The Impact of Interstate Tuition Differences on College Student Migration: Evidence from Regional Reciprocity Agreements*

Yuanting Wu

30 November 2019

[For the Latest Version] : https://xiaoshen1111.github.io/JMP.pdf

* Yuanting Wu is a PhD student of Economics Department at Rutgers University. I would like to express my deepest thank to my advisor Professor Jennifer Hunt for her great guidance, continued encouragement and support. I am grateful to Professor Amanda Agan, Professor Bingxiao Wu, Professor Anne Piehl, Professor Hilary Sigman for insightful discussions that greatly improved this paper. I also thank the seminar participants in the labor group meetings and at the Empirical Micro Workshops at Rutgers.

Abstract

I investigate the migration response of college students to tuition differences between states, using variation introduced by tuition regional reciprocity agreements. Out-of-state students generally pay higher tuition than in-state students, but reciprocity agreements reduce the premium paid by students from other states in the agreement (sometimes to zero). I examine migration between directed pairs of states in a panel, with the tuition difference faced by a potential migrant as the covariate of interest. By instrumenting the tuition difference with a dummy for the pair of states' memberships in a common regional reciprocity agreement, I find that a one percent decrease in the nonresident tuition of the destination state due to the regional reciprocity agreements would increase nonresident students' inflow to the destination state by 0.4-0.5%. The reduced form shows that having a regional reciprocity agreement between states increases college migration between states by 25%.

1 Introduction

Nonresident students pay as much as two or three times the in-state tuition in public postsecondary institutions in the United States. In 2017, the average ratio of nonresident to resident tuition in public postsecondary institutions was around 2.6, though it varied considerably across states: for example, Massachusetts had the highest ratio with 7.3 and South Dakota had the lowest ratio with 1.2.[1] Tuition is clearly an important concerns when students are deciding where and which college to attend.[2]. Many students have to restrict their choices to in-state schools due to financial concerns, limiting their ability to attend the college which is the best fit, and hence leading to inefficiencies (Knight and Schiff 2019). In Fall 2016, around 81% of the first-time bachelor's degree seeking residents in the United States studied in their home states with the largest being 91% in Utah (Snyder, Brey and Dillow 2019). It is natural to ask the degree to which this high share represents a distortion caused by barriers to out-of-state enrollment and whether there are policies that can improve efficiency.

The formation of regional reciprocity agreements is one such intervention that reduces the tuition public institutions charge nonresidents from other member states. In 1957-1958, the New England Board of Higher Education (NEBHE) established the first-ever regional reciprocity agreement, the Regional Student Program (RSP), to share higher education resources and expand educational opportunities for residents in the New England area. With this agreement, nonresidents from the member states in New England can study in member states at discounted tuition ranging from the

[1] Data from 2017 Integrated Postsecondary Education Data System (IPEDS).
[2] In 2012, 67% of high school seniors in the High School Longitudinal Study of 2009 reported that cost of attendance was very important in influencing their college choice, and 29% said it was somewhat important (LaFave, Kelly and Ford 2018).

same rate as residents to only 150% of resident tuition depending on the state and program they attend. Since then, following the RSP, other regions in the United States have launched similar regional reciprocity agreements. The Southern Regional Education Board (SREB) launched the Academic Common Market (ACM) program in 1979; the Western Interstate Commission for Higher Education (WICHE) established the Western Undergraduate Exchange (WUE) program in 1988; and the Midwestern Higher Education Compact (MHEC) set up the Midwest Student Exchange Program (MSEP) in 1994. As of 2018, these regional reciprocity agreements cover 45 states in the United States in total.[3] According to the annual report of the RSP of NEBHE, in the academic year 2018-2019, a full-time nonresident undergraduate saved an average of $7,900 by taking advantage of the program. These programs have drawn limited attention from economists.

In this paper, I ask what impact tuition gaps between in- and out-of-state tuition have on college student migration. The challenge for identifying the causal effect of the tuition gap on college migration is that tuition is endogenous, meaning it could be correlated with migration determinants that are unable to be controlled for, including the quality of education and a sudden migration shock. It is hard to rule out bias from these omitted variables without a credible empirical identification analysis

I exploit the regional reciprocity agreements to estimate the effect of tuition on migration of college students, using regional reciprocity as an instrument for the tuition gap between states. I use data on membership of the four major regional reciprocity agreements in the United States since 1958. I also analyze the effect of bilateral reciprocity agreements negotiated by neighbor states, though not

[3] There are 6 states in the RSP; 14 states in the ACM; 15 states in the WUE, and 10 in the MSEP.

those negotiated between pairs of schools in different states. Using microdata from the 5% sample of the 1960, 1970, 1980, 1990 and 2000 the United States Census of population, I match directed pairwise college migration flows observed between states with the states' reciprocity agreement membership, tuition data from the Integrated Postsecondary Education Data Service (IPEDS), state education expenditure data from the Annual Survey of State and Local Government Finances, unemployment data from the Bureau of Labor Statistics (BLS) and gross state product data from the Bureau of Economic Analysis (BEA).

I argue that the regional reciprocity agreements are unlikely to be correlated with these omitted college migration determinants: education quality and unobserved shocks. Most states joined the agreements all at once as soon as the agreement was established, making it unlikely each was responding to an unobserved shock. To check this, I repeat my analysis using a sample restricted to members of those agreements where 75% of members joined all at once and have more than two states in them, and to states that never joined an agreement. In addition, I also directly explore the pre-trends in migration before each state-pair joined the reciprocity agreement. Endogeneity is more likely in bilateral agreements with neighboring states, which is why I use these agreements only as a robustness check.

I find that the LATE effects estimated by my IV, in all specifications, are substantially larger (in absolute value) than the fixed effects results, which, if unbiased, represent average treatment effects (ATEs). A one percent decrease in the nonresident tuition the of destination state due to the regional reciprocity agreements increases nonresident students' inflow to the destination state by 0.4-0.5%. To learn more directly about the reciprocity agreement program, I also provide a reduced

form evaluation of the regional reciprocity agreements program on college student migration using the fixed effects model. The reduced form shows that having a regional reciprocity agreement between states increases college migration between states by 25%.

My results may most directly be compared with those of Dwenger, Storck, and Wrohlich (2012), who study the introduction of tuition fees in certain German states. They find that the introduction of home state tuition fees reduces the probability students apply to a university in their home state by 2 percentage points. The most similar American paper to mine is Knight and Schiff (2019). They compare attendance at institutions for students living close to state borders from 1997 to 2011 using a border discontinuity design. They find that a 1000 dollar increase in tuition is associated with 6 less students. And in addition, they compare borders of states in the same reciprocity agreement with the borders of states not in the same reciprocity agreement and find that borders under the same reciprocity agreement have 22 fewer students enrolling in-state. The effect found in my study is larger than theirs (a 1000 dollar increase is associated with 40 fewer students in my study).

The main differences between my study and theirs are identification strategy and data. Firstly, I use IV while they use a regression discontinuity (RD) to identify the effect of tuition on enrollment. RD must focus on students living near to the border, while the effect on students living close to border might be different from the effect on other students. Therefore, their RD result is less representative than my IV result. Besides, the comparison of in-state enrollment change crossing the borders between states in the same reciprocity agreement and states not in the same reciprocity agreement could be biased. Given students can study in any member state in the same regional

reciprocity agreement, it is not necessary for them to just study in states directly across the border. Given the large regional area covered by each agreement, there are many other states than the adjacent states that are also available to students of member states. For example, if we think of two neighbor states that are in different reciprocity agreements, this is a pair of states which their paper assigns to the "control" groups. But the size of the border discontinuity actually reflects which side the reciprocity agreement has a larger power. In addition, they did not take into consideration bilateral agreements negotiated by neighbor states or neighbor schools. Lastly, the Higher Education Research Institute data used in their study is a survey data that covers only institutions that responded, which might have more measurement error problems and might be less representative than the Census data used in my study.

