The Local Economic Impacts of Foreign Students*

Raghav Rakesh†

November 2022

Abstract

Do foreign students affect the economic outcomes of the natives at places where they attend college? I address this question by examining the local economic impacts of foreign post-secondary student enrollment expansion-induced demand shocks between 2004 and 2016 in the US. By exploiting the spatial variation in the change in foreign student enrollment and using an instrumental variables methodology, I estimate the causal effects on a vector of local economic outcomes. On average, the demand shock leads to a substantial increase in employment, business establishments, and wages in the local economy. Contrary to what standard models of spatial equilibrium suggest, I find no significant effect on rent, potentially because of the elastic housing supply. The findings suggest welfare gains for native workers as employment opportunities and wages increased, while the local cost of living did not. At the same time, I find no evidence of negative spillover effects on neighboring places that do not host college students. I further provide some evidence that the welfare gains for the native workers might be larger in sparsely populated counties in the long run due to higher housing supply elasticity than in densely populated counties. While the multiplier effect of foreign student enrollment on local economic outcomes is sizable, the marginal effect of domestic student enrollment is small.

Keywords: Local Demand Shocks, Foreign Students, Higher Education, Immigration, Place-based Policy

*I am grateful to Todd Elder, Ben Zou, and Stacy Dickert-Conlin for their constant guidance and feedback. I am also thankful to Abhiroop Mukhopadhyay, Nishith Prakash, Anjali Priya Verma; participants at SEA conference and Michigan State University for their helpful comments and suggestions. All errors remain my own responsibility.

†Raghav Rakesh: Department of Economics, Michigan State University, East Lansing, Michigan 48823. Email: rakeshra@msu.edu

I. Introduction

The past couple of decades have seen a massive increase in the number of foreign students in post-secondary education (henceforth, foreign students) in the US. Following an almost two-fold increase since the beginning of the twenty-first century, the total foreign student enrollment stood at 1 million in 2016, which accounted for roughly 5% of total post-secondary enrollment in the US.[1] Foreign students bring billions of dollars in revenue to the US institutions and the economy, in addition to global talent and diverse cultural values; however, there are serious concerns about adverse effects on the economic outcomes of the natives in the host area. This paper addresses this concern by examining the impact of foreign student expansion-induced demand shocks on the local economic outcomes of the natives.

An influx of foreign students creates local demand shocks, similar to various "place-based" policies aimed at fostering local economic growth in targeted geographic areas.[2] As the local economic activities are interconnected, the local demand shocks evolve, creating a multiplying effect and affecting different aspects of the local economy. Because of this externality, place-based policies that promote local demand are implemented. However, the impact on the local economy could eventually dissipate as labor and firms move across locations to arbitrage the benefits of the increased local demand, putting upward pressure on the land rents. Economists have long debated the distortions in economic behavior and eventual benefits caused by place-based policies (Glaeser and Gottlieb, 2008; Kline and Moretti, 2014*b*). Overall, the incidence and efficiency of local demand shocks are both empirical questions. It depends on the mobility of workers and firms, housing supply elasticity, and changes in the factor prices. The effect of foreign students could be particularly important for local economies that depend heavily on the education sector and lack growth opportunities in other sectors. A positive effect may help to reduce the economic disparities in such areas.

While there has been a long-standing debate on the impact of immigrants on the native outcomes and the host economy (Abramitzky and Boustan, 2017; Kerr and Kerr, 2011), the

[1] The number of newly enrolled foreign students on the most commonly issued student visa for the US, F1 visa, has dramatically increased from 138,500 in 2004 to 364,000 in 2016 (Ruiz and Budiman, 2018). There is no official yearly limit on the number of F1 visas that can be issued, unlike any other visa type issued by the government of the United States.

[2] Kline and Moretti (2014*b*), Neumark and Simpson (2015), Bartik (2020)

foreign students are notably different. Usually, the immigrant population live, consume and work in the host area, thereby affecting both the demand and supply in the labor market. Dustmann, Schönberg and Stuhler (2017) study an unusual case where the immigrants were only allowed to work in the host area, but were denied residency rights, which led to a labor supply shock only.[3] On the other hand, a distinctive and key feature of foreign students in the US is that they cannot work on a student visa until they have finished their education;[4] hence the shock is arguably a "pure" demand shock. In addition to contributing to the debate of whether foreign students are good for the local economy, this paper fills a gap in the literature by exploring the effects of an unique case of "pure" demand shock.

In this paper, I study the local economic impacts of foreign student enrollment expansions between 2004 and 2016, when the foreign student enrollment doubled in the US. Focusing on the counties that predominantly had a sizable share of the student population in the base year (henceforth, sample counties[5]), I estimate the causal effects on the local economic outcomes. I also look at the local economic effects of domestic post-secondary student (henceforth, domestic student) enrollment and discuss the potential welfare impacts on different agents in the local economy.

I use publicly available data from various sources for the analysis. Of them, the primary sources are Integrated Postsecondary Education Data System (IPEDS), Bureau of Economic Analysis (BEA), County Business Pattern (CBP) series, and National Historical Geographical Information System(NHGIS). I use a long difference specification and exploit the cross-county variation in the change in enrollment of foreign and domestic students. However, a major challenge in estimating the causal impact is that the student enrollment could be correlated to the unobserved county-specific secular trend or the unobserved contemporaneous shocks affecting the local economic outcomes of the county. For instance, a worsening state economy could reduce state appropriations to public universities and increase universities'

[3] Dustmann, Schönberg and Stuhler (2017) evaluate a policy that was implemented 14 months after the fall of Berlin wall. The policy allowed Czech workers to seek employment in German border municipalities, but denied residency rights, leading to an exogenous labor supply shock.

[4] An exception to this is working part-time on-campus or full time on Curricular Practical Training (CPT). CPT is temporary employment authorization for students on F-1 visa while enrolled in a college-level degree program. Also, the work on CPT must be related to the student's degree program and necessary to complete the degree.

[5] To be precise, I set the student-to-population ratio cutoff to be 5% in the year 2004.

reliance on foreign students leading to a problem of reverse causality and biased estimates.

First, to address the potential endogeneity issue between the enrollment and the secular trend, I control for predetermined observable characteristics of the county. Second, to address the potential endogeneity concern between the foreign student enrollment and the unobserved contemporaneous shock, I construct a shift-share instrument (henceforth, the foreign IV) based on the historical share of the foreign students in a county in the US. Counties with higher initial share of foreign students are more likely to substantially increase foreign student enrollment during a period when foreign enrollment increases at the national level. One of the potential reasons for this is the network effect — foreign students provide information and assistance to a compatriot planning to study abroad. In particular, the foreign IV, which is the predicted change in the actual foreign enrollment, is the interaction of the historical presence of foreign students in a county ("share") and the contemporaneous national level expansion in foreign student enrollment ("shift"). While the instrument is uncorrelated with contemporaneous shocks as long as the "shift" part of the instrument is not driven by idiosyncratic local shocks, the "share" part of the instrument could be correlated with the unobserved secular trend. Therefore, it is crucial to credibly partial out the secular trend of the local economic outcomes, without which the instrument can be invalid.

Third, I construct a shift-share instrument (henceforth, the domestic IV) to address the endogeneity concern with the domestic student enrollment as well. However, unlike the foreign IV, the domestic IV uses a variation of the historical share of the domestic students in a county from different states in the US, rather than from total domestic students in the US as it better explains the variation in actual domestic enrollment. In particular, the instrument is constructed by summation of all the interaction terms between the historical presence of domestic students in a county ("share") from a particular state and the contemporaneous change in the number of post-secondary students who are residents of the corresponding state ("shift"). Using similar arguments as for foreign IV, the domestic IV is plausibly exogenous to the local economy.

My empirical estimates find sizable effects of increase in foreign student enrollment on the level of local economic activities. I find that the local job multiplier of an additional foreign student enrollment is 2.35 over the 12 years. In other words, a net increase of one

foreign student enrollment created 2.35 jobs in that county. Given that the financial conditions of foreign students' families have improved a lot in recent decades, it is no surprise that the multiplier is sizable and comparable to one for skilled jobs where workers command higher earnings (Moretti, 2010), leading to a strong initial demand shock. There was a steep rise in demographic-adjusted wages as well — it increased by 1.92% for a percentage point increase in the foreign student enrollment-to-population ratio. A potential reason that the effects are stronger than in other immigration contexts is because the foreign students have very restricted work opportunities, thereby reducing possible supply side effects. Additionally, there was one more business establishment for every 12 additional foreign student enrollment, suggesting that a major part of the increase in employment came from new businesses. Further, the magnitude of the effect of foreign student enrollment on the county population is positive, but it is not statistically significant. In the housing market, I find that the housing supply was elastic in the sample counties — the housing units increased by 1.2 for every additional foreign student enrollment. At the same time, I do not find a significant effect on rent. This could be because the housing units increased rapidly to match the increased demand, leading to no significant effect on the rent.

