U.S. Office of Education

2018.12.17

DECISION MEMORANDUM

TO: Mr. Lethen, Director of US Office of Education
FROM: Yuhao Chen and Siyu Wang
SUBJECT: Research Summary on the Effect of Great Recession on College Enrollment Rates

Summary

This memo summarizes the replication and extension of the paper "Expanding Enrollments and Contracting State Budgets: The Effect of the Great Recession on Higher Education" (BARR et al, 2013). The paper showed the impact of Great Recession (marked by sharp rise of unemployment rate in the U.S. in 2007-2009) on college enrollment rate through plotting the two variables' trends over time and comparing their changes in the Great Recession with previous economic downturns. In replicating the graphs and the key findings, we found it unrigorous to make causal inferences merely based on historical comparisons that dismiss the unobserved variables, and thus used matching to find the pre-Great-Recession period that has least systematic differences with the treatment period, in order to accurately quantify the causal effect of Great Recession on college enrollment rates. The treatment effect we finally get is around -0.01, which counters Barr's opinion, and declares a negative relationship between unemployment rate(appearance of Great Recession) and the enrollment rate. Although the p-value for our result does not suggest a great significance level, it still gives insights on U.S. government's future appropriation arrangements.

Background Information

In contrast with the common intuition, Great Recession has witnessed increasing demand for post-secondary education, in times of rising unemployment and decreasing social educational support. It is of interest to U.S. Office of Education to find whether there is causal impact of Great Recession on rising college enrollment rate, in order to allocate educational and monetary resources more efficiently. If the causal relationship is statistically significant, it may suggest new ways of arranging government appropriations in post-secondary education in the future, such as adding more employment programs than educational subsidies in economic downturns, since educational demand will rise as a causal effect of rising unemployment rate, with or without

educational programs. Reasons for such occurrence may include less opportunity cost for people who were previously unenrolled in college, but this is a future direction of study beyond the scope of this decision memo.

Replication

The original graphs from Barr and Turner's paper are Figure 1a), b), while the replicated graphs are Figure 2a),b).

Figure 1a), b)