Although there is a literature examining the impact of tuition on enrollment, which finds mixed results[4], there is surprisingly little research on the longstanding, geographically widespread regional tution agreements specifically. DesJardins (1999) studies the effect of the tuition reciprocity agreement between Minnesota and Wisconsin in 1997 and find that a 196 dollar decrease in tuition is associated with having 8 more students. Herzog and Stanley (2017) find that residents in states joining the WUE are 57% more likely to enroll than residents in other states. Rizzo and Ehrenberg (2004) study how the nonresident enrollment strategies at institutions react to changes in federal and state need-based student aid and state appropriations in 91 flagship public research institutions in the United States during the 1979 to 1998 period. They control for the share of undergraduates who are reciprocal to control for the enrollment pressure institutions face. They find a small negative relationship between share of reciprocal undergraduates and share of out-of-

[4] McHugh and Morgan (1984), Leslie and Kane (1994), Card and Lemieux (2000), Mixon and Hsing (1994), Groat (1964), Tuckman (1970), Morgan (1983), Mixon (1992) and Noorbakhsh and Culp (2002).

state undergraduates using cross-section analysis and no relationship in the panel analysis. Likewise, Marsicano (2015) studies the effect of a state's membership in a regional reciprocity agreement on its own nonresident enrollment. This study focuses on the out-of-state enrollment in institutions located in the border of states from 2003 to 2012 and finds that four-year institutions in a state participating a reciprocity agreement on average have 100% enrollment increase. Firstly, my study covers a longer period (1960-2000) and wider region (nationwide), which allow the membership variable in my study have more variations. The most volatile period of state membership change happened before 1994. Most previous studies either cover a later period or cover a shorter period when the membership barely changed over time. Therefore, the effect they captured mostly only come from difference from region to region. Rizzo and Ehrenberg (2004) measure membership via a survey of institutions with a low response rate. Secondly, given the outcome variable in these studies is stock variable: the share of out-of-state students in institution, they are not checking the matrix of flows between states as I do. Therefore, it is impossible for them to control for the source of state characteristics which are also very important to college migration.

I find larger impacts than papers studying the effect of merit-based scholarships at public universities, designed to keep top students in state. Dynarski (2004) shows that the effect of the HOPE scholarship on student enrollment might happen through retaining students who would have studied out of state. Zhang and Ness (2010) checked the brain drain phenomenon in the United States in STEM major and find that merit-based scholarship successfully attract more talent students with a 10% increase in in-state enrollment and a 10% decrease in students out migration. Cornwell, Mustard and Sridhar (2006) find that HOPE in Georgia increased its freshman

enrollment by 5.9%. Cohodes and Goodman (2014) compare students just below and above the merit scholarship threshold of schools with relatively lower quality and finds that eligibility for the scholarship increases student enrollments in these schools by 4.8-6.9%. Kane (2007) finds that the DC TAG program increase enrollment in DC and a 1,000 dollars (in 2002 dollars) decrease in tuition is associated with 5.4% increase in enrollment. Given that my results show that 1% decrease in nonresident tuition, which is around 52 dollars, is associated with 0.36% increase in enrollment and my reduced form results show that the effect of the reciprocity agreement is around 25% increase in nonresident enrollment, overall, the effect found in my results is larger than most results find via merit-based scholarships.

A usual concern with the merit-based scholarship analysis is that it may have endogeneity problems because student with better academic performance might have some unobserved personal characteristics that determine the enrollment as well. In order to solve this endogeneity problem, many studies of merit-based scholarship have to restrict their sample to a specific group or a specific state, which limits their generality.

2 Data

I use four sources of data in this analysis. Firstly, I use the 5% sample of 1960-2000 Census data from the Integrated Public Use Microdata Series (IPUMS) for the migration and demographic information. I identify undergraduate students aged 30 or under who enroll in public universities and note their current state and their reported state five years previously. If these two states are not the same, then I count this student as a college migrant, and I define his or her current state as the destination state and the state five years prior as the source state. I aggregate the number of college

migrants by each directed pair of states in the United States by each Census year. There are 12750 directed pairs (2550 per year*5 year) in total in my sample and 28% (3566) pairs among them have zero college migration.[5] I do not extend the sample period using the ACS because the question about past migration refers to 1 year prior rather than 5, introducing a break in the series.[6]

Secondly, I collect the state reciprocity agreement participation information by checking websites and contacting program directors. This dataset includes the membership of each state from 1958 to 2018 in the four major regional reciprocity agreements and bilateral reciprocity agreements negotiated by neighbor states. Thirdly, I get the tuition information data from the 1980 and 1984-2017 IPEDS dataset.[7] The unit of observation in the IPEDS dataset is institution. This dataset includes important variables such as out-of-state tuition and in-state tuition for each public institution. However, the data for DC in 1984 is missing. I take unweighted averages of the institution-level out-of-state tuitions and in-state tuitions separately by state and year to get the average annual state level tuitions for both nonresidents and residents. Finally, I add more control variables by using gross state product (GSP) from 1962 to 2017 from the Bureau of Economic Analysis (BEA). I impute the 1960 value for use in my regressions.[8]

[5] In future work, I will check the robustness of the results to recoding these zero flows as the migration of a single person.
[6] In future work, I will check the robustness of the results to multiplying ACS migration rates by five.
[7] The 1981-1983 IPEDS data is unavailable.
[8] I impute using predicted values from:

$$\log(GSP_{st}) = \beta_1 \log(GDP_t^{US}) * Region_r + \beta_2 unemployment\ rate_{st} + \beta_3 \log(population_{st}) + \gamma_s + \beta_4 year + \epsilon_{st}$$

where s indexes state, t stands for census year. $Region_r$ stands for the census region dummy and γ_s stands for a set of state dummies. For this purpose, I ignore the break in the GSP series in 1997. I use decadal data, but the imputed results are very similar if I use yearly data, whose disadvantage is that I

I get unemployment rates from 1976 to 2017 from the Bureau of Labor Statistics (BLS). The years before 1976 are not available in the BLS. Therefore, I also construct the state unemployment rate from 1960 to 2000 using the Census 1960-2000. In order to make sure the unemployment rate is comparable; I use state unemployment rate from the BLS in the IV regressions which only cover years after 1980 and use the state unemployment rate computed by the Census for the reduced form analysis. I collect government education expenditure ranging from 1960 to 2017 from the Annual Survey of State and Local Government Finances.[9]

I define a new variable named *Log tuition gap* to measure the log of the difference in tuition between source and destination state. It is defined as:

$$Log\ tuition\ gap_{sdt}$$

$$= \begin{cases} log(resident\ tuition_{dt}) - log(resident\ tuition_{st}), & Reciprocity_{sdt} = 1 \\ log(nonresident\ tuition_{dt}) - log(resident\ tuition_{st}), & Reciprocity_{sdt} = 0 \end{cases}$$

Where $Reciprocity_{sdt}$ is the reciprocity agreement dummy, it equals 1 if the pair of states *(s, d)* are in a common regional reciprocity agreement in year t; otherwise it equals 0.[10] $resident\ tuition_{st}$ is the average in-state tuition in source state *s* in year *t*.

cannot control for annual state unemployment rate because the annual unemployment rate before 1976 is not available in the BLS

[9] The 2001 and 2003 data are missing, but my analysis currently ends in 2000.

[10] I only included the major four regional reciprocity agreements in the IV analysis, so *Log tuition gap* for those states with bilateral agreements are left as through there is no agreement.

$resident\ tuition_{dt}$ is the average in-state tuition in destination state *d* in year *t*. $nonresident\ tuition_{dt}$ is the average out-of-state tuition in destination state *d* in year *t*.[11]

Given the unavailability of certain variables in certain years, I define two samples. First, I define the shorter sample covering the period 1980-2000 for the IV analysis due to the tuition information being available only since 1980. Second, I define the longer sample covering 1960-2000, used in the reduced form analysis.

Table 1 shows the summary statistics for the shorter 1980-2000 sample used in the IV analysis. Column 1 shows there are 7650 potential source-destination pairs by year in my sample and among them, 17% (1365) pairs have zero college migration. Among the 6285 pairs of states by year with positive college student migration, 835 (12.3%) of them have a reciprocity agreement. Columns 2 and 3 show more details of how the number of college students migrating between pairs of states varies by whether the pair is in a common reciprocity agreement: the average *Log tuition gap* of pairs with a reciprocity agreement is 0.01 while the average *Log tuition gap* for pairs without any reciprocity agreement is 0.5, which is much higher than states with reciprocity agreements. The average number of students migrating between pairs with a reciprocity agreement is higher than pairs without any reciprocity agreement.

[11] Note: Having a reciprocity agreement between A and B does not in general imply a tuition gap of zero. The existence of the reciprocity agreement only allows resident from A to pay B's in-state tuition (rather than B's out-of-state tuition when absent of agreement) when studying in B. The tuition gap then reflects any difference in in-state tuition.

