# College Enrollment by Race based on Macroeconomic Changes

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## Abstract

Economic literature surrounding the college enrollment response with vector auto-regressive models focuses on understanding trends in regards to gender. This research aims to understand the estimation of the college enrollment response with respect to race, categorized into "WHITE" and "MINORITY." I use a structural vector auto-regressive approach to identify the responses based off of macroeconomic shocks. Findings vary dramatically between the two groups and prove that there is some existing relationship between the macroeconomic indicators and the respective race categories.

## Introduction

Institutions of higher education require the understanding of US college enrollment trends in relationship to macroeconomic activity. Current literature cites the relationship of the college enrollment response with such activity, particularly with each individual factor (economic growth, inflation, the unemployment rate, etc.) Ewing, Beckert, and Ewing (2009) conducted a time series analysis where a vector auto-regression was used to interpret the effects of college enrollment by gender based on unanticipated changes in economic growth and inflation; I will extend that general premise, but instead focus on three differences. First, an additional variable, unemployment rate, will be factored into the vector auto-regression and utilized as a third macroeconomic indicator. Second, the former analysis was based on the effects on gender and college enrollment; instead, the focus will be attributed towards race, specifically White and Minority. *(Minority denotes the college fall enrollment in degree-granting institutions of individuals that select "Black," "Hispanic," "Asian/Pacific Islander," "American Indian/Alaska Native," or "Two or more races" in the selected race category)* Third, the timeframe used to produce the analysis was from 1963 to 2004. To incorporate more modern data, data will be utilized from 1976 to 2019. The goal of this research is to identify the racial trends in US college enrollment according to the unanticipated macroeconomic activity.

**Note:** The data used for college enrollment rates was collected from the US Department of Education, National Center for Education Statistics, Digest of Education Statistics, 1995 to 2020. The industrial production index (IP), consumer price index (CPI), and unemployment rate (UNRATE) were all collected from the Federal Reserve Bank of St. Louis Economic Database (FRED).

## Method

Using vector auto-regressions and impulse response functions, we will estimate the enrollment response rate to economic shocks. A vector auto-regressive function is a statistical model used to estimate the relationship between multiple quantities as they change over time. It uses single equations to estimate multivariate time series.

$$ENROLL_t = \alpha_{10} + \sum_{i=1}^{m} a_{i1}ENROLL_{t-i} + \sum_{i=1}^{m} b_{i1}GROWTH_{t-i} + \sum_{i=1}^{m} c_{i1}INF_{t-i} + \sum_{i=1}^{m} d_{i1}UNRATE_{t-i}$$

$$GROWTH_t = \alpha_{20} + \sum_{i=1}^{m} a_{i2}ENROLL_{t-i} + \sum_{i=1}^{m} b_{i2}GROWTH_{t-i} + \sum_{i=1}^{m} c_{i2}INF_{t-i} + \sum_{i=1}^{m} d_{21}UNRATE_{t-i}$$

$$INF_t = \alpha_{30} + \sum_{i=1}^{m} a_{i3}ENROLL_{t-i} + \sum_{i=1}^{m} b_{i3}GROWTH_{t-i} + \sum_{i=1}^{m} c_{i3}INF_{t-i} + \sum_{i=1}^{m} d_{i3}UNRATE_{t-i}$$

$$UNRATE_t = \alpha_{40} + \sum_{i=1}^{m} a_{i4}ENROLL_{t-i} + \sum_{i=1}^{m} b_{i4}GROWTH_{t-i} + \sum_{i=1}^{m} c_{i4}INF_{t-i} + \sum_{i=1}^{m} d_{i4}UNRATE_{t-i}$$

These are the series of equations utilized for the VAR estimation. *ENROLL* is categorized into "WHITE" and "MINORITY," thus equaling a total of 8 equations to estimate. *GROWTH* is the industrial production (IP) index as economic output. *INF* refers to the consumer price index (CPI) as the inflation rate. *UNRATE* denotes the unemployment rate.

After defining the vector auto-regressive function, we then create a structured vector auto-regressive function (SVAR) to measure the impulse response functions (IRFS) or shocks to the equation.

Ordering is also imperative to determining the contemporaneous effects of the modeling; therefore, the following identification orders were also tested.

$$\begin{bmatrix} UNRATE_t \\ GROWTH_t \\ INF_t \\ ENROLL_t \end{bmatrix} \& \begin{bmatrix} ENROLL_t \\ INF_t \\ GROWTH_t \\ UNRATE_t \end{bmatrix}$$

## Results

8 impulse response functions are displayed below. Chart 1 displays the impulse response functions with the WHITE variable. Chart 2 displays the impulse response functions with the MINORITY variable. Comparing the two charts, WHITE and MINORITY both have inverted effects in each step/lag.