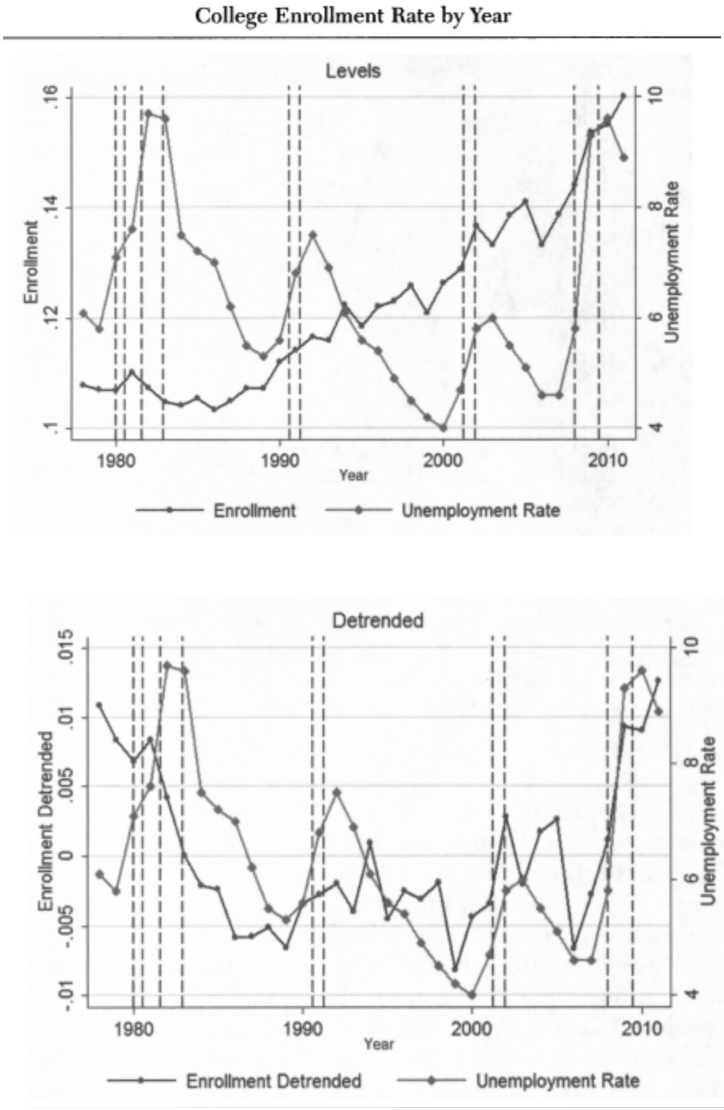
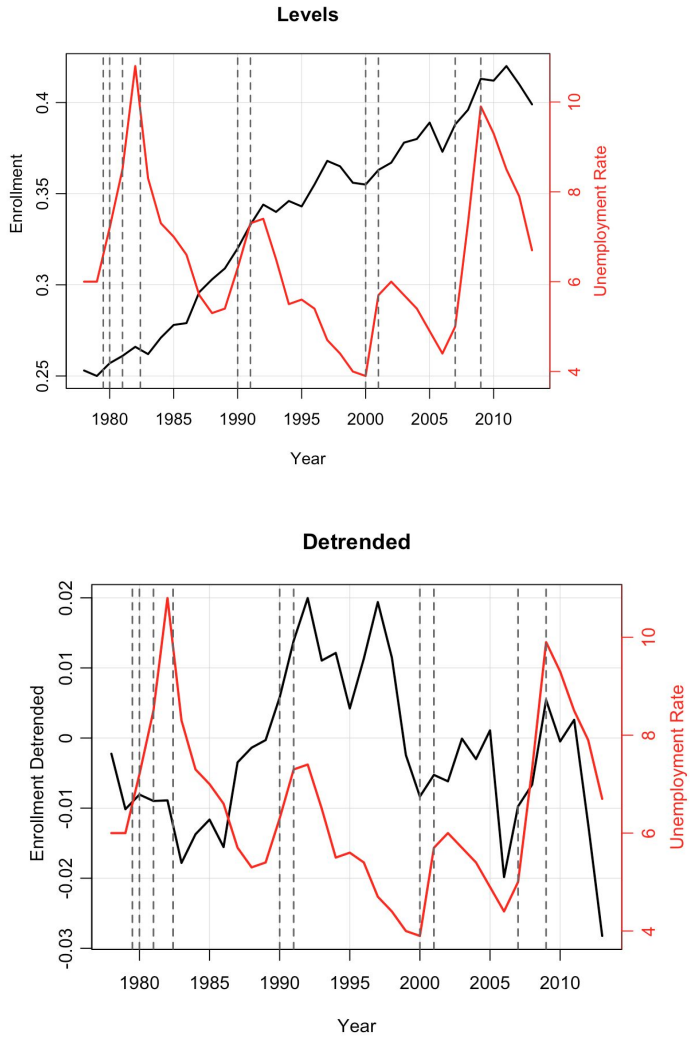


Figure 2a), b)



In Figure 1a),b), college enrollment rate from 2007 to 2009 rapidly increased in response to the Great Recession, showing a much higher rise than previous recession periods. After data are detrended to eliminate the growth due to the rising regression line, there is still substantial rise of enrollment rate in this time period.

In replicating Exhibit 1, historical data of unemployment rate and college enrollment rate are retrieved from Bureau of Labor Statistics and National Center for Education Statistics. The sample groups are from 18-24 years old, with identical time span of 30 years from 1980 to 2010. The age group is a subset of the 18-40 year-old age group in the original paper, so the enrollment rates are much higher than those in the original graph, which are diluted by the low enrollment rates in older age groups. Yet the general trends of enrollment changes in economic downturns are consistent, showing a rapid increase in enrollment rate in times of Great Recession. The smaller age group is selected as the subject of interest since the focus of most educational programs are targeted towards traditional college-going age groups. Data are detrended to find the true deviations in the Great Recession period besides the rise of regression line, and the 30-year time span is sufficient for the regression line to accurately model the trend.

In the original graph the left axis of enrollment rates is in decimals, while the right axis of unemployment rates is in percentages. We used the same method in the replication graphs to recover the original results, yet it's worth noticing that the scales should better be consistent to avoid confusions.

Extension

In order to attain the treatment effect of the Great Recession on college enrollment rates, observing historical trends is far from being sufficient. Correlation doesn't imply causation, and there are countless unobserved variables that may cause the strike of enrollment rate in the Great Recession, and the society has went through structural changes across the past 30 years that cause systematic differences between Great Recession and previous economic downturns.