In contrast, the marginal effect of an additional domestic enrollment is much smaller on levels of local outcomes compared to the effect of an additional foreign enrollment. One potential reason could be that foreign students, on average, are more affluent than domestic students. Another potential reason could be that foreign students from different parts of the world would create a demand for more diverse goods and services, creating opportunities for a wide variety of new businesses, and thus a larger multiplier effect, compared to the more homogenous demand from domestic students.

Overall, the results suggest potential welfare gains for native workers as employment opportunities and wages improved but there is no significant effect on the local cost of living. In theory, the movement of firms and workers into a particular geographical area puts upward pressure on rent. And if the housing supply is inelastic, it leads to welfare gains capitalized in land rents that would otherwise accrue to resident workers. However, in this paper, I find no significant effect on the rent, potentially because of elastic housing supply in the sample counties.

While the foreign student enrollment had an increasing trend over the 12 years, the domestic student enrollment increased significantly until 2010 and declined rapidly after that. A 12-year long difference specification masks this sharp change in trend and could lead to conflated effects. However, a split period analysis addresses this concern and validates the main results. Several robustness tests further strengthen the results presented in this paper. The findings are robust to the additional controls that partial out secular trend more flexibly and alternate sample analysis. Moreover, I do not find any negative economic impacts on the counties without institutions that neighbor counties with institutions. Without looking at the effect on neighboring counties, the overall impact of the expansion of foreign student enrollment could be misrepresented. Further, I examine the plausibility of identifying assumptions, including the validity of exclusion restrictions in the case of shift-share instruments. I conduct a test recently suggested by Goldsmith-Pinkham, Sorkin and Swift (2020) and show that the instruments are unlikely to be correlated with the unobservables.

Local economies might adjust to demand shocks differently depending on the area's population density, which will lead to different welfare outcomes in different areas. To understand this further, I look at the heterogeneity by population density of the county. While I find that local job multiplier and wages increase with increasing population density, the housing rents also increase. Although the welfare impacts on the resident workers would depend on the relative magnitude of the increase in wages and housing rent, the results provide some preliminary evidence of greater benefits for residents in sparsely populated counties than in densely populated counties in the longer run.

This paper makes three broad contributions to the literature. First, it contributes to the literature on the effects of local demand shocks on the local economy. To the best of my knowledge, my paper is the first to look at the effects of local demand shocks created by foreign students on various outcomes of the local economy. While the literature on local demand shocks includes papers that focus on place-based policies (Busso, Gregory and Kline, 2013; Chodorow-Reich et al., 2012; Kline and Moretti, 2014*a*; Neumark and Kolko, 2010), shocks to amenities and infrastructure (Chirakijja, 2022), or other specific shocks (Black, McKinnish and Sanders, 2005; Zou, 2018), the expansion of foreign students provides a suitable and unique setup to study the effects of "pure" demand shocks. Many studies in this literature focus

on the local labor markets and look at the local job multiplier, which is the number of additional jobs created by exogenously generating one more job (Black, McKinnish and Sanders, 2005; Chodorow-Reich et al., 2012; Moretti, 2010). However, looking at only the job multiplier may misrepresent the true welfare impacts since the various aspects of the economy are connected, and factors move across locations (Zou, 2018).[6] So, I look at a vector of outcomes and provide a complete picture of the local economic impacts. My paper further examines the heterogeneous effect of the local demand shocks by the county's population density, a relatively understudied area within this literature. This aspect is essential as the potential welfare gains or losses to native workers would depend on how prices adjust in different markets in the local economy, which can vary substantially by the county's population density.

Second, this paper contributes to the extensive literature on the impact of immigration on the host economy. Most papers in this literature look at the immigrant population that can provide labor (Altonji and Card, 1991; Card, 1990, 2001; Doran, Gelber and Isen, 2014; Ottaviano and Peri, 2012); however, my paper focuses on a distinct type of immigrants who have very limited opportunities to work, i.e., the foreign students. Due to this unique feature, it is essential to examine their effects separate from the existing literature on the effects of immigrants on the local economy. While it is still an unresolved debate whether immigration negatively affects the local economic outcomes, my paper finds sizable positive effects of foreign students on the natives and the local economy (Abramitzky and Boustan, 2017), potentially due to their distinctive feature of not being able to supply labor.

Finally, this paper also contributes to relatively new and growing economics literature on foreign post-secondary students, an immigrant type that is expanding rapidly around the world and is expected to grow further in the future with the globalization of education. The existing literature on foreign students focuses on domestic students' educational outcomes (Anelli, Shih and Williams, 2020; Borjas, 2007; Shih, 2017), university's reliance on foreign students to generate revenue (Bound et al., 2020) or future labor market effects on natives (Demirci, 2020). My paper, in contrast, looks at the local economic effects of foreign students

[6] Zou (2018) looks at the local economic impact of the US military contractions between 1988 and 2000. It shows that even though the local job multiplier was sizable, the welfare costs to workers were small as the local population adjusted quickly to the shock, mainly through reduced in-migration, which led to small changes in wages but large declines in the rental prices.

in the counties where they pursue their post-secondary education. A related study that looks at the impact of the international student boom between 2005 and 2015 focuses on the housing markets at the college-town level (Mocanu and Tremacoldi-Rossi, 2019). My paper looks at the number of outcomes at the county level that arguably constitutes a local economy.

As mentioned previously, the effects of local demand shocks created by the increase in foreign students have characteristics similar to place-based policies. Usually, policymakers meet the costs for place-based policies by diverting resources from other geographical areas. While these policies may improve the local economy of the target areas, it is always a concern if the gains outweigh the losses incurred in providing the financial incentives. On the contrary, the demand created by increasing foreign student enrollment is funded primarily by foreign investments. The financial incentives provided by all tiers of the US government under place-based job policies was around $60 billion in 2015 (Bartik, 2020)[7], whereas the foreign students contributed nearly $41 billion to the US economy in the academic year 2018-19 (NAFSA, 2020).[8] Given that students seeking international education are further increasing, the findings from this paper show the potential advantages of policies that promote foreign student enrollment.

The rest of the paper is organized as follows. Section 2 provides the research background on the significant increase in foreign students in the US post-secondary institutions between 2004 and 2016. Section 3 lays out the empirical strategy. Section 4 talks about various data sources used in the analysis, sample, and variable construction. Section 5 presents the results of empirical analysis. Section 6 presents the results of robustness tests. Section 7 concludes.

II. Foreign Students in US Post-Secondary Institutions

The number of foreign students enrolled in degree programs in post-secondary institutions in the United States has increased dramatically over the last two decades. Figure 1a shows that

[7] Some other estimates of incentives are provided by Thomas (2011) and Story (2012). Thomas (2011) calculates $73 billion, and Story (2012) calculates $101 billion (in 2019 dollars) in incentives.

[8] Foreign students contribute to the host economy by paying for their education and expenditure to support themselves while enrolled in post-secondary institutions, creating local demand shocks. NAFSA (2020) estimate of economic value contribution by foreign students is the overall imported dollars from foreign students without any multiplier effect.

foreign student degree enrollment increased by 70% from around 565,000 students in 2004 to 950,000 students in 2016. This includes total degree enrollment at post-secondary institutions of all level[9] and control[10] types that are eligible for the federal financial aid program. The increase in undergraduate enrollment accounts for 60% of this increase, and the number of new foreign students enrolled has grown faster at public institutions than at private institutions (Ruiz and Budiman (2017)). The average increase in foreign student degree enrollment was 517 per county over the 12 years among the sample counties. Over the same period, the share of foreign students in total post-secondary degree enrollment increased from 3.5% to over 5%. Not only has the foreign student enrollment increased in absolute numbers, but also as a share of the population. In the counties with at least a post-secondary institution, the average foreign student-to-population ratio has almost doubled (Figure 1b). The countries that send the most students are China, India, South Korea, and Saudi Arabia. In fact, China, India, and South Korea accounted for 54% of all the new foreign students in the US in 2016 (Ruiz and Budiman, 2017).