Table 2 Column 1 shows corresponding statistics for the longer sample covering 1960-2000, used in the reduced form regressions. There are 12750 potential pairs by year in this sample and among them, 28% (3566) pairs have zero college migration. Among 9184 pairs of states having positive college migration, 883 (9.6%) of them have a reciprocity agreement. Columns 2 and 3 show the average number of students migrating between pairwise states with any reciprocity agreement is 459, while the average number for those pairs of states without any reciprocity agreement is lower and only 346.

3 Methodology

My identification strategy consists of three parts: directed pair-wise state fixed effects (for each state pair i and j, a dummy for flows from state i to state j and another for flows from state j to state i), instrumental variables and reduced form regressions.

3.1 Fixed effects estimation

I begin by estimating a log-log fixed effect regression to estimate the effect of the tuition gap on college migration:

$$\log(M_{sdt}) = \theta_1 Log\ tuition\ gap_{sdt} + \theta_2 x_{st} + \theta_3 x_{dt} + \alpha_{sd} + \tau_t + \varepsilon_{sdt},$$

where *s* indicates source state, *d* indicates destination state, and *t* indicates census year. M_{sdt} is the number of college students moving from the source state *s* to the destination state *d* in census year *t*. x_{st} stands for control variables for source state. It includes log gross state product to control

source state economics condition, state and local government education expenditure to control source state government's revenue and government policy, and the state unemployment rate to control source state labor market condition. x_{dt} stands for the same covariates for destination state. α stands for directed pair fixed effects to control for time invariant directed pair specific variables, such as location, climate. τ stands for time fixed effects to control for time-varying but common across directed pair factors, such as national policy, national business cycle. ε is the error term. In addition, I also run a specification with source state-specific trends and destination state-specific trends to control for other state-level linear trends in college student migration and run another specification with directed pair-specific trends to control for other directed pair level linear trends in college student migration. These specifications with trends also serve as a robustness check for the underlying assumption of the fixed effects model that the counterfactual trends of college migration between directed pairs of states are identical. All the standard errors are clustered by pairs of states. The $Log\ tuition\ gap_{sdt}$ defined before is the difference in log tuition between the source state *s* and the destination state *d* in year *t*.

3.2 Instrumental variables estimation

If the college migration determinants mentioned above, along with the tuition gap, capture all determinants of migration, then the fixed effects estimator will be unbiased. However, omitted variables such as education quality, unobserved migration shocks, could cause bias. In addition to the issue of state education quality which I explained in the introduction above, bias could come from state governments' changing tuition in response to unobserved college migration shocks. For example, there is a possibility that some state policymakers want to have more college students

with the hope that these educated students would stay after college to increase the productivity of the local labor market. If an unobserved shock decreases the college student inflow to the state, the government might reduce nonresident tuition, and hence the tuition gap, to retain nonresidents. In this case, the effect of the tuition gap estimated from the fixed effects regressions will be biased up (less negative coefficient) because the tuition gap is positively correlated with the shock in the error term. Conversely, if an unobserved shock increases the college student inflow, a state government with limited education capacity and resources may response by raising nonresident tuition, increasing the tuition gap, to restrict the inflow of nonresident students. As before, the effect of the tuition gap estimated from the fixed effects regressions will be biased up (less negative coefficient) since tuition gap is positively correlated with the error term containing the shocks.

To address omitted variables bias, I apply an instrumental variable strategy, using a dummy for a pair of states' memberships in a common regional reciprocity agreement as an instrument. I argue that this instrumental variable satisfies the two requirements for a valid instrument. This instrument is highly correlated with the endogenous variable: the tuition gap. The policy of the tuition reciprocity agreement is to eliminate or shrink tuition gap between resident and nonresident tuition by reducing nonresident tuition. Thus, the tuition gap between destination state and source state would decrease if both states in the pair join the same regional reciprocity agreement.

More importantly, I argue that this instrument is unlikely to be correlated with these omitted college migration determinants mentioned above. The decision to join a regional reciprocity agreement is unlikely to be influenced by an education quality change within state, since joining the agreement will have no direct effect on quality (I assume that the net flows of students are

small enough that changes in faculty-student ratios or laboratory crowding are minimal). More plausible is a correlation between joining and unobserved shocks to migration. Consider a state which values out-of-state student but faces a decreasing college inflow. Joining the reciprocity agreement could appear attractive to the state because a lower nonresident tuition brought by the agreement might help the state boost college inflows. Therefore, the effect of my IV would be biased up. However, I argue that this is not very likely. Firstly, note that the participation of most states happened together when the agreement was launched. It seems unlikely that all these states were experiencing college migration shocks in the same direction. For example, 12 of the 14 states in the ACM joined the ACM agreement at once when it was established in 1979. All states in NERSP joined the agreement at once in 1958 when it was established. In addition, almost all the states, except for North Carolina, never leave the agreements (North Carolina joined the ACM in 2001 and left in 2011). For example, all members in NERSP have remained members since joining the agreements since 1958. However, the participation of members in the other agreements has more variation, with some of them joining early and some later. Given that joining behavior that may be endogenous to migration is more likely in these other agreements, I do a robustness check using a restricted sample on those agreements with 75% of members joined all at once when the agreement was established and have more than two states in them, and on states that never joined an agreement. In addition, I also directly check the college student migration trend for each state before the pair of states joined the reciprocity agreement.

I interpret my instrumental variables results through the lens of heterogeneity. Since there is no state that would increase its nonresident tuition when joining the reciprocity agreement, my IV satisfies the monotonicity requirement. Therefore, the effect identified by my IV is a LATE (the

local average treatment effect) among "compliers". Compliers in my study refer to those pairs of states who would not have lowered tuition gap without signing the reciprocity agreements but lower the tuition gap due to the reciprocity agreement.

3.3 Reduced form models

I use fixed effects regressions to evaluate the reduced form impact of regional reciprocity agreement on migration. The main regression equation is:

$$\log(M_{sdt}) = \beta_0 + \beta_1 Reciprocity_{sdt} + \beta_2 x_{st} + \beta_3 x_{dt} + \alpha_{sd} + \tau_t + \varepsilon_{sdt}$$

The new covariate compared to the previous regression is $Reciprocity_{sdt}$, which is the reciprocity agreement dummy, equal to 1 if the state pair *(s, d)* has any reciprocity agreement in year *t*; otherwise it equals 0. The coefficient β_1 on $Reciprocity_{sdt}$ is the effect of interest. All the standard errors are clustered by pairs, i.e. the number of groups is equal to the number of pair and a pair *(s, d)* is viewed as a different group from a pair *(d, s)*. The coefficient resulting from this reduced form regression identifies the overall effect from the regional reciprocity agreement. I argue that this reduced form complements the IV results. The LATE identified by IV is of more scientific interest, while the effect from the reduced form of the policy is more straightforward and useful for policy.

4 Results

Table 3 presents the fixed effects regression results and the IV regression results. Four specifications with increasingly detailed controls for the fixed effects results are presented across Columns 1 to 4, with the corresponding specifications for the IV results in Columns 5 to 8. All the regressions include the *Log tuition gap* variable, which is the main variable of interest. The base specification (Column 1 and Column 5) also controls for the directed pair fixed effects, and year fixed effects. In Columns 2 and Column 6, I also control for both source and destination state log gross state product, log state and local education expenditure and state unemployment rate. In Columns 3 and Column 7, I also include source state-specific trends and destination state-specific trends. In Columns 4 and Column 8, instead of source and destination state-specific trends, I add specific trends for each directed pair of states.

4.1 Fixed effects results

Columns 1 to 4 in Table 3 show the key coefficient from the fixed effects analysis – the full coefficients are shown in Table A1. The coefficient on *Log tuition gap* is small and statistically significant in all specifications. The Column 1 coefficient of 0.04 implies that a one percent increase in the nonresidents' tuition in the destination state of a directed pair of states would increase its nonresident undergraduate inflow by a negligible 0.04%. Adding more controls in Column 2 to 4 does not change the magnitude of the coefficient a lot.

