggests no direct dependence on past unemployment rates, with 4 moving average terms representing a linear combination of the past four error terms.

VAR Model

$$x_{cgt} = [ULV_{cgt}, GDP_{cgt}, CPI_{cgt}]$$

X = output per equation
GDP = Change in the Log of Gross Domestic Product
c= country
t= year

ULV = Log of Unemployment Rate
CPI = Change in the Log of Consumer Price Index
g = gender

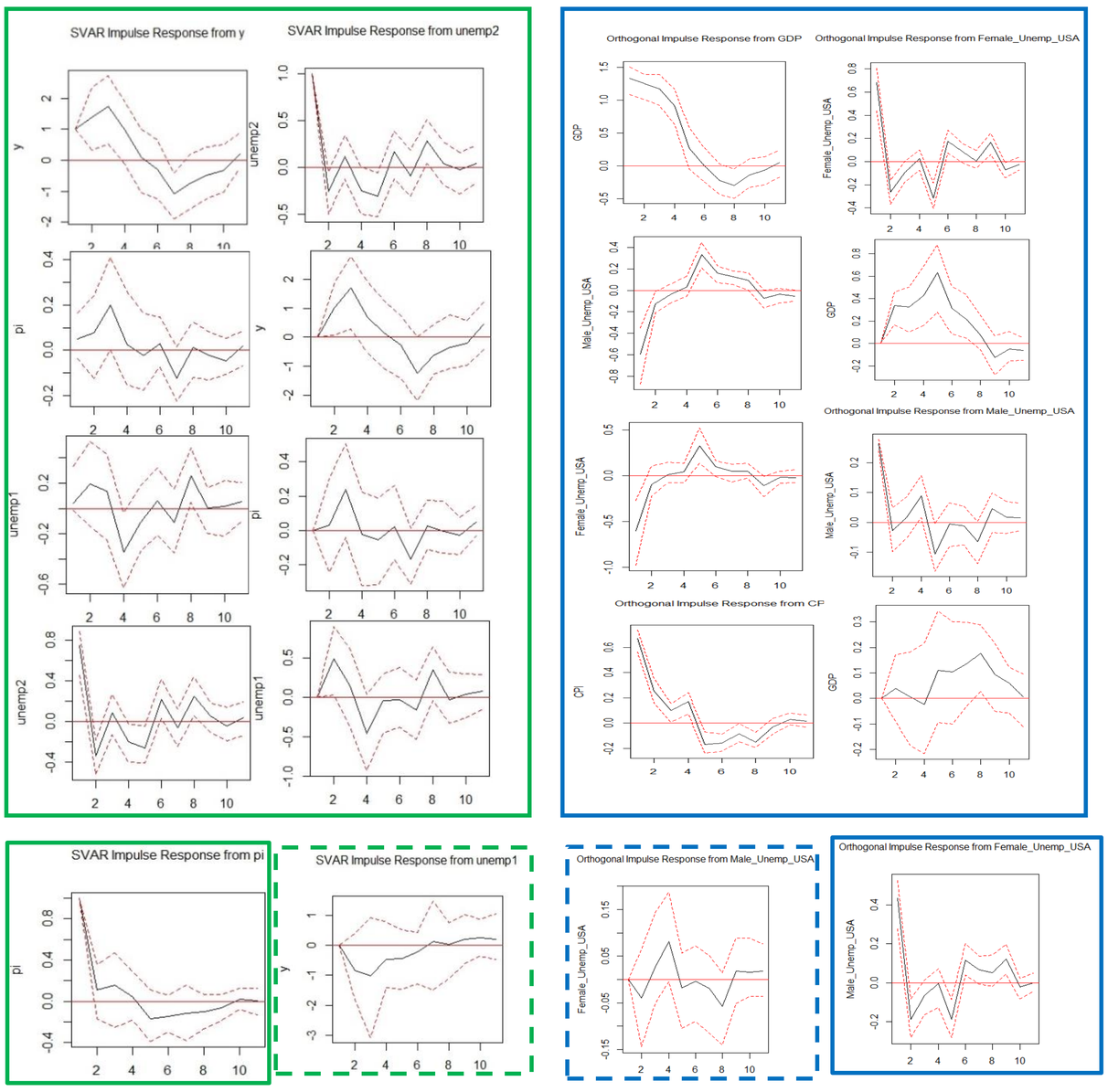

Chart 2. Relevant IRF plot for Male and Female Unemployment, CPI, GDP (USA and Italy)

•Plots within the solid green line are the significant irf plots for our Italy VAR model.
• GDP shocks show significant and lasting effects on all variables.
• Unemp2 (male) shocks show significant and lasting effects on all variables.
• CPI shock has a significant contemporaneous effect on itself, but eventually tapered down.
• the plot within the dashed line is insignificant but show interesting information on women unemployment shock on GDP.

- Each shock immediately affects its corresponding variable: GDP, CPI, female unemployment, and male unemployment.
- GDP shocks contemporaneously impacts both male and female unemployment, which aligns with our theoretical understanding and the ordering in our VAR model.
- Female unemployment shocks have an impact on GDP after two periods and maintain significance for eight consecutive periods, whereas male unemployment shocks affect GDP after four periods but with less significance.
- Notably, it's fascinating to observe the immediate impact of female unemployment shocks on male unemployment, whereas male unemployment seems to affect female unemployment after a delay of two periods, although the effect is not as pronounced.

Discussion

We employed both models to explore our data and test our hypothesis. Through ARMA analysis, we identified unemployment disparity between the two countries. Italy shows a varying pattern, while the U.S. shows a constant rate. Ultimately, the VAR model emerges as the more robust method for gauging unemployment, given its ability to consider multiple variables. For Italy, we found that GDP made the biggest impact on unemployment for both women and men. In the United States, similar trends were observed, where GDP wielded the most significant influence on unemployment rates across genders. A thorough examination of the autocorrelation function (acf) and partial autocorrelation function (pacf) for the selected lag revealed no autocorrelation in the residuals.

Conclusions

In conclusion, our study illuminates the nuanced impact of unemployment, revealing distinct patterns across genders and disparities between two distinct countries. Through a comprehensive analysis, we gained valuable insights into the differential effects of unemployment on men and women, contributing to a deeper understanding of the complexities inherent in these socio-economic dynamics.

References
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