Various push and pull factors contributed to the significant increase in foreign students in the US. First, the number of families from the sending countries who can afford their child's post-secondary education in a foreign country has increased in the last two decades. This is due to the rapid economic growth of the sending countries.[11] Second, universities to generate higher revenue are admitting more foreign students who pay higher out-of-state tuition. In addition to an increased number of seats in already existing programs, many new programs have also sprung up, particularly in the STEM fields, where foreign students are heavily represented. The increase in foreign student enrollment is closely related to the decrease in state appropriations to public universities. Bound et al. (2020) estimate a 16% increase in foreign enrollment at the public research universities, which partially compensate for lost funding, with a 10% reduction in the state appropriations. Third, the Optional Practical Training (OPT)

[9] A classification of whether an institution's programs are 4-year or higher (4-year), 2-but-less-than 4-year (2-year), or less than 2-year

[10] A classification of whether an institution is operated by publicly elected or appointed officials or by privately elected or appointed officials and derives its major source of funds from private sources

[11] Bound et al. (2020) document that with the fourfold increase in China's GDP per capita between 1996 and 2012 and appreciation of yuan since 2005, the percentage of Chinese families with average income greater than the average out-of-state tuition plus boarding expense increased exponentially from 0.005% in 2000 to over 2% in 2013.

period was extended from one year to 29 months in 2008 for the STEM graduates to retain foreign STEM students as workers.[12] OPT is a program that allows full-time foreign students to temporarily work on their student visas after completing their post-secondary education. The extension addressed the US concerns of losing students due to a limit on H-1B visas, a primary work visa for the US. Unlike H-1B work visa, which has an annual cap of 85,000 visas, the number of approvals under OPT has no cap. So, an increased OPT period meant that the foreign students in the US would have two additional chances (once every year) of getting approved for the H-1B work visa and entering the US labor market, which encouraged more foreign students to enroll for a post-secondary STEM course in the US (Amuedo-Dorantes, Furtado and Xu, 2019).[13] Finally, an increase in the number of students completing high school or an undergraduate degree in the sending countries also contributed to the increase in foreign students in the US (UNESCO, Institute for Statistics, 2017).

During the same period, the number of domestic students enrolled in degree programs increased from around 15 million to around 17.5 million. However, the enrollment numbers have not constantly been increasing. Figure 1c shows that it increased to 19.3 million by 2010 and decreased after that. Most of this decrease in domestic student enrollment since 2010 is due to a decrease in enrollment at 2-year and less than 2-year post-secondary institutions.

In counties with a substantial share of the student population, the local economy would depend heavily on them. So, a large influx of foreign student population between 2004-2016 would have created sizable local demand shocks in the local economy. The shock could spill through multiple channels. First, existing businesses expand, and new businesses open up due to the local demand shock, generating more employment, which in turn creates additional jobs mainly through increased demand for goods and services (Moretti, 2010). Increased demand for labor with supply fixed increases the wages in the short term. Second, new employment opportunities lead to population adjustments, mainly through increased in-migration of workers and their families, which partially offsets the increase in wages over time. Third, there is an increased demand for housing units due to the increased student and

[12] This period was further extended to 36 months in 2016.

[13] Also, 20,000 visas of the total H-1B visas are set aside for those who hold advanced degrees (master's, professional, or doctorate) in any subject from a US higher educational institution. This provides an added advantage to foreign students enrolled in a US post-secondary institution.

non-student population, leading to upward pressure on the rent and housing prices. Fourth, the housing market responds with the supply of new housing units. Depending on the housing supply elasticity of the area, it might partially offset the housing market prices over time. Finally, resident families might move out from neighborhoods close to the post-secondary institutions with a higher share of the student population. They might move to neighborhoods in the same county or neighboring ones leading to some out-migration. Because the local economic activities are so interconnected, we must look at various outcomes in the local economy to get a complete picture of the effects, which would depend on the mobility of workers and firms, the local housing market conditions, and other local characteristics.

III. Econometric Framework

I estimate the impact of change in the number of foreign and domestic student enrollment on the local economic outcomes during the phase of the dramatic increase in foreign post-secondary student enrollment in the US over the period 2004-16 using the following long-difference specification:

$$\Delta y_{kc} = \alpha_k + \beta_{k1}\Delta foreign_c + \beta_{k2}\Delta domestic_c + X_{kc} \cdot \Theta_k + \Delta\epsilon_{kc} \tag{1}$$

The unit of observation is the county and is denoted by the c subscript in the regression. Δ denotes the 12-year difference between the years 2004 and 2016. y_k denotes a local outcome, which is (a) employment, (b) wages, (c) the number of business establishments, (d) the non-student population, (e) housing units, and (f) rent. Outcome variables Δy_{kc} are changes in local outcomes y_k of county c, scaled by the county's 2004 population, wherever required. In particular, for local outcomes (a), (c), (d), and (e), outcome variables are scaled by population. α_k is the outcome-specific trend common to all counties. $\Delta foreign_c = (Foreign_{c,2016} - Foreign_{c,2004})/Pop_{c,2004}$ is the change in number of foreign students in county c scaled by the county's population in 2004. Similarily, $\Delta domestic_c = (Domestic_{c,2016} - Domestic_{c,2004})/Pop_{c,2004}$ is the change in number of domestic students in county c scaled by the county's population in 2004. $X_{kc} \cdot \Theta_k$ is the county-specific secular trend in outcome k, where X_{kc} is a vector of

county characteristics. The primary coefficients of interest are β_{k1} and β_{k2}, which are the changes in the local outcome associated with a net increase of one foreign student and one domestic student, respectively, for the local outcomes (a), (c), (d), and (e). Lastly, $\Delta\epsilon_{kc}$ is the error term that includes the unobserved factors that might influence the outcome variables.

There are a few challenges to causally estimating the impact of change in foreign and domestic enrollment on the local economy using an ordinary least squares regression. First, the county-specific secular trend could be correlated with enrollment and the local outcome. For instance, a fast-growing county economy could lead to higher housing prices which could discourage students from enrolling in an institution in that county. This could bias the OLS estimates downward. Second, foreign and domestic student enrollment changes could be endogenous to unobserved contemporaneous shocks. For instance, a worsening state economy could reduce state appropriations to universities, inducing universities to admit more students. This could bias the OLS estimates downward. Third, measurement error in student enrollment could attenuate the OLS estimate. For instance, I aggregate the number of students enrolled in all the institutions in a county to get the total enrolled students residing in that county. However, in some cases, students could be residing in a neighboring county with an institution, which could lead to undercounting in one county and overcounting in the other. This induces measurement error, leading to attenuation bias.

To address the potential endogeneity issues, it is important to partial out the heterogeneous secular trend of the county. The conventional approach is to control for a vector of pre-determined observable county characteristics. Following which, I control for the county-specific secular trend in outcome k driven by the observable characteristics X_{kc}. Specifically, I control for the growth rate of the outcome variable from the year 1996 to 2001. For the logarithmic outcome variables, the control is the change in the log of the outcome variable in the pre-period. For the housing market outcomes, the change is between 1990 and 2000 due to a lack of data availability on those variables in the non-census years.

To address the potential endogeneity issue of correlation between foreign student enrollment and the unobserved contemporaneous shocks, I construct an instrument using the initial distribution of number of foreign students by county. Network effect is one of the primary

determinant of location choice of foreign students (Beine, Noel and Ragot, 2014).[14] A foreign student is likely to provide information and assistance to a compatriot planning to study abroad. So, countries with higher initial share of foreign students are more likely to substantially increase foreign student enrollment during a period when foreign student enrollment increases at the national level. Figure 2 presents the fitted line of the county level regression of the change in the ratio of foreign student-to-population between 2004 and 2016 on the ratio in the year 2001.[15] The slope of the fitted line is 0.63, and it is significant at the 1% level. It shows that the increase in the foreign student population in counties was across the board. The foreign student enrollment increased in most counties with an institution and increased even more in counties with a higher initial foreign student enrollment-to-population ratio. This means that the number of foreign students in a county in the US strongly predicts the future inflow of foreign students in that county. This idea motivates the construction of the IV for foreign student enrollment.

The foreign IV is the predicted change in the number of foreign student enrollment in a county, which is based on the understanding that the initial distribution of the number of foreign students by county is somewhat preserved with the future inflow of foreign students in the US. This is similar to the one used in Altonji and Card (1991), which only uses the geographic distribution of all foreign students in the US. Specifically, I use the following instrument for the change in foreign student enrollment in a county:

$$\Delta foreign_c^{IV} = \frac{1}{Pop_{c,2004}} \cdot \frac{Foreign_{c,2001}}{Foreign_{N,2001}} \cdot (Foreign_{N,2016} - Foreign_{N,2004}) \tag{2}$$

In equation 2, $Foreign_{N,t}$ denotes the total foreign student enrollment in the US in year t. The second term is the "share part" of the instrument, which is the ratio of foreign students in county c to foreign students in the US in the year 2001. The third term is the "shift" part

[14] Beine, Noel and Ragot (2014) study the location choice determinants of foreign students and finds network effect to be a primary determinant. They define network to include stock of all migrants from the origin country living at the destination. Although they look at the determinants of the location choices at the country level, similar factors should determine the location choices at the city or county level within a particular destination country.