4.2 IV results

To fix potential endogeneity problems of tuition, Table 3 Columns 5 to 8 present the IV results with the second stage results in the upper rows and the first stage results below. The coefficient on the reciprocity variable in the first stage in Column 5 in Table 3 is -0.36 and it is statistically

significantly at 1% level (the full results from the first stage are shown in Table A2). This coefficient shows that having a reciprocity agreement between a directed pair of states reduces nonresident tuition in destination state by 36%. Adding source state-specific trends and destination state-specific trends in Column 7 reduces the coefficient somewhat to -0.26. Adding directed pair-specific trends in Column 8 further reduces the coefficient to -0.17. Given what we know about how much the reciprocity agreements reduce the average tuition gap on paper – 50% - it seems unlikely that their effect is this small. Further, there are only three periods in this IV analysis, and while this is sufficient in theory to estimate a model with trends specific to the unit being followed as a panel (here, direct state pairs), Angrist and Pischke (2008) point out that "three periods is typically inadequate to pin down both the trends and the treatment effect in practice". In addition, given most reciprocity agreements were formed (treatment) before 1990, I have only one pre-treatment period. Pischke (2005) points out that when the effects of the treatment take place dynamically and limited pre-treatment periods are available, panel unit-specific trends would mainly rely on post-treatment periods and absorb the actual treatment effects. Thus, adding specific trends in this case could be problematic. Instead, this result suggests that including directed pair-specific trends constitutes over-controlling and is eliminating the genuine variation introduced by the agreements. Therefore, this specification will not be my preferred one.

The coefficient on *Log tuition gap* in the second stage in Column 5 is -0.49 and it is statistically significant at 1% level (the full results from the second stage are shown in Table A3). This coefficient shows that a one percent decrease in the nonresident tuition for the destination state in a directed pair of states would increase college inflow into that state by 0.49%, consistent with the prediction of theory. Adding the source and destination state characteristics in Column 6 does not

change the sign but reduces the absolute value of the coefficient a little from 0.49 to 0.40. The coefficient is still statistically significant at 1% level. Given the standard error is 0.13, coefficient is probably not statistically significantly different from the coefficient in the previous column. Adding source and destination state-specific trends in Columns 7 reduces the absolute value of the coefficient to 0.36 and reduces its statistically significant level to 10%. Again, given the standard error, it shows that the coefficient does not change much. This effect is relatively large in the literature, compared with the effect of a 0.27% increase in enrollment in Kane (2007), where he checks the effect of the DC Tuition Assistant grant program.

In contrast to the stability of the coefficient in Columns 5-7, the coefficient changes greatly, from -0.36 to 0.80, when I add directed pair-specific trends in Column 8 .This seems to suggest that the increase in college migration that seemed to be due to the reduction in the tuition gap is actually due to the directed pair-specific trends. However, I do not prefer this specification, as noted above.

Table A4 shows the results of the robustness check of using a sample restricted to members of those agreements where 75% of members joined all at once and have more than two states in them, and to states that never joined an agreement. These results are suggestively similar to the main analysis using the full sample. In addition, the results of pre-trends checking for each state are shown in Figures 1-5. I see no clear evidence of migration trending either up or down before joining. While this does not completely rule out the possibility that states were reacting to desires to change migration or forecasts of future migration changes, it does make us more confident that they were not reacting to concurrent trends in college migration.

4.3 Reduced form results

Table 4 presents the main reduced form results – the full coefficients are reported in Table A5. The first four specifications of Table 4 correspond to those in the IV analysis. Column 1 in Table 4 shows that the coefficient on the reciprocity agreement dummy is 0.20 and it is statistically significant at 1% level. This suggests that the reciprocity agreement between a directed pair of states would increase the undergraduate flow from its source state to its destination state by 20%. Adding source and destination state covariates in Column 2 does not change the coefficient. Adding source and destination state-specific trends in Column 3 increases the coefficient from 0.20 to 0.25 and it is statistically significant. Therefore, the effect so far is quite robust across the different specifications. Adding directed pair-specific trends in Column 4 does not change the coefficient's sign but reduces the coefficient to a small and statistically insignificant 0.07. This suggests that there is almost no effect of the reciprocity agreement on college migration. For reasons stated previously, I do not prefer this specification.

In order to make these reduced form results (based on 1960-2000) consistent with the IV results (based on 1980-2000), in Column 5 in Table 4 I restrict the sample to 1980-2000 and return to the Column 3 specification. This cuts the coefficient in half and leaves it statistically significant only at the 10% level. This suggests that, had I been able to estimate the IV results for the longer period, the estimated effects might have been larger. The difference between Columns 3 and 5 in Table 4 lies more in the coefficient than the standard error, suggesting that the difference may be caused by heterogeneity in the effects of reciprocity agreements struck before and after 1980.

There are other bilateral reciprocity agreements negotiated by neighbor states or schools themselves. I also do another robustness check by adding a dummy representing these reciprocities. Table 5 shows that while the coefficient on the regional agreement dummy is unchanged, the coefficient on the bilateral agreement is much larger (the full coefficients are reported in Table A6). This suggests that although fixed effects remove the direct effect of distance, the effect of reciprocity agreements weakens with distance.

5 Conclusion

In this paper, I study how interstate college migration responds to the inter-state tuition gaps in the United States. By instrumenting the tuition gap between the destination state's nonresident tuition and source state's resident tuition in a pair of states with a dummy for the pair of states' membership in a common regional reciprocity agreement, I provide evidence that a reduced tuition gap would increase college migration from the source state to the destination state. I find that a one percent decrease in nonresident tuition of destination state due to the regional reciprocity agreements would on increase nonresident students' inflow to the destination state by 0.4-0.5%. This effect is a LATE effect among the "complier" states who change tuition due to the agreement. The reduced form analysis shows that having a regional reciprocity agreement between states would increase college migration between states by 25%.

My study has several policy implications. Firstly, the results of my study can help policymakers have a better understanding and evaluation of regional reciprocity agreements and confirm their function in providing students with more options and increasing institutions' diversity. However, more evidence on the performance of the additional out-of-state students and their post-graduation

geographic mobility, as well as data on the cost of educating a marginal student, is needed to complete the picture. Secondly, young and highly educated people are the most mobile demographic group in the United States, and among reasons of migration, going to another state for college ranks the first. (Raven, Smith, and Wozniak, 2011) This mobility could be even larger with a lower tuition gap according to my study. Thus, reducing the tuition gap could become one of the available options to arrest the long-term decline in interstate migration since 1980.

6 Reference

Abraham, K. G., and Clark, M. A. (2006). Financial aid and students' college decisions evidence from the District of Columbia Tuition Assistance Grant Program. *Journal of Human Resources*, 41(3), 578-610.

Angrist, J. D., and Pischke, J. S. (2008). Mostly harmless econometrics: An empiricist's companion. Princeton University Press.

Card, D., and Lemieux, T. (2000). Dropout and enrollment trends in the post-war period: What went wrong in the 1970s? National Bureau of Economic Research Working Paper 7658.

Castleman, B. L., and Long, B. T. (2016). Looking beyond enrollment: The causal effect of need-based grants on college access, persistence, and graduation. *Journal of Labor Economics*, 34(4), 1023-1073.

Cohodes, S. R., and Goodman, J. S. (2014). Merit aid, college quality, and college completion: Massachusetts' Adams scholarship as an in-kind subsidy. *American Economic Journal: Applied Economics*, 6(4), 251-85.

Cornwell, C., Mustard, D. B., and Sridhar, D. J. (2006). The enrollment effects of merit-based financial aid: Evidence from Georgia's HOPE program. *Journal of Labor Economics*, 24(4), 761-786.

DesJardins, S. L. (1999). Simulating the enrollment effects of changes in the tuition reciprocity agreement between Minnesota and Wisconsin. *Research in Higher Education*, *40*(6), 705-716.

Dwenger, N., Storck, J., and Wrohlich, K. (2012). Do tuition fees affect the mobility of university applicants? Evidence from a natural experiment. *Economics of Education Review*, *31*(1), 155-167.

Dynarski, S. (2000). Hope for whom? Financial aid for the middle class and its impact on college attendance. National Bureau of Economic Research Working Paper 7756.

Dynarski, S. (2004). The new merit aids. In College choices: The economics of where to go, when to go, and how to pay for it (pp. 63-100). University of Chicago Press.

Greenwood, M. J. (1997). Internal migration in developed countries. *Handbook of Population and Family Economics*, 1, 647-720.

Groen, J. A. (2004). The effect of college location on migration of college-educated labor. *Journal of Econometrics*, 121(1-2), 125-142.

Herzog, S., and Stanley, J. C. (2017). 11 Researching the Different Effects of Tuition Policies that Impact Enrollment. *Institutional Research Initiatives in Higher Education*, 187.