In order to account for those biases in observational studies where random assignment is implausible, we find the control period that doesn't have rising unemployment rate and match the people in that period with those in the Great Recession based on covariates of household income, gender, race (dummy variable of white or others, as majority of the samples are white), state, and a year number variable.

By examining the replicated graph closely, we pinpointed a control period of 2004 to 2007, which is right before the treatment period of 2007 to 2010, to have little systematic difference with Great Recession, and have decreasing unemployment rate. The Great Recession of U.S. officially ended in 2009, yet year 2010 is included to account for lingering societal and economic effects. Since the control period and treatment period are each of 3 years, a year number variable is added into the matching process, which indicates whether it's year 1, 2, or 3 in the 3-year period. Taking into account the phase of economic recession the people making enrollment decisions live in is significant, as the social conditions vary due to market reactions and government policies in response to the economic downturn, and thus including this additional variable in the matching process adds more accuracy and results in higher balance between the treatment and control groups.

We applied three types of matching: logistic regression, propensity score matching and genetic matching. The matching results are summarized in Table 1.

Table 1

	Tmt Effect	p-value
Logistic Regression	-0.01092228	NA
Propensity Score Matching 1	-0.0079229	<2.22e-16
Propensity Score Matching 2[1]	-0.0068036	<2.22e-16
Genetic Matching	-0.015702	<2.22e-16

Discussion

From the table, the treatment effects are -0.011, -0.008, -0.007 and -0.016 generated respectively from logistic regression, two propensity score matchings, and genetic matching. The p-values for match balance results are extremely small, showing high imbalance between the matched treatment group and the control group. Maybe the reason for this is that there are no correlations between the covariates we are match at and the results, therefore being hard to match the control and treatment group. The p-values for the treatment effects are also small, showing a small statistical significance.

While it's opposed to the hypothesis of causal relationship between unemployment rate and enrollment rate, it is reasonable that the correlation between the two variables in the Great Recession barely leads to causation.

Conclusion

The treatment effect we finally get is around -0.01, which counters Barr's opinion, and declares a negative relationship between unemployment rate(appearance of Great Recession) and the enrollment rate. Although the p-value for our result does not suggest a great significance level, it still gives insights on U.S. government's future appropriation arrangements about educational resources and funds. More research are needed to further the study!

[1] Since we find the p-value for match balance for the first propensity score matching is too small, we try to match on different covariates. However, the effect of match is still not ideal.

Reference

BARR, A., & TURNER, S. (2013). Expanding Enrollments and Contracting State Budgets: The Effect of the Great Recession on Higher Education. The Annals of the American Academy of Political and Social Science, 650, 168-193. Retrieved from http://www.jstor.org/stable/24541681

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Detrend Data. (2018, June 07). Retrieved December 21, 2018, from https://www.statisticshowto.datasciencecentral.com/detrend-data/

Appendix

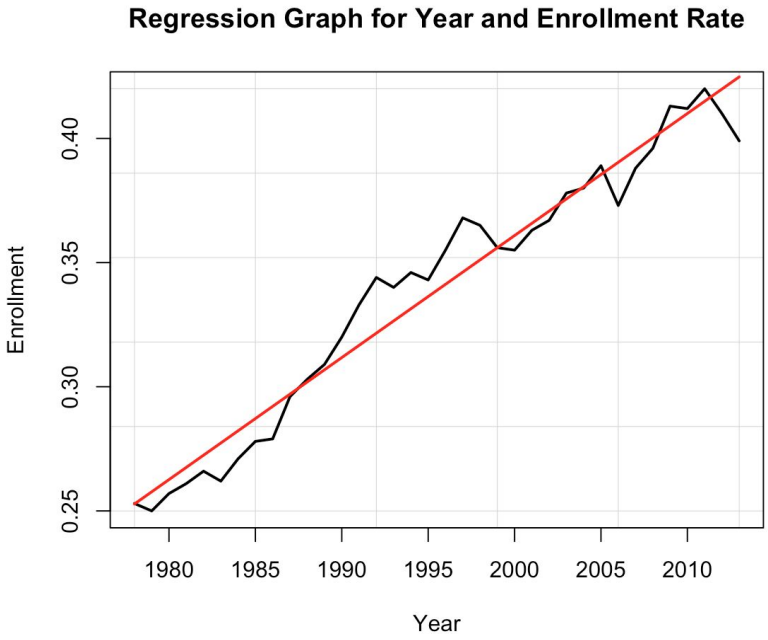
A: Contribution of Work

We collaborate to work out this paper. At the beginning, we individually read papers about our chosen topic and discuss with each other which graph we should replicate, how to replicate, what extension we can make and why we should make these extensions. We work together and come up with the main structure of the paper. Yuhao focus more on writing and running the code, and Siyu focus more on organize the language and return a well-formed paper. Whenever we have questions, we enjoy sharing with each other and solve it them together.