[15] I use 2001 as the base year because the US government imposed restrictive immigration policies in the immediate aftermath of 9/11 due to security concerns, which could have affected the natural distribution of foreign students across locations in the US in a couple of years following 2001.

of the instrument, which is the change in the number of foreign students in the US between 2004 and 2016. Similar to the main explanatory variables, the product of terms is scaled by the baseline population of the county. As long as the "shift" part of the instrument is not driven by idiosyncratic local shocks, the instrument is uncorrelated with contemporaneous shocks.

I again use a shift-share instrument to address the potential endogeneity issue of correlation between domestic student enrollment and unobserved contemporaneous shocks. The instrument uses the same principle of calculating the predicted change in enrollment, which in this case would be of the domestic students. For this, I use the information on the total number of first-time degree-seeking first-year domestic students in an institution by the state of residence.[16] The instrument I construct for the change in the number of domestic students enrolled in a county is the weighted average of the change in the numbers of first-time freshmen by the state of residence, with weights being the county-specific freshmen enrollment share in those resident states in the year 2004. Specifically, I construct the domestic IV using the following equation:

$$\Delta domestic_c^{IV} = \frac{1}{Pop_{c,2004}} \cdot \sum_{s \in S} \frac{Freshmen_{c,s,2004}}{Freshmen_{s,2004}} \cdot (Freshmen_{s,2016} - Freshmen_{s,2004}) \qquad (3)$$

In the equation 3, $Freshmen_{s,t}$ denotes the total first-time degree-seeking domestic freshmen coming from a resident state s in the year t. S is the set of all states in the US. The second term $\frac{Freshmen_{c,s,2004}}{Freshmen_{s,2004}}$ is the share of first-time degree-seeking freshmen from the resident state s in county c in the year 2004. The third term is the total change in the number of first-time degree-seeking freshmen from the resident state s between 2004 and 2016. Finally, the summation of the product of the second and the third term over all the resident states $s \in S$ is scaled by the baseline population of the county. Consider, for example, two counties where the total domestic enrollment is the same, but the share of domestic enrollment from different states is different. If the total number of post-secondary students from a state increases

[16] It might be better to use the state of residence data for all students attending an institution, but IPEDS provides it for first-year freshmen only.

(decreases), the county with a higher share of students from that state receives more (less) domestic students from that resident state.

Note that the "shift" part of the foreign IV is same for all counties. The variation comes from the "share" part of the instrument, which can be correlated to the secular trend of the local economy. In other words, the "share" part of the instrument could be related to various county-specific factors (observed and unobserved) that affect the outcome variable. For instance, a county that experienced a higher growth rate in the 1990s could have a higher share of foreign student enrollment in 2001. A similar argument goes for the domestic IV as well. So, it is imperative to control for and partial out the heterogenous secular trend of the county without which the instruments could violate the exclusion restriction. As mentioned previously, I partial out the secular trend by controlling for the pre-period growth rate of the outcome variable, but there could still be concerns about the term adequately capturing the secular trend. So, as a robustness exercise, I control for more variables to capture the secular trend more flexibly, and the results are similar. In an additional exercise, I find only slight to no correlation between the instruments and the observable terms capturing the secular trend, suggesting that the estimates are unlikely to be correlated to the unobservable factors affecting the secular trend.

IV. Data

The empirical analysis in this paper uses publicly available data from multiple sources. Annual institution-level enrollment numbers of domestic and foreign students, along with county information, are available from the Integrated Postsecondary Education Data System (IPEDS). Also, institution-wise state of residence data for first-time degree-seeking first-year students (this includes students who enrolled in the fall term and the last summer term) is available from IPEDS, collected in every even-numbered year. IPEDS gathers information for every institution participating in the federal student financial aid program (henceforth, Title IV institution). Under The Higher Education Act of 1965, it is required for all the Title IV institutions to report to IPEDS every year. The IPEDS universe includes institutions of all levels, sectors, and degree-granting and non-degree-granting status. A non-Title IV institution must

request to be part of IPEDS, but IPEDS does not identify what percentage of those institutions are represented in its universe. Aggregate annual enrollment in non-Title IV institutions accounts for less than 0.05% of aggregate annual enrollment in all institutions in the IPEDS universe in 2004 and 2016. For the analysis, I only consider those institutions that were Title IV eligible in at least one of the years from 1996 to 2017.

I use the Fall Enrollment component of IPEDS to calculate the annual enrollment in an institution, which collects data on the number of foreign and domestic students enrolled in an institution in the fall. I also only take degree/certificate-seeking enrollment as the total enrollment. Non-degree/certificate-seeking students are more likely to be enrolled in an online or distant program and not directly influence the county's local economy. So, taking them into account might introduce measurement errors in the enrollment numbers of the students. However, these students might affect the local economy indirectly as they are paying tuition to the institution. Next, using the county information for the institutions, I aggregate the institution-level annual enrollment to get county-level annual enrollment for both foreign and domestic students. For some institutions, the county information was entered manually, particularly for those that did not operate pre-2000 and post-2008, as IPEDS does not provide county information from 2000 to 2008.

Annual county-level population, employment, and earnings by industry are taken from the Regional Economic Accounts (REA) available on the Bureau of Economic Analysis (BEA) website. Annual county-level business establishment numbers are available from the County Business Pattern (CBP) series. Data on housing units and rents are taken from county-level tabulations of Census and American Community Survey (ACS) data on National Historical Geographical Information System (NHGIS). The county density variable is constructed using the area information from county shapefiles available from NHGIS. Housing market variables are used from the county level tabulations of 5% ACS 2009 as a proxy for the year 2004 as no dataset provides data on these variables for all the counties for the year 2004. Lastly, the county adjacency files are taken from NBER public use data archive.

There are 1534 counties (including county equivalents) with at least one Title IV institution and 1591 counties without any Title IV institution. I restrict the sample to counties with a high student-to-population ratio. This restriction ensures that shocks to student composition in

the county create substantial demand shocks in the local economy. Moreover, these counties would generally produce more pronounced adjustments due to demand shock by students. I set the student-to-population ratio threshold to be 5% in the base year, leaving a final sample of 657 counties (Figure 3) — these counties hosted over 80% of foreign students in the US in 2004.

V. Empirical Results

V.A Effects of Foreign and Domestic Enrollment on Employment

This subsection looks at various versions of the empirical specification to estimate the effect of changes in foreign and domestic student enrollment on change in employment between 2004 and 2016. I first look at the first stage results for both the endogenous explanatory variables in Table 1. Column 1 reports results for foreign student enrollment, and column 2 reports results for domestic student enrollment. The coefficient for the foreign IV in column 1 is 1.003, which means the foreign IV quite accurately predicts the actual change in foreign student enrollment between 2004 and 2016. The coefficient for domestic IV is 4.098 in column 2, which means that the actual change in domestic enrollment is almost four times the predicted change in domestic freshman enrollment. It is reasonable to argue that the total number of domestic students would be approximately four times that of domestic freshmen since most undergraduate programs are four-year-long.[17] Next, the positive and significant coefficient for foreign IV in the second column indicates the correlation between foreign student enrollment and domestic student enrollment. This positive correlation could be linked to the cross-subsidization of domestic enrollment fees by high tuition payments from foreign students leading to an increase in domestic enrollment (Shih, 2017). Moreover, this suggests that it is essential to control for domestic student enrollment in the first place, without which the foreign IV will violate the exclusion restriction. The last row reports the first stage

[17] There are a couple of other factors that could affect this ratio of domestic enrollment to domestic freshmen enrollment. First, freshmen dropping out of college would decrease this ratio. Second, considering the domestic graduate enrollment would increase this ratio. So, on average, it is reasonable to argue that the domestic enrollment would approximately be four times the domestic freshmen enrollment.

Angrist-Pischke (AP) F-statistic of 50.07 and 19.19 for foreign and domestic student enrollment, respectively, which suggests the strong predictive power of the instruments.