High School Longitudinal Study of 2009 (HSLS:09), a nationally representative sample survey. To learn more, visit **http://nces.ed.gov/surveys/hsls09/**. For questions about content or to view this report online, go to https://nces.ed.gov/pubsearch/ pubsinfo.asp?pubid=2019119.

Hoxby, C. M. (2009). The changing selectivity of American colleges. *Journal of Economic Perspectives*, *23*(4), 95-118.

Hunt, J. (2006). Staunching emigration from East Germany: Age and the determinants of migration. *Journal of the European Economic Association*, 4(5), 1014-1037.

Kane, T. J., and Rouse, C. E. (1995). Labor-market returns to two-and four-year college. The *American Economic Review*, 85(3), 600-614.

Kane, T. J., and Rouse, C. E. (1999). The community college: Educating students at the margin between college and work. *Journal of Economic Perspectives*, 13(1), 63-84.

Kane, T. J. (2007). Evaluating the impact of the DC tuition assistance grant program. *Journal of Human Resources*, 42(3), 555-582.

Knight, B., and Schiff, N. (2019). The Out-of-State Tuition Distortion. *American Economic Journal: Economic Policy*, 11(1), 317-50.

LaFave, A., Kelly, E., and Ford, J. (2018). Factors That Influence Student College Choice. Data Point. NCES 2019-119. *National Center for Education Statistics*.

Leslie, L. L., and Brinkman, P. T. (1988). *The Economic Value of Higher Education.* American Council on Education/Macmillan Series on Higher Education. Macmillan Publishing, 866 Third Avenue, New York, NY 10022.

Malamud, O., and Wozniak, A. (2012). The impact of college on migration evidence from the Vietnam generation. *Journal of Human Resources*, 47(4), 913-950.

Marsicano, Christopher Russell. (2015). "Regional state tuition exchanges and out-of-state enrollment at public universities and community colleges." https://www.researchgate.net/profile/Christopher_Marsicano/publication/272181353_Regional_state_tuition_exchanges_and_out-of-state_enrollment_at_public_universities_and_community_colleges/links/54de85a70cf29666378c0aa/Regional-state-tuition-exchanges-and-out-of-state-enrollment-at-public-universitiesandcommunity-colleges.pdf.

Molloy, R., Smith, C. L., and Wozniak, A. (2011). Internal migration in the United States. *Journal of Economic perspectives*, *25*(3), 173-96.

Pischke, J. S. (2005). *Empirical Methods in Applied Economics: Lecture Notes*. *Downloaded July*, *24*, 2015.

Rizzo, M., and Ehrenberg, R. G. (2004). Resident and nonresident tuition and enrollment at flagship state universities. In *College choices: The economics of where to go, when to go, and how to pay for it* (pp. 303-354). University of Chicago Press.

Rouse, C. E. (1994). What to do after high school: The two-year versus four-year college enrollment decision. Choices and consequences: *Contemporary Policy Issues in Education*, 59-88.

Saks, R. E., and Wozniak, A. (2011). Labor reallocation over the business cycle: New evidence from internal migration. *Journal of Labor Economics*, 29(4), 697-739.

Sjoquist, D. L., and Winters, J. V. (2015). State merit aid programs and college major: A focus on STEM. *Journal of Labor Economics*, 33(4), 973-1006.

Snyder, T. D., de Brey, C., and Dillow, S. A. (2019). Digest of Education Statistics 2017, NCES 2018-070. *National Center for Education Statistics*.

Stevenson, B., and Wolfers, J. (2003). Bargaining in the shadow of the law: Divorce laws and family distress. National Bureau of Economic Research Working Paper 10175.

Stewart, G., Wright, D. B., and Kennedy, A. (2008). Tuition Reciprocity in the United States. *College and University*, *84*(2), 65.

Wozniak, A. (2010). Are college graduates more responsive to distant labor market opportunities? *Journal of Human Resources*, 45(4), 944-970.

Zhang, L., and Ness, E. C. (2010). Does state merit-based aid stem brain drain? *Educational Evaluation and Policy Analysis*, 32(2), 143-165.

7 Tables

Table 1: Means: sample for the IV analysis (1980-2000)

	All	Reciprocity=1	Reciprocity=0
Panel A: Census& IPEDS 1980-2000			
Log tuition gap*	0.44	0.01	0.50
	(0.63)	(0.44)	(0.63)
College migration from source to destination	404	473	393
	(729)	(690)	(734)
State and local education expenditure (source)	1771	1419	1825
	(2281)	(2367)	(2262)
State and local education expenditure (destination)	1778	1425	1832
	(2280)	(2367)	(2262)
Unemployment rate (source)	5.36	5.10	5.40
	(1.73)	(1.57)	(1.75)
Unemployment rate (destination)	5.36	5.13	5.39
	(1.72)	(1.57)	(1.74)
Gross state product (source)	136919	99255	142690
	(186295)	(179449)	(186668)
Gross state product (destination)	136863	99565	142577
	(186182)	(179380)	(186560)
Observations	6285	835	5450

Notes: Unweighted means, standard deviations in parentheses. The sample is college students aged under 30 who study in public school from Census year 1980-2000. Gross state product and state and local government expenditure is in millions of current dollars. The years before 1997 is based on the Standard Industrial Classification (SIC) and years after 1997 is based on the North American Industry Classification System (NAICS).

$$*Log\ tuition\ gap_{sdt} = \begin{cases} log(resident\ tuition_{dt}) - log(resident\ tuition_{st}), & Reciprocity_{sdt} = 1 \\ log(nonresident\ tuition_{dt}) - log(resident\ tuition_{st}), & Reciprocity_{sdt} = 0 \end{cases}$$

Unemployment rate is collected from Bureau of labor statistics (BLS)

Source: Census 1980-2000& IPEDS 1980, 1984-2017& BLS 1976-2017& BEA 1962-2017.

Table 2: Means: sample for the reduced form analysis (1960-2000)

	All	Reciprocity=1	Reciprocity=0
Panel B: Census 1960-2000			
College migration from source to destination	358	460	347
	(654)	(677)	(650)
State and local education expenditure (source)	1271	1345	1263
	(2030)	(2323)	(1997)
State and local education expenditure (destination)	1277	1350	1269
	(2030)	(2322)	(1997)
Unemployment rate (source)	0.06	0.06	0.05
	(0.01)	(0.01)	(0.01)
Unemployment rate (destination)	0.06	0.06	0.06
	(0.01)	(0.01)	(0.01)
Gross state product (source)	99589	94307	100151
	(164106)	(175727)	(162822)
Gross state product (destination)	99336	94575	99843
	(164094)	(175680)	(162816)
Observations	9184	883	8301

Notes: Unweighted means, standard deviations in parentheses. The sample is college students aged under 30 who study in public school from Census year 1960 to 2000. Gross state product and state and local government expenditure is in millions of current dollars. The gross state product of the years before 1997 is based on the Standard Industrial Classification (SIC) and years after 1997 is based on the North American Industry Classification System (NAICS). 1960 gross state product is missing in the initial data and is predicted using Census data from 1960-2000.

**Unemployment rate is calculated using Census 1960-2000.*

Source: Census 1960-2000& IPEDS 1980, 1984-2017& BLS 1976-2017& BEA 1962-2017.

Table 3: Effects of tuition gaps on college interstate migration (1980-2000)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS regressions				IV regressions			
Log tuition gap*	0.04	0.04	-0.02	0.02	-0.49***	-0.40***	-0.36*	0.80
	(0.03)	(0.03)	(0.05)	(0.08)	(0.13)	(0.12)	(0.19)	(0.67)
R-squared (within)	0.03	0.05	0.13	0.62	0.03	0.04	0.12	0.58
Log gross state product (source&destination)	-	YES	YES	YES	-	YES	YES	YES
Log state&local education expenditure (source&destination)	-	YES	YES	YES	-	YES	YES	YES
Unemployment rate (source&destination)	-	YES	YES	YES	-	YES	YES	YES
Source& destination state-specific trends?	-	-	YES	-	-	-	YES	-
Pair-specific trends?	-	-	-	YES	-	-	-	YES
P value: F-statistic of trends	-	-	0.00	0.00	-	-	0.00	0.00
Coefficient on reciprocity 1st stage	-	-	-	-	-0.36***	-0.39***	-0.26***	-0.17***
	-	-	-	-	(0.03)	(0.03)	(0.01)	(0.04)
Observations 1st stage	-	-	-	-	6285	6285	6285	6285
F-statistic 1st stage	-	-	-	-	166	248	429	18
R-squared 1st stage (within)	-	-	-	-	0.66	0.70	0.89	0.92

*Notes: The dependent variable is the log number of college students migrating between pairwise states. 6285 observations. The sample is college students aged under 30 who study in public school from Census 1980-2000. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The instrument in columns 5-8 is reciprocity, a dummy for a pair of states' memberships in a common regional reciprocity agreement. And the first stage uses census years. *** p<0.01, ** p<0.05, * p<0.1*

$$*Log\ tuition\ gap_{sdt} = \begin{cases} log(resident\ tuition_{dt}) - log(resident\ tuition_{st}), & Reciprocity_{sdt} = 1 \\ log(nonresident\ tuition_{dt}) - log(resident\ tuition_{st}), & Reciprocity_{sdt} = 0 \end{cases}$$

Source: Census 1980-2000& IPEDS 1980, 1984-2017& BLS 1976-2017& BEA 1962-2017.