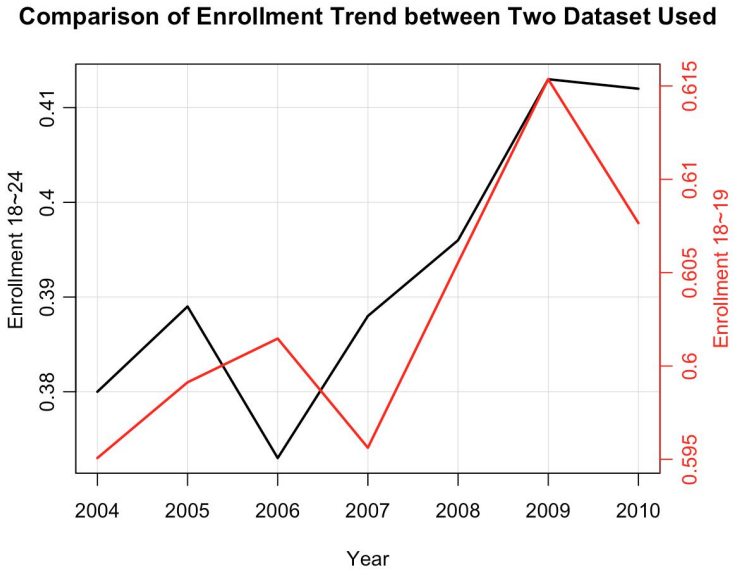
B: Code

Link of code: https://drive.google.com/drive/folders/1av1izAflRi29PN8L-gtsA6CeaVsxsIfO?usp=sharing

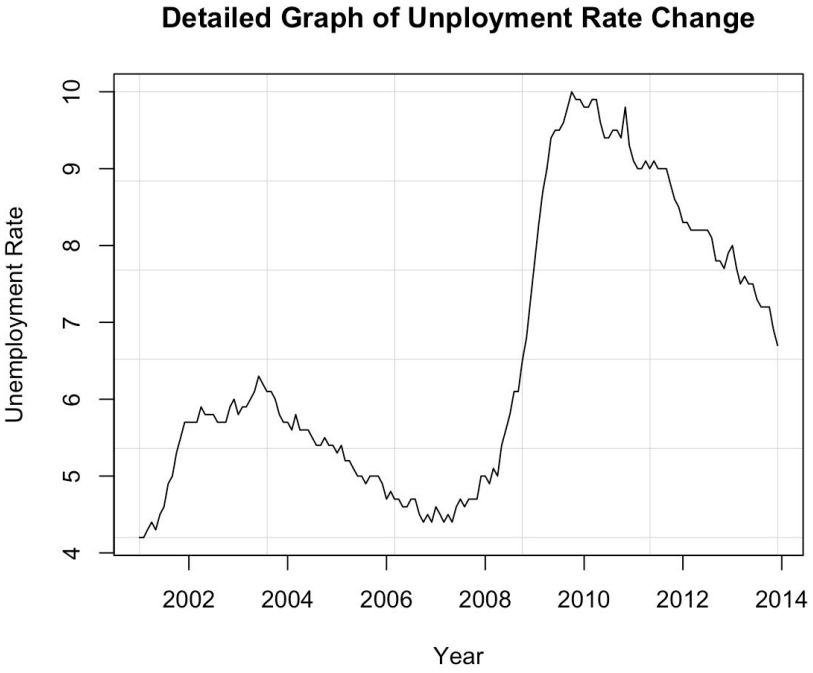
C: Replication Graphs



Graph helps to do the detrend enrollment by getting the regression line of the trend of enrollment rate.



The graph shows there are no obvious difference in the trend of enrollment rate between the two datasets we use.



A detailed graph of the change of the unemployment rate which helps us decide which is treatment group and which is control group.