Table 2 reports the estimation results from various versions of equation 1 using OLS and 2SLS estimators. The coefficients can be interpreted as local job multiplier, which would be the increase in the number of jobs due to additional student enrollment. Column 1 is the OLS estimation using just the foreign student enrollment, and the estimated effect is 1.297, which is statistically significant at the 1% level. In column 2, we add the domestic student enrollment in the OLS estimation. The coefficient for foreign student enrollment is 0.847, and domestic student enrollment is 0.219. The coefficient for foreign student enrollment drops because the domestic student enrollment is likely to be positively correlated with both employment and foreign student enrollment, so without controlling for domestic enrollment, foreign enrollment picks up its effect on employment. Moreover, the coefficient associated with foreign student enrollment is higher than the coefficient for domestic student enrollment. One potential reason is that the foreign students from different countries would create demand for more diverse goods and services than more homogenous demand from domestic students. In column 3, I control for the county-specific secular trend of employment, and the estimated coefficient drops slightly to 0.784 and 0.108 for foreign and domestic student enrollment, respectively.

Columns 4 to 7 report the estimation results using the 2SLS estimation method. The Angrist Pischke first-stage F statistics are reported in the last two rows of the table depending on the version of the specification 1 used in that column. Column 4 instruments for the foreign student enrollment but does not control for domestic student enrollment or secular trend. Column 5 adds domestic student enrollment as a control to column 4 specification. Columns 6 instruments for both the enrollment variables to address the endogeneity concern due to contemporaneous shocks. The next step is to partial out the secular trend, without which the IV could be invalid and could lead to biased estimates. Column 7 addresses the endogeneity concern due to contemporaneous shocks and secular trends. It reports the estimated local job multiplier of foreign and domestic student enrollment over the 12 years. Moving from column 4 to 7, the estimated coefficient for foreign student enrollment decreases when we control and instrument for domestic student enrollment, and it further decreases when

we partial out the secular trend. The result shows how the estimated coefficient for foreign enrollment can be biased if we do not account for the domestic enrollment and secular trend correctly. As a point of reference, the OLS estimates also tell a similar story.

From column 7, which is the preferred specification, the local job multiplier of foreign enrollment over the 12 years is 2.35, and the estimate is significant at the 5% level. In other words, between 2004 and 2016, a net increase of one foreign student in a county created 2.35 jobs in that county. At the same time, a net increase of one domestic student enrollment in a county created 0.37 jobs in the same county, and the estimate is significant at 5%. Given that the average initial employment-to-population ratio is 0.575 and the average increase in the foreign student enrollment-to-population ratio in the sample is 0.26 percentage points, the employment in the sample counties increased by 1.06% due to the foreign student boom over the 12 years. In comparison, the average increase in the domestic enrollment-to-population ratio is 0.6 percentage points, leading to a 0.37% increase in the employment of the sample counties over the same period.

Comparing the estimates with other local job multiplier estimates in the literature suggests that the effect of foreign student enrollment is sizable. Moretti (2010) finds that an additional job in tradable sector[18] in a given city creates 1.6 jobs in the nontradable sector in the same city over a decade, whereas an additional skilled job in the tradable sector generates 2.5 jobs in the nontradable sector. The effect is significantly larger for skilled jobs because they command higher earnings leading to stronger local demand shocks. The estimate associated with foreign student enrollment is similar to the one for the skilled job in the tradable sector. The foreign students in the US are likely to have a strong local demand shock as well because of the strong financial background of the foreign students.[19] Also, as mentioned previously, unlike in many other immigration contexts, the foreign students have restricted access to work, thus reducing possible supply effects.

[18] The tradable sector includes industries whose products could be primarily traded nationally or internationally. Whereas the nontradable sector includes industries whose products are primarily traded locally.

[19] There has been rapid improvement in the financial conditions of the families from the primary sending countries. China, India, and Korea, the top 3 sending countries, have experienced rapid economic growth in the past couple of decades.Using the administrative data on the F-1 student visa, Bound et al. (2020) documented that for the 2010-15 period, only 6% of undergraduate students from China at research universities received funding from the universities they attended, which again suggests strong financial background of the foreign students in the US.

V.B Effects of Foreign and Domestic Enrollment on Other Outcomes

Table 3 reports estimates for various outcomes in local labor markets and local businesses. All columns in this table present results for the specification in Table 2, column 7 with the respective Angrist Pischke first-stage F statistics in the last two rows. Column 1 reports the same result as Table 2, column 7. Next, I look at the effect on employment in tradable and nontradable sectors of industries (Black, McKinnish and Sanders, 2005; Zou, 2018). Columns 2 and 3 report that a net increase of one foreign student enrollment creates 0.6 jobs in the tradable sector and 2.1 jobs in the nontradable sector. At the same time, a net increase of one domestic enrollment creates 0.3 jobs in the nontradable sector and does not affect the tradable sector jobs. The estimates are significant for the foreign enrollment but not for the domestic enrollment. Consistent with the literature, the effects of local demand shocks are primarily concentrated in the nontradable sector. As one would expect, the production of goods and services sold locally will be impacted more. The average nontradable employment-to-population ratio was 0.4 in the sample counties in 2004, so employment in the nontradable sector expanded by 1.4% during the foreign student boom. At the same time, the initial tradable employment-to-population ratio is very low at 0.06 in the sample counties, so even a small foreign student enrollment multiplier effect expanded the employment in the sector by 2.6% over the 12 years.

Column 4 reports the effect on the log demographic-adjusted average wage in the county. The adjusted wage increases by 1.92% for a percentage point increase in the foreign student enrollment-to-population ratio. There is no impact of the change in domestic student enrollment on wages. Column 5 reports that a net increase of 12 foreign students in a county leads to an increase in one business establishment in the county, suggesting that primarily more small businesses might have opened up as a response to local demand shocks. This multiplier is much smaller for domestic students, potentially because the foreign students' demand for diverse goods and services would create opportunities for a wide variety of new businesses. Moreover, the market for goods and services "traditionally" demanded by the domestic students might already exist to a large extent. Given that the initial average ratio of business establishments-to-population is 0.025, the number of business establishments expanded by 0.9% due to the foreign student enrollment expansion. The result suggests that

a large part of the increase in employment was through expanding new business establishments.

Table 4 reports effects on county population and outcomes in the housing market. Column 1 shows that with a net increase of one foreign student enrollment, the non-student population in the county increases by 2, however, the estimate is not statistically significant. Even if there was a population increase, which would have partially offset the increase in wages, there was a substantial increase in the wages over the 12 years. Column 2 reports that the total housing units increased by 1.2 with additional foreign student enrollment, and the coefficient is statistically significant at the 1% level. This suggests how the supply of new housing units increased with the foreign students' increased demand for housing properties. The number of housing units increased by 0.7% over 12 years. Although the estimated coefficient shows that median rent increased by 1.2% with a percentage point increase in foreign student enrollment-to-population ratio, it is not surprising that the effect is not statistically significant. The increased supply of housing units likely matched up to the increased demand leading to no effect on median rent in many counties. On average, the wages increased more than the increase in the median rent, suggesting increased welfare for the natives. It also suggests that the local cost of living of the domestic students is unlikely to be affected. Lastly, the coefficient associated with domestic student enrollment for all the outcomes in Table 4 is small and not significant at any conventional level suggesting little or no effect on migration or housing market outcomes due to change in domestic student enrollment over the 12 years.

I find sizable effects of the local demand shocks created by the increase in foreign student enrollment on the level of local economic activities. The results suggest potential welfare gains for native workers of the county who chose to be renters as the employment opportunities and wages improved, but there was no significant effect on rent. In theory, the movement of firms and workers into a particular geographical area puts upward pressure on rent. And if the housing supply is inelastic, it leads to welfare gains capitalized in land rents that would otherwise accrue to resident workers. But, I find no significant effect on rent. The potential reason is the elastic housing supply in the sample counties, which might have eased the upward pressure on rent. At the same time, the change in domestic enrollment had very little

to no effect on the levels of local economic outcomes over the 12 years.