Table 4: Effect of reciprocity agreements on college interstate migration

	(1)	(2)	(3)	(4)	(5)
		1960-2000			1980-2000
Reciprocity	0.20***	0.20***	0.25***	0.07	0.10*
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Observations	9184	9184	9184	9184	6285
R-squared (within)	0.39	0.42	0.47	0.68	0.13
Log gross state product (source&destination)	-	YES	YES	YES	YES
Log state&local education expenditure (source&destination)	-	YES	YES	YES	YES
Unemployment rate (source&destination)	-	YES	YES	YES	YES
Source& destination state-specific trends?	-	-	YES	-	YES
Pair-specific trends?	-	-	-	YES	-
P value: F-statistic of trends	-	-	0.00	0.00	0.00

*Notes: The dependent variable is the log number of college students migrating between pairwise states. 9184 observations. The sample is college students aged under 30 who study in public school from Census year 1960-2000. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The coefficients of controls are in the appendix. *** p<0.01, ** p<0.05, * p<0.1*

Source: Census 1960-2000& BLS 1976-2017& BEA 1962-2017.

Table 5: Effect of reciprocity agreements on college interstate migration-Including bilateral reciprocity agreements

	(1)	(2)	(3)	(4)	(5)
		1960-2000			1980-2000
Reciprocity	0.20***	0.19***	0.25***	0.06	0.09*
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Other Reciprocity	0.80***	0.95***	1.04***	0.72***	0.52***
	(0.22)	(0.25)	(0.23)	(0.22)	(0.13)
Observations	9,184	9,184	9,184	9,184	6,285
R-squared (within)	0.40	0.42	0.47	0.68	0.13
Log gross state product (source&destination)	-	YES	YES	YES	YES
Log state&local education expenditure (source&destination)	-	YES	YES	YES	YES
Unemployment rate (source&destination)	-	YES	YES	YES	YES
Source& destination state-specific trends?	-	-	YES	-	YES
Pair-specific trends?	-	-	-	YES	-
P value: F-statistic of trends	-	-	0.00	0.00	0.00

*Notes: The dependent variable is the log number of college students migrating between pairwise states. Besides the four major regional reciprocity agreements, these regressions also include bilateral reciprocity agreements. 9184 observations. The sample is college students aged under 30 who study in public school from Census year 1960-2000. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The coefficients of controls are in the appendix. *** p<0.01, ** p<0.05, * p<0.1*

Source: Census 1960-2000& BLS 1976-2017& BEA 1962-2017.

Table A1: Effects of tuition gaps on college interstate migration-Fixed effects with detailed coefficients

	(1)	(2)	(3)	(4)
Log tuition gap	0.04	0.04	-0.02	0.02
	(0.03)	(0.03)	(0.05)	(0.08)
Log GSP (destination)		0.40***	0.68***	0.88***
		(0.09)	(0.19)	(0.26)
Log GSP*dummy1997 (destination)		-0.05***	-0.08***	-0.08**
		(0.02)	(0.03)	(0.04)
Log GSP (source)		0.02	-0.72***	-0.94***
		(0.08)	(0.21)	(0.28)
Log GSP*dummy1997 (source)		-0.01	-0.02	-0.02
		(0.02)	(0.03)	(0.04)
Log state&local education expenditure (destination)		0.16	0.33	0.18
		(0.12)	(0.20)	(0.26)
Log state&local education expenditure (source)		0.13	-0.45**	-0.45*
		(0.09)	(0.20)	(0.26)
Unemployment rate (destination)		-0.00	0.00	0.01
		(0.01)	(0.02)	(0.02)
Unemployment rate (source)		0.06***	0.04**	0.03
		(0.01)	(0.02)	(0.02)
R-squared (within)	0.03	0.05	0.13	0.62
Source& destination state-specific trends?	-	-	YES	-
Pair-specific trends?	-	-	-	YES
P value: F-statistic of trends	-	-	0.00	0.00

*Notes: The dependent variable is the log number of college students migrating between pairwise states. The sample is college students aged under 30 who study in public school from census year 1980-2000. 6285 observations. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. *** p<0.01, ** p<0.05, * p<0.1*

Source: Census 1980-2000& IPEDS 1980, 1984-2017& BLS 1976-2017& BEA 1962-2017.

Table A2: Effects of tuition gaps on college interstate migration-First stage with detailed coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	First stage using census years				First stage using annual data			
Coefficient on reciprocity 1st stage	-0.36***	-0.39***	-0.26***	-0.17***	-0.32***	-0.31***	-0.25***	-0.31***
	(0.03)	(0.03)	(0.01)	(0.04)	(0.01)	(0.01)	(0.01)	(0.02)
Log GSP (destination)		0.21***	0.38***	0.40***		-0.04**	0.23***	0.22***
		(0.04)	(0.07)	(0.09)		(0.02)	(0.03)	(0.03)
Log GSP*dummy1997 (destination)		0.00	0.01	0.01		0.01***	0.00	0.00
		(0.01)	(0.01)	(0.02)		(0.00)	(0.00)	(0.00)
Log GSP (source)		-0.70***	-0.39***	-0.37***		-0.37***	-0.53***	-0.53***
		(0.05)	(0.08)	(0.10)		(0.02)	(0.03)	(0.03)
Log GSP*dummy1997 (source)		-0.07***	0.11***	0.11***		-0.05***	0.02***	0.02***
		(0.01)	(0.01)	(0.02)		(0.00)	(0.00)	(0.00)
Log state&local education expenditure (destination)		-0.23***	0.40***	0.41***		-0.01	-0.14***	-0.15***
		(0.04)	(0.07)	(0.10)		(0.02)	(0.02)	(0.02)
Log state&local education expenditure (source)		0.67***	-0.32***	-0.28**		0.22***	0.26***	0.26***
		(0.06)	(0.09)	(0.12)		(0.02)	(0.02)	(0.02)
Unemployment rate (destination)		0.00	0.01*	0.01		0.01***	0.01***	0.01***
		(0.01)	(0.01)	(0.01)		(0.00)	(0.00)	(0.00)
Unemployment rate (source)		-0.03***	0.03***	0.02***		-0.02***	-0.02***	-0.02***
		(0.01)	(0.01)	(0.01)		(0.00)	(0.00)	(0.00)
Observations 1st stage	6285	6285	6285	6285	81,500	81,500	81,500	81,500
R-squared (within)	0.66	0.70	0.89	0.92	0.59	0.62	0.70	0.71
Source& destination state-specific trends?	-	-	YES	-	-	-	YES	-
Pair-specific trends?	-	-	-	YES	-	-	-	YES
F-statistic 1st stage	166	248	429	18	572	667	672	326

*Notes: The dependent variable is the Tuition Gap. The sample is college students aged under 30 who study in public school from census year 1980-2000. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The instrument is a dummy for a pair of states' memberships in a common regional reciprocity agreement. *** p<0.01, ** p<0.05, * p<0.1*

Source: Census 1980-2000& IPEDS 1980, 1984-2017& BLS 1976-2017& BEA 1962-2017.