**Chart 1 (white_ -> white_):** slight decrease up to period 3, followed by an increase and a sharp decrease in period 6.
**Chart 1 (white_ -> d_cpi):** Initial decrease up to period 2, increase in periods 2-4, followed by a decrease, then tendencies for increase past period 6.
**Chart 1 (white_ -> d_ip):** No initial change until period 4 where there is staggered decrease up to period 6, then an immediate increase.
**Chart 1 (white_ -> d_unrate):** sharp decrease into negative effects up to period 3, followed by increase into positive area by period 6.
**Chart 2 (minority_ -> minority_):** consistent with mean up to period 2, followed with negative decrease and asymmetric intervals into period 7.
**Chart 2 (minority_ -> d_cpi):** positive effect up to period 1, followed by negative decrease up to period 4, with a positive increase into period 6 and a decrease in period 7.
**Chart 2 (minority_ -> d_ip):** no initial change until period 3, with a positive increase followed by a sharp decrease into negative area by period 6.
**Chart 2 (minority_ -> d_unrate):** sharp increase into positive effects until period 3, then sharp decrease into mean.
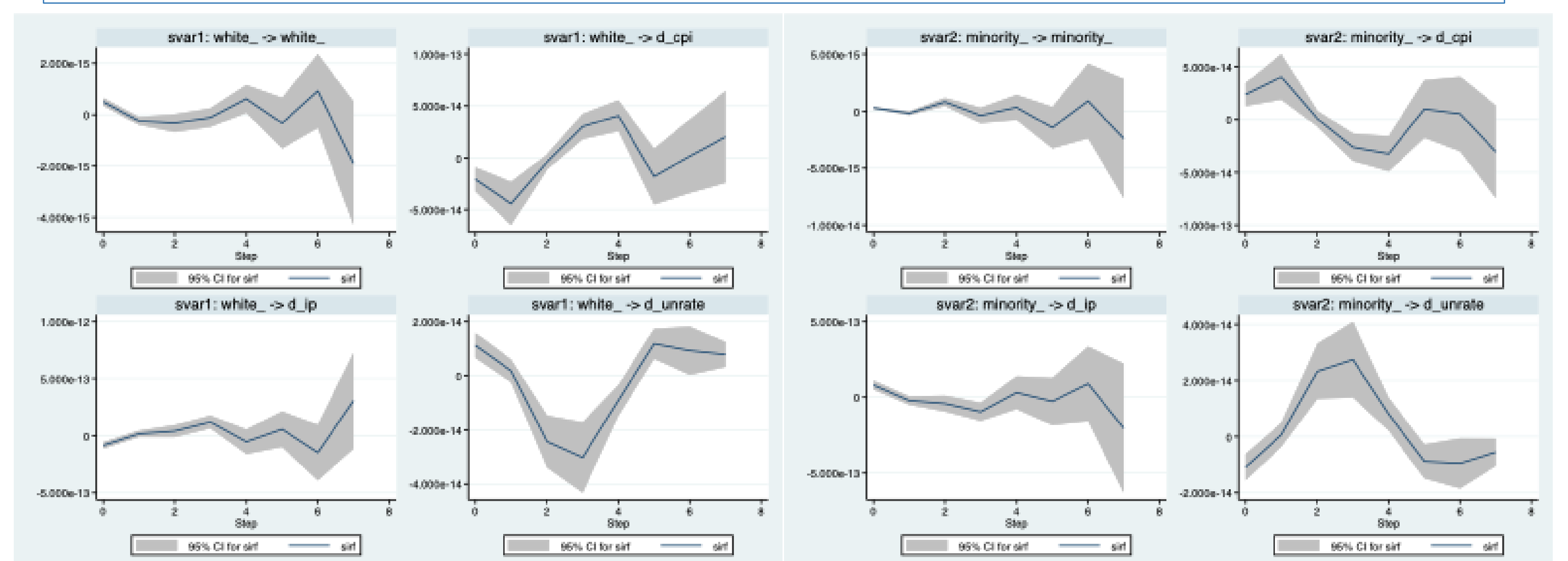


**Chart 1. IRF with WHITE**          **Chart 2. IRF with MINORITY**

## Discussion

In the short run, it is apparent that there is diverse array of impacts of exogenous shocks associated with WHITE. In particular, there is a negative relationship between the unemployment rate and WHITE; this indicates that shocks on the unemployment rate will have a negative effect on college fall enrollment for the race category "white." Opposing this statement, there is a positive relationship between the unemployment rate and MINORITY, indicating that shocks on the unemployment rate will have a positive effect on college fall enrollment for the race category "minority." In the long run, shocks on economic growth play a positive effect on college fall enrollment for the race category "white" while they play a negative effect on college fall enrollment for the race category "minority." Finally, the effects of the inflation rate are very inconsistent. They depict a negative relationship in the short run with WHITE, indicating less college enrollment, but eventually become positive. MINORITY, on the other hand, has a sudden positive increase, followed by a negative relationship in the long run, which shows college enrollment spikes and then decreases.

## Conclusions

There exists a relationship between race categories and macroeconomic indicators. Individuals of the race category "white" are subject to decreased college fall enrollment with a shock in the unemployment rate, while individuals of the race category "minority are subject to an increase instead. The next steps is to identify the economic reasoning for these empirical results.

## Robustness

Addressing the comments provided in the presentation:
**1) Switching of the ENROLL and UNRATE variable:** after conducting the VAR with the two switched variables because of the exogeneity claim that the unemployment rate listed last in the SVAR ordering would have a contemporaneous effect on college enrollment, the IRF produced no visible effect between the two on WHITE or MINORITY (straight lines at 0), thus was excluded from the analysis.
**2) Switching of CPI and IP variable:** after switching the ordering of the two variables in the VAR because of the Keynesian school of thought claiming that prices are sticky and could respond with a lag, the effects were nearly identical, the only difference indicated in the final 6th and 7th period where the effect fluctuated between negative and positive.

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## References

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