V.C Effects of Foreign and Domestic Enrollment on Local Outcomes using Split Long Difference

While there was a net increase in the domestic student enrollment between 2004 and 2016, the long difference masks the substantial increase in domestic enrollment between 2004 and 2010 and equally rapid decline between 2010 and 2016 (Figure 1c). In this subsection, I address this concern by splitting the long difference equation (2014-16) into two periods and using them to estimate the effect on the local outcomes. The two split periods are 2004-10 (henceforth, first period) and 2010-16 (henceforth, second period). Specifically, I estimate the following equation:

$$\Delta y_{kct} = \alpha_k + \beta_{k1}\Delta foreign_{ct} + \beta_{k2}\Delta domestic_{ct} + X_{kc} \cdot \Theta_k + \tau_t + \Delta\epsilon_{kct} \tag{4}$$

This equation is a modified version of equation 1 where I introduce subscript t with the outcome and the enrollment variables to denote the two time periods. Here the unit of observation is county cross time period and is denoted by the subscript ct in the equation. Δy_{kct} either denotes $y_{kc,2010} - y_{kc,2004}$ or $y_{kc,2016} - y_{kc,2010}$, depending on the time period t, scaled by the county's 2004 population, where y_k is a local outcome of the county c. The outcomes include employment, business establishments and non-student population. Housing market variables are not included in this analysis due to non availability of the data for the two split periods. $\Delta foreign_{ct} = (Foreign_{c,t2} - Foreign_{c,t1})/Pop_{c,2004}$ is the change in number of foreign students in county c scaled by the county's population in 2004, where t2 = 2010, t1 = 2004 for the first period and t2 = 2016, t1 = 2010 for the second period. The construction of domestic student enrollment variable is analogous to this. I also introduce the time period dummy τ_t to absorb the time period effect which takes value 0 and 1 for the first and second period respectively. As before, $X_{kc} \cdot \Theta_k$ controls for the secular trend. $\Delta\epsilon_{kct}$ is the error term.

The instruments are modified accordingly as well. The "share" part of the foreign and domestic IVs is the same as before for both periods, but the "shift" part depends on the time period. Specifically, the modified foreign and domestic IV are as follows:

$$\Delta foreign_{ct}^{IV} = \frac{1}{Pop_{c,2004}} \cdot \frac{Foreign_{c,2001}}{Foreign_{N,2001}} \cdot (Foreign_{N,t1} - Foreign_{N,t2}) \tag{5}$$

$$\Delta domestic_{ct}^{IV} = \frac{1}{Pop_{c,2004}} \cdot \sum_{s \in S} \frac{Freshmen_{c,s,2004}}{Freshmen_{s,2004}} \cdot (Freshmen_{s,t1} - Freshmen_{s,t2}) \tag{6}$$

where t1 = 2010, t2 = 2004 for the first period and t1 = 2016, t2 = 2010 for the second period. The 2SLS estimates using the specification 4 is reported in the table 5. The standard errors are clustered at the county level. The last two rows in the table showing the Angrist-Pischke F-statistics indicate reasonably strong first stage relevance.

The point estimate of the local job multiplier of foreign student enrollment is slightly higher than the earlier estimate, but they fall within the range of one standard error from each other. The estimated local job multiplier of domestic student enrollment is even smaller than before and not statistically significant. The estimates of coefficients associated with business establishments are almost precisely the same as before. Furthermore, the estimated coefficient of the non-student population confirms our earlier notion that there was sizable population increase as a result of an increase in foreign enrollment. The specification in this subsection addresses the concerns associated with a sharp change in domestic student enrollment trend that could lead to conflated effects in the 12-year long difference estimation; the estimates validate the earlier results.

V.D Heterogeneity with Population Density

Adjustment of local economies to the local demand shocks can vary with the area's population density. More densely populated areas might have agglomeration benefits, better urban amenities, or demand for a wider variety of goods and services, which could lead to a larger positive impact on wages or local job multiplier. At the same time, the housing market could be tight due to lower vacancy rates, or the housing supply could be inelastic due to scarcity of land, which could put upward pressure on the house rents when firms and workers move into the area to arbitrage the benefits of local demand shocks. Depending on these factors, the

welfare implications of the same shock in different local economies could vary a lot, which is interesting to identify. In this subsection, I further investigate the heterogeneous effects of the local demand shocks with the area's population density.

To study the heterogeneous effects, I include an interaction term of the foreign student explanatory variable and the population density of the county in the main equation 1. In particular, I estimate the following equation:

$$\Delta y_{kc} = \alpha_k + \beta_{k1}\Delta foreign_c + \beta_{k2}\Delta domestic_c + \beta_{k3} Inter_c + \gamma_k D_{kc} + X_{kc} \cdot \Theta_k + \Delta\epsilon_{kc}, \qquad (7)$$

where D_{kc} is the demeaned log of population density of the county c and $Inter_c$ is the interaction term of $\Delta foreign_c$ and D_{kc}. All the other terms are the same as before. In addition to the earlier two instruments, I construct a third one similarly as the interaction term, by interacting $\Delta foreign_c^{IV}$ and D_{kc}. The 2SLS estimates using specification 7 is reported in table 6. The Angrist-Pischke F-statistics show that all endogenous variables have a reasonably strong first stage. Finally, the standard errors are clustered at the county level.

Column 1 in Table 6 shows that the local job multiplier increases with population density. The estimated coefficient on the interaction term is 2.6, which is statistically significant at the 1% level. This means that with every 10% increase in population density, the job multiplier increases by roughly 0.26. The effects on log wage, business establishments, and the non-student population exhibit similar patterns, although the estimates of heterogeneous effects are significant for log wage only. The results suggest that the characteristics of densely populated areas lead to the creation of more better-paying jobs due to local demand shocks in those areas. I do not find the effects on housing units differ by the area's population density; the estimated coefficient on the interaction term in column 5 is small and not significant. In light of a larger positive effect on employment but no effect on housing units in more densely populated areas, it is not surprising that the effect on housing rents is stronger (and statistically significant at the 10% level) with increasing population density of the area.

There could be a stronger positive effect on the housing rent in the future because of the possible housing supply saturation in more densely populated areas due to the relative

scarcity of land. In contrast, sparsely populated areas would have more slack in the local housing market to absorb the increasing population without upward pressure on rent. Although the welfare impacts of a resident worker would depend on the relative magnitude of the increase in wages and housing rent, the results provide some evidence that their welfare benefits might get smaller in more densely populated areas, due to increasing house rents, compared to sparsely populated areas.

VI. Robustness

VI.A Alternative Specifications

In this subsection, I look at several alternate specifications to confirm the tenor of the results presented in previous sections. In the interest of space, all the tables are included in the Appendix of the paper. First, I include the quadratic and cubic terms of the growth rate of the dependent variable in the pre-period to control for the secular trend because one might argue that a linear term might not fully capture and partial out the secular trend. The results are robust to this inclusion and are reported in Table A.2 of the Appendix. Second, I include the pre-period growth rate of all the local economic outcomes in every regression. The results are consistent with our main specification (Table A.3).

Third, I expand the sample by sequentially including counties with a smaller student enrollment-to-population ratio in the base year. For the main sample, the ratio threshold was set to be 5%. Tables A.4 to A.7 report the results when I estimate the main specification on samples of varying size. Results tell a similar story.

Finally, I look at the impact of the local demand shocks on the local outcomes of the neighboring counties without institutions. As workers and firms are mobile, the demand shocks could affect the local outcomes of the neighboring counties, so without looking at them, the true overall effects of the foreign student enrollment boom might be misrepresented. More importantly, one would be interested to know if the welfare gains in counties with institutions would come at the expense of a negative impact on the neighboring counties. I use a similar specification as before to measure this effect. In particular, using a sample of the coun-

ties without institutions that neighbors a county with an institution (henceforth, neighboring counties), I use the 12-year long difference in the local outcome of the neighboring counties as the outcome variable. Some of the outcome variables are scaled by the county's initial population like before. The two main explanatory variables are the 12-year enrollment changes of domestic and foreign students summed over all the adjacent counties with institutions. I further scale the main explanatory variables by the neighboring county's initial population. The instruments are also constructed similarly. I find that there is no effect of the foreign student enrollment increase on the local outcomes of the neighboring counties except a very small positive effect on the housing supply (Table A.8). The results address the concerns related to negative spillover effects on the neighboring counties.

VI.B Plausibility of Identifying Assumptions

In this subsection, I provide evidence to support the validity of the identifying assumptions. The first identifying assumption is that the growth rate of the dependent variable in the pre-period correctly specifies the heterogeneous county-specific secular trend of the dependent variable. In the previous subsection, I showed that the results are robust to including a long list of controls that might flexibly capture the secular trend for every outcome variable. This fact fortifies the validity of the assumption.