Table A3: Effects of tuition gaps on college interstate migration-Second stage with detailed coefficients

	(1)	(2)	(3)	(4)
Log tuition gap	-0.49***	-0.40***	-0.36*	0.80
	(0.13)	(0.12)	(0.19)	(0.67)
Log GSP (destination)		0.49***	0.80***	0.57
		(0.09)	(0.21)	(0.37)
Log GSP*dummy1997 (destination)		-0.05***	-0.08***	-0.08**
		(0.02)	(0.03)	(0.04)
Log GSP (source)		-0.28**	-0.85***	-0.64
		(0.12)	(0.23)	(0.40)
Log GSP*dummy1997 (source)		-0.03*	0.01	-0.11
		(0.02)	(0.03)	(0.08)
Log state&local education expenditure (destination)		0.06	0.49**	-0.17
		(0.12)	(0.22)	(0.41)
Log state&local education expenditure (source)		0.43***	-0.54***	-0.25
		(0.12)	(0.21)	(0.31)
Unemployment rate (destination)		-0.00	0.01	-0.00
		(0.01)	(0.02)	(0.02)
Unemployment rate (source)		0.04***	0.05***	0.01
		(0.01)	(0.02)	(0.03)
R-squared (within)	0.03	0.04	0.12	0.58
Source& destination state-specific trends?	-	-	YES	-
Pair-specific trends?	-	-	-	YES
P value: F-statistic of trends	-	-	0.00	0.00
Coefficient on reciprocity 1st stage	-0.36***	-0.39***	-0.26***	-0.17***
	(0.03)	(0.03)	(0.01)	(0.04)
Observations 1st stage	6285	6285	6285	6285
F-statistic 1st stage	166	248	429	18
R-squared 1st stage (within)	0.66	0.70	0.89	0.92

*Notes: The dependent variable is the log number of college students migrating between pairwise states. The sample is college students aged under 30 who study in public school from census year 1980-2000. 6285 observations. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The instrument is a dummy for a pair of states' memberships in a common regional reciprocity agreement. *** p<0.01, ** p<0.05, * p<0.1*

Source: Census 1980-2000& IPEDS 1980, 1984-2017& BLS 1976-2017& BEA 1962-2017.

Table A4: Effects of tuition gaps on college interstate migration-Restricted sample

	(1)	(2)	(3)	(4)
Log tuition gap*	-0.40***	-0.33***	-0.22	0.91
	(0.12)	(0.11)	(0.26)	(0.84)
R-squared (within)	0.01	0.01	0.13	0.57
Log gross state product (source&destination)	-	YES	YES	YES
Log state&local education expenditure (source&destination)	-	YES	YES	YES
Unemployment rate (source&destination)	-	YES	YES	YES
Source& destination state-specific trends?	-	-	YES	-
Pair-specific trends?	-	-	-	YES
P value: F-statistic of trends	-	-	0.00	0.00
Coefficient on reciprocity 1st stage	-0.39***	-0.42***	-0.23***	-0.14***
	(0.03)	(0.03)	(0.02)	(0.05)
Observations 1st stage	4084	4084	4084	4084
F-statistic 1st stage	158	240	224	11
R-squared 1st stage (within)	0.62	0.67	0.88	0.92

*Notes: The dependent variable is the log number of college students migrating between pairwise states. 4084 observations. The sample is college students aged under 30 who study in public school from Census 1980-2000. This sample is restricted to those agreements where 75% of members joined all at once and have more than two states in them. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The instrument in columns 5-8 is reciprocity, a dummy for pairwise states having a reciprocity agreement with each other since agreement starting years. And the first stage uses census years. *** p<0.01, ** p<0.05, * p<0.1*
Source: Census 1980-2000& IPEDS 1980, 1984-2017& BLS 1976-2017& BEA 1962-2017.

Table A5: Effect of reciprocity agreements on college interstate migration-Reduced form with detailed coefficients

	(1)	(2)	(3)	(4)	(5)
		1960-2000			1980-2000
Reciprocity	0.20***	0.20***	0.25***	0.07	0.10*
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Log GSP (destination)		0.32***	0.25***	0.36***	0.63***
		(0.05)	(0.09)	(0.11)	(0.21)
Log GSP*dummy1997 (destination)		0.02	-0.11***	-0.12***	-0.09***
		(0.02)	(0.02)	(0.02)	(0.03)
Log GSP (source)		0.31***	-0.32***	-0.41***	-0.56**
		(0.05)	(0.08)	(0.11)	(0.22)
Log GSP*dummy1997 (source)		0.05***	-0.07***	-0.06***	-0.03
		(0.02)	(0.02)	(0.02)	(0.03)
Log state&local education expenditure (destination)		0.29***	0.11*	0.10	0.35*
		(0.05)	(0.06)	(0.07)	(0.21)
Log state&local education expenditure (source)		0.04	0.11**	0.11**	-0.47**
		(0.04)	(0.05)	(0.06)	(0.20)
Unemployment rate (destination)		0.82	-0.17	0.30	-0.51
		(1.00)	(1.08)	(1.26)	(1.82)
Unemployment rate (source)		2.93***	3.50***	2.91**	6.04***
		(0.95)	(1.09)	(1.29)	(1.81)
Observations	9184	9184	9184	9184	6285
R-squared (within)	0.39	0.42	0.47	0.68	0.13
Source& destination state-specific trends?	-	-	YES	-	YES
Pair-specific trends?	-	-	-	YES	-
P value: F-statistic of trends	-	-	0.00	0.00	0.00

*Notes: The dependent variable is the log number of college students migrating between pairwise states. 9184 observations. The sample is college students aged under 30 who study in public school from census year 1960-2000. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The 1960 gross state product is predicted using census years from 1970 to 2000. The coefficients of controls are in the appendix. *** p<0.01, ** p<0.05, * p<0.1*

Source: Census 1960-2000& BLS 1976-2017& BEA 1962-2017.

Table A6: Effect of reciprocity agreements on college interstate migration with detailed coefficients-Including bilateral reciprocity agreements

	(1)	(2)	(3)	(4)	(5)
		1960-2000			1980-2000
Reciprocity	0.20***	0.19***	0.25***	0.06	0.09*
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
Other Reciprocity	0.80***	0.95***	1.04***	0.72***	0.52***
	(0.22)	(0.25)	(0.23)	(0.22)	(0.13)
Log GSP (destination)		0.32***	0.25***	0.37***	0.64***
		(0.05)	(0.09)	(0.11)	(0.21)
Log GSP*dummy1997 (destination)		0.02	-0.12***	-0.12***	-0.09***
		(0.02)	(0.02)	(0.02)	(0.03)
Log GSP (source)		0.31***	-0.32***	-0.41***	-0.55**
		(0.05)	(0.08)	(0.11)	(0.22)
Log GSP*dummy1997 (source)		0.05***	-0.07***	-0.06***	-0.03
		(0.02)	(0.02)	(0.02)	(0.03)
Log state&local education expenditure (destination)		0.30***	0.11*	0.10	0.35*
		(0.05)	(0.06)	(0.07)	(0.21)
Log state&local education expenditure (source)		0.05	0.11**	0.12**	-0.47**
		(0.04)	(0.05)	(0.05)	(0.20)
Unemployment rate (destination)		0.94	-0.13	0.32	-0.52
		(1.00)	(1.08)	(1.26)	(1.82)
Unemployment rate (source)		3.06***	3.54***	2.93**	6.04***
		(0.94)	(1.09)	(1.29)	(1.81)
Observations	9,184	9,184	9,184	9,184	6,285
R-squared (within)	0.40	0.42	0.47	0.68	0.13
Source& destination state-specific trends?	-	-	YES	-	YES
Pair-specific trends?	-	-	-	YES	-
P value: F-statistic of trends	-	-	0.00	0.00	0.00

*Notes: The dependent variable is the log number of college students migrating between pairwise states. 9184 observations. The sample is college students aged under 30 who study in public school from census year 1960-2000. Besides the four major regional reciprocity agreements, these regressions also include bilateral reciprocity agreements. Standard errors clustered by state pair in parentheses. All regressions include year and state pair dummies. The 1960 gross state product is predicted using census years from 1970 to 2000. The coefficients of controls are in the appendix. *** p<0.01, ** p<0.05, * p<0.1*

Source: Census 1960-2000& BLS 1976-2017& BEA 1962-2017.

Figure 1: State migration trends

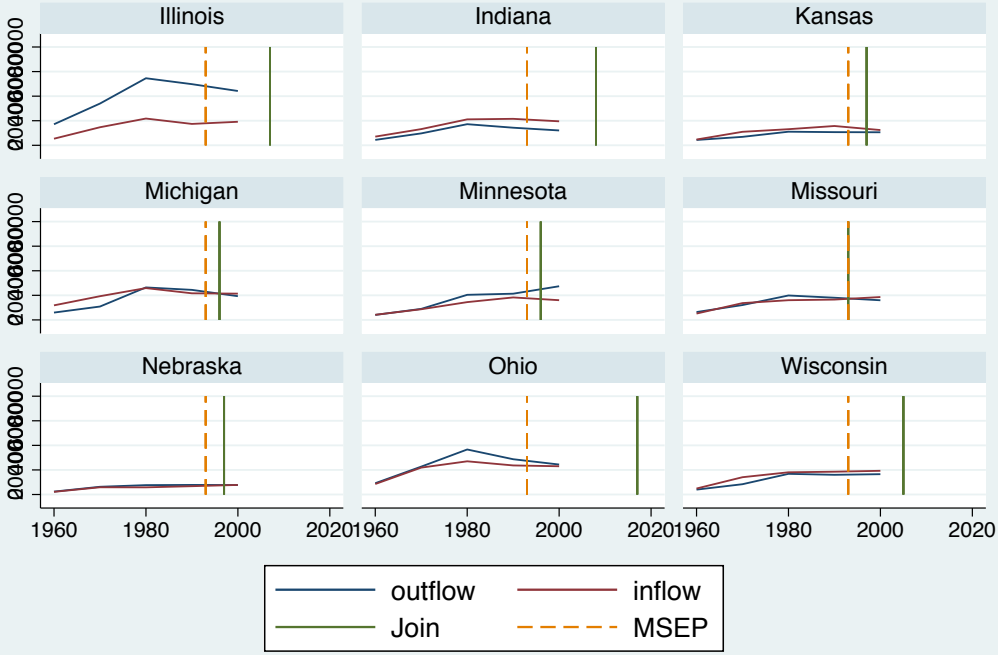

Figure 2: State migration trends

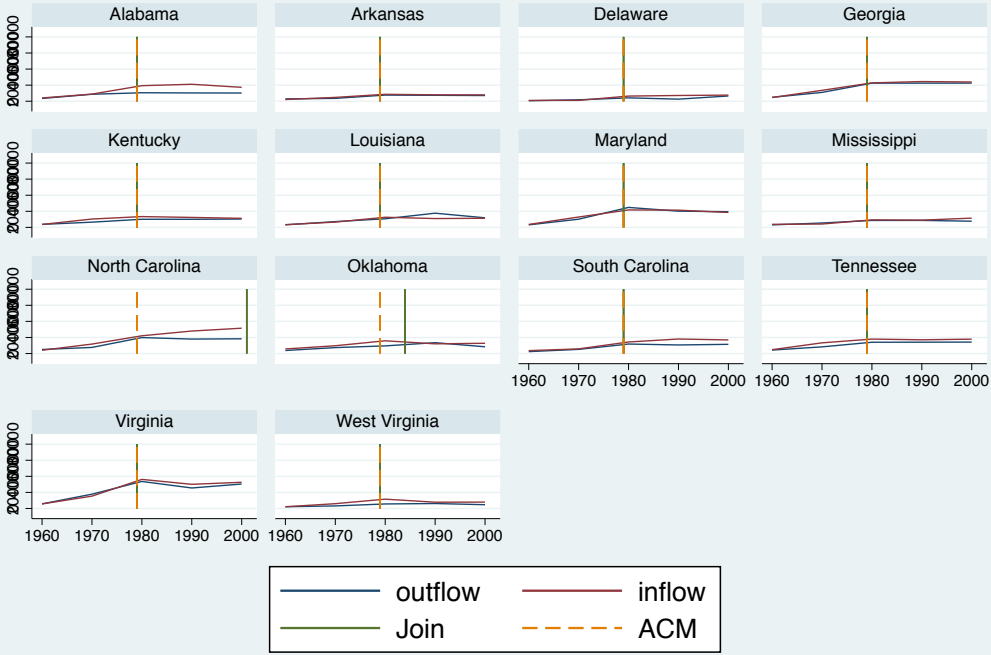

Figure 3: State migration trends

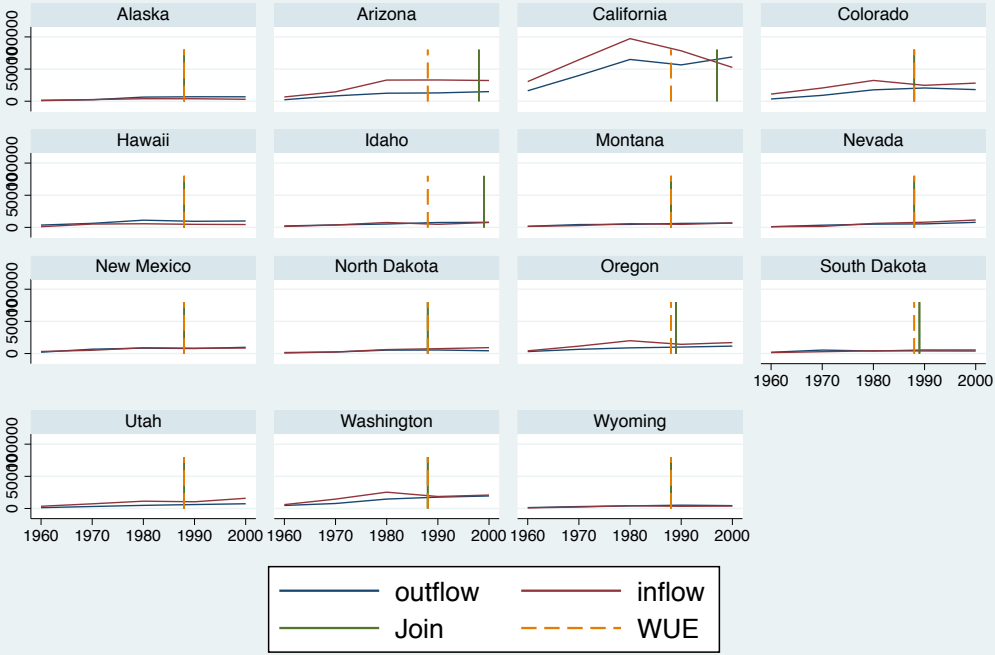

Figure 4: State migration trends

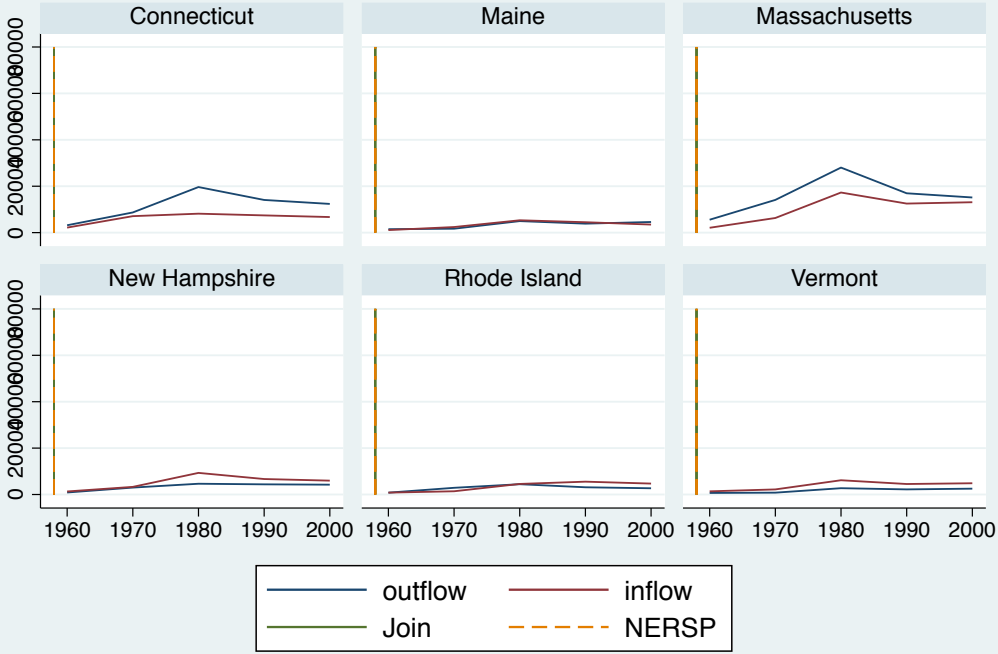

Figure 5: State migration trends