The second identifying assumption is that the instrument is not correlated to the unobserved part of the secular trend (exclusion restriction). As mentioned previously, the "shift" part of the foreign IV is the national level change in foreign enrollment over the years, the variation comes from the "share" part of the instrument, which could be correlated to the unobserved part of the secular trend. In other words, the initial share of the foreign student in a county could be correlated to the unobserved county-specific factors that affect the outcome variable. A similar argument goes for domestic IV as well. Given the previous assumption, this assumption would be vacuously true. Nonetheless, I conduct a standard test suggested by Goldsmith-Pinkham, Sorkin and Swift (2020) to look at how balanced instruments are across observable potential confounders, which will suggest the importance of the unobservable confounders. So, I regress the foreign IV and domestic IV on the list of covariates used in the regressions previously and report the results in Table 7. I use the logarithmic transforma-

tion[20] of the non-logarithmic variables so that the coefficient interpretation is straightforward. In Columns 1 and 3 of Table 7, the instrument is regressed on all the pre-period growth rates of the outcome variables. I find that the R^2 is very low in both the regressions; the covariates only explain 3% and 7% variation in the foreign IV and domestic IV, respectively. Even after adding the quadratic and cubic terms of the covariates in columns 2 and 4, the R^2 increases to 9% and 13%, respectively. As a point of reference, the R^2 is pretty low compared to the R^2 of 43% in the canonical model in Goldsmith-Pinkham, Sorkin and Swift (2020). Moreover, the magnitude of the statistically significant coefficients is very small. This suggests that the instruments are unlikely to be correlated with the unobservables, and it is reasonable to assume that the instruments satisfy the exclusion restrictions.

Finally, the last identifying assumption is that the instrument is not correlated to the unobserved contemporaneous factors (exclusion restriction). By construction, the shift-share IV should not be correlated to the contemporaneous factors. However, one concern in the literature is that if a local economy is particularly big in a particular "industry" (foreign enrollment in this case), national shock could be correlated to the local shock. In other words, it means that the national level shocks and the main effects are driven by only a few influential counties, which might violate the exclusion restriction. To check that, I remove counties with the highest absolute number of foreign student enrollment in 2004 and run the main results. In particular, I remove counties in the top 1 percentile of total foreign student enrollment in 2004. Results are similar (Table A.9).

VII. Conclusion

This paper looks at the local economic impacts of the demand shocks induced by the rapid increase in foreign student enrollment between 2004 and 2016 in US counties that rely heavily on the education sector. I look at several outcomes and provide a complete picture of the effects on the local economy. On average, expansion in foreign student enrollment led to a substantial increase in local employment and wages. At the same time, there was no effect

[20] Because the non-logarithmic variables can take the least value of -1, I add 1.1 to all the variables and then take the logarithm of it.

on the local cost of living. The results suggest potential welfare gains for the native workers. Further, the results suggest that the welfare gains for native workers might be larger in sparsely populated counties in the long run than in densely populated counties, where the rents could rise steeply, leading to a shift of welfare gains from the native workers to the landlords. Finally, while foreign students have a sizable marginal effect, domestic students have little to no marginal effect on the local economy over the 12 years.

Many argue that place-based policies may be inefficient and just reallocates economic activity across locations. Often, the equity argument is made in support of these policies as they are usually implemented in underperforming locations to reduce economic disparity. Whether the policy leads to welfare gains for intended recipients is largely an empirical question. In this paper, I find potential welfare gains for residents in the sample counties, while at the same time, there is no evidence of the negative effect on the counties without institutions. Further, unlike the place-based policies usually funded by diverting resources from other regions, which might not be cost effective, the local demand shocks created by foreign students are funded primarily by money from abroad. While informing about the overall effects of foreign student enrollment on the local economy, the results in this paper highlight the potential advantages of policies that promote foreign student enrollment — they can lead to economic growth in targeted locations, similar to place-based policies. ■

References

Abramitzky, Ran, and Leah Boustan. 2017. "Immigration in American Economic History." *Journal of Economic Literature*, 55(4): 1311–1345.

Altonji, Joseph G., and David Card. 1991. "The Effects of Immigration on the Labor Market Outcomes of Less-Skilled Natives." In *Immigration, Trade, and the Labor Market*. , ed. John M. Abowd and Richard B. Freeman, 201–234. Chicago and London:University of Chicago Press.

Amuedo-Dorantes, Catalina, Delia Furtado, and Huanan Xu. 2019. "OPT Policy Changes and Foreign Born STEM Talent in the US." *Labour Economics*, 61.

Anelli, Massimo, Kevin Shih, and Kevin Williams. 2020. "Foreign Peer Effects and STEM Major Choice." Working Paper.

Bartik, Timothy J. 2020. "Using Place-Based Jobs Policies to Help Distressed Communities." *The Journal of Economic Perspectives*, 34(3 (Summer)): 99–127.

Beine, Michel, Romain Noel, and Lionel Ragot. 2014. "Determinants of the International Mobility of Students." *Economics of Education Review*, 41: 40–54.

Black, Dan, Terra McKinnish, and Seth Sanders. 2005. "The Economic Impact of the Coal Boom and Bust." *Economic Journal*, 115(503): 449–76.

Borjas, George J. 2007. "Do Foreign Students Crowd Out Native Students from Graduate Programs?" In *Science and the University*. , ed. Ronald G. Ehrenberg and Paula E. Stephan.

Bound, John, Breno Braga, Gaurav Khanna, and Sarah Turner. 2020. "A Passage to America: University Funding and International Students." *American Economic Journal: Economic Policy*, 12(1): 97–126.

Busso, Matias, Jesse Gregory, and Patrick Kline. 2013. "Assessing the Incidence and Efficiency of a Prominent Place Based Policy." *American Economic Review*, 103(2): 897–947.

Card, David. 1990. "The Impact of the Mariel Boatlift on the Miami Labor Market." *Industrial and Labor Relations Review*, 43(2): 245–257.

Card, David. 2001. "Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration." *Journal of Labor Economics*, 19(1): 22–64.

Chirakijja, Janjala. 2022. "The Local Economic Impacts of Prisons." Working Paper.

Chodorow-Reich, Gabriel, Laura Fieveson, Zachary Liscow, and William Gui Woolston. 2012. "Does State Fiscal Relief During Recessions Increase Employment? Evidence From the American Recovery and Reinvestment Act." *American Economic Journal: Economic Policy*, 4(3): 118–45.

Demirci, Murat. 2020. "International Students and Labour Market Outcomes of US-born Workers." *Canadian Journal of Economics*, 53(4): 1495–1522.

Doran, Kirk, Alexander Gelber, and Adam Isen. 2014. "The Effects of High-Skilled Immigrantion Policy on Firms: Evidence from H-1B Visa Lotteries." NBER Working Paper 20668.

Dustmann, Christian, Uta Schönberg, and Jan Stuhler. 2017. "Labor Supply Shocks, Native Wages, and the Adjustment of Local Employment." *The Quarterly Journal of Economics*, 132(1): 435–483.

Glaeser, Edward L., and Joseph D. Gottlieb. 2008. "The economics of place-making policies." *Brookings Paper on Economic Activity*, 39(1): 155–253.

Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift. 2020. "Bartik Instruments: What, When, Why, and How." *American Economic Review*, 110(8): 2586–2624.

Kerr, Sari Pekkala, and William R. Kerr. 2011. "Economic Impacts of Immigration: A Survey." NBER Working Paper 16736.

Kline, Patrick, and Enrico Moretti. 2014*a*. "Local Economic Development, Agglomeration Economies, and the Big Push: 100 Years of Evidence from the Tennessee Valley Authority." *The Quarterly Journal of Economics*, 129(1): 275–331.

Kline, Patrick, and Enrico Moretti. 2014*b*. "People, places, and public policy: Some simple welfare economics of local economic development programs." *Annual Review of Economics*, 110(8): 629–662.

Mocanu, Tatiana, and Pedro Tremacoldi-Rossi. 2019. "International Student Migration and Local Housing Markets." Mimeo.

Moretti, Enrico. 2010. "Local Multipliers." *American Economic Review: Papers and Proceedings*, 100(2): 373–77.

NAFSA. 2020. "Losing Talent 2020: An Economic and Foreign Policy Risk America Can't Ignore." *Policy Resources*.

Neumark, David, and Helen Simpson. 2015. "Chapter 18 - Place-Based Policies." In *Handbook of Regional and Urban Economics*. Vol. 5, , ed. Gilles Duranton, J. Vernon Henderson and William C. Strange, 1197–1287. Elsevier.

Neumark, David, and Jed Kolko. 2010. "Do enterprise zones create jobs? Evidence from California's enterprise zone program." *Journal of Urban Economics*, 68(1): 1–19.

Ottaviano, Gianmarco I. P., and Giovanni Peri. 2012. "Rethinking the Effect of Immigration on Wages." *Journal of the European Economic Association*, 10(1): 152–97.

Ruiz, Neil G., and Abby Budiman. 2017. "New Foreign Enrollment at U.S. Colleges and Universities doubled since Great Depression." *Pew Research Center*.

Ruiz, Neil G., and Abby Budiman. 2018. "Number of Foreign College Students Staying and Working in U.S. After Graduation Surges." *Pew Research Center*.

Shih, Kevin. 2017. "Do International Students Crowd-Out or Cross-Subsidize Americans in Higher Education." *Journal of Public Economics*, 156: 170–84.

Story, Louise. 2012. "As Companies Seek Tax Deals, Governments Pay High Price." *The New York Times*.

Thomas, Kenneth. 2011. "The Effects of Immigration on the Labor Market Outcomes of Less-Skilled Natives." In *Investment Incentives and the Global Competition for Capital*. London and New York:Palgrave Macmillan.

UNESCO, Institute for Statistics. 2017. "Enrollment by Level of Education."

Zou, Ben. 2018. "The Local Economic Impacts of Military Personnel." *Journal of Labor Economics*, 36(3): 589–621.

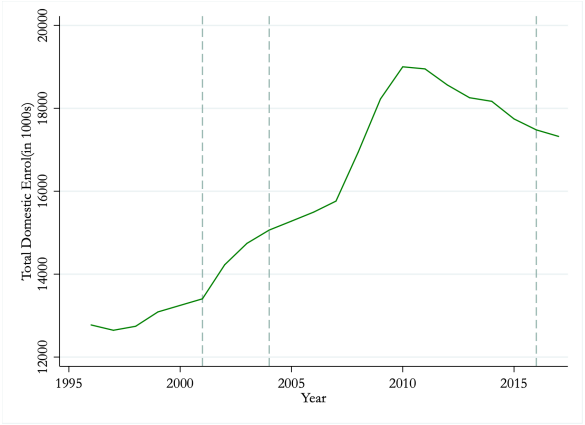
Main Tables and Figures

Figure 1: DEGREE ENROLLMENT IN US POST-SECONDARY INSTITUTIONS OVER TIME

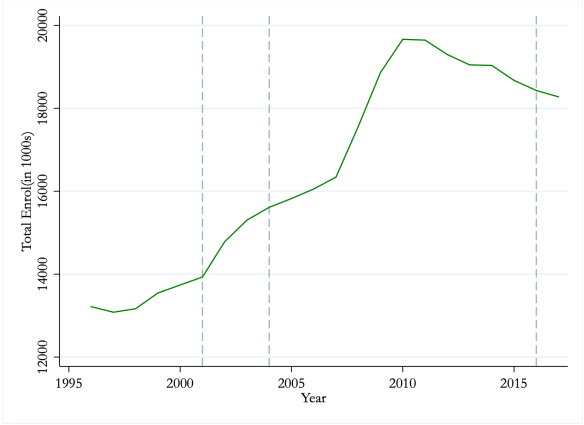
(a) FOREIGN STUDENT ENROLLMENT

(b) FOREIGN STUDENT BY POPULATION

(c) DOMESTIC STUDENT ENROLLMENT

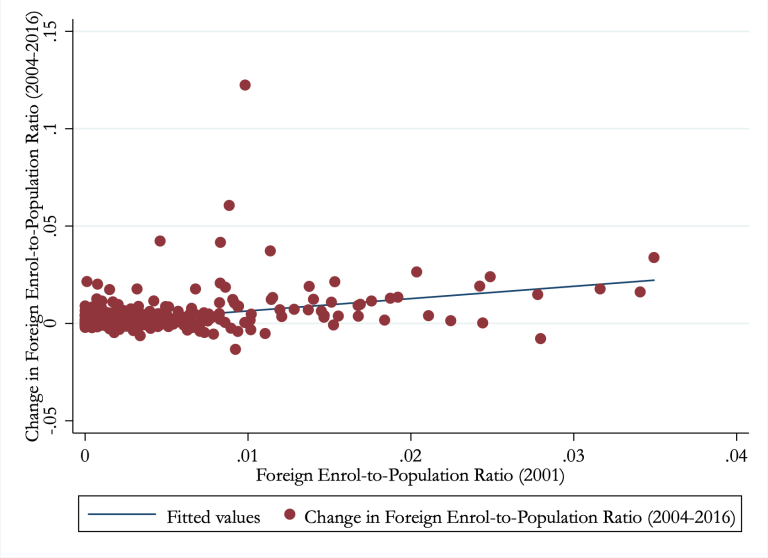


(d) TOTAL STUDENT ENROLLMENT



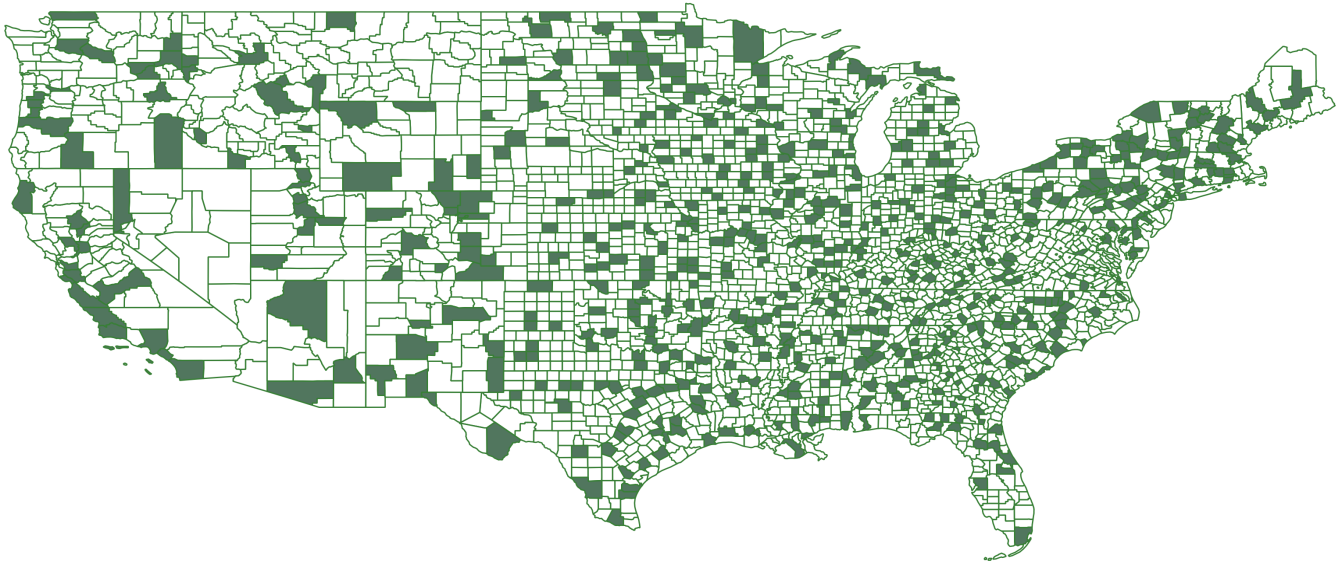
Notes: The figures show the student enrollment numbers in degree programs over the years in the US starting from 1996. Three vertical light green lines indicate the years 2001, 2004, and 2016 in all the panels. Only post-secondary institutions eligible for federal financial aid program are included in calculating the enrollment numbers. Source: IPEDS data

Figure 2: INITIAL FOREIGN STUDENT SHARE AND FUTURE INCREASE



Notes: This figure shows the fitted line of the regression of future change in foreign student enrollment-to-population ratio in on the initial ratio at the county level. Each dot is a county. The slope of the fitted line is 0.63 and the robust standard error is 0.09. Source: IPEDS and BEA Data

Figure 3: MAIN SAMPLE COUNTIES



Notes: This figure shows the map of the US with the main sample counties highlighted in green. Two of the sample counties in Alaska and Hawai are not shown on this map. Source: IPEDS and NHGIS Data

Table 1: EMPLOYMENT: FIRST STAGE REGRESSION FOR BOTH ENDOGENOUS EXPLANATORY VARIABLE

	Δ foreign	Δ domestic
	(1)	(2)
Δ foreign IV	1.003***	2.219**
	(0.158)	(0.890)
Δ domestic IV	-0.002	4.098***
	(0.076)	(0.940)
Secular Trend	×	×
N	657	657
AP Fstat	50.07	19.19

Notes: This table reports the first stage results for employment as an outcome. Column 1 reports the results for Δ foreign IV and column 2 reports the results Δ domestic IV. In both the columns, the endogenous explanatory variable is regressed on both the excluded instruments and the secular trend control for employment. "AP Fstat" row reports the Angrist Pischke first stage F statistics. N denotes the number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2: EFFECT OF CHANGE IN STUDENT ENROLLMENT ON EMPLOYMENT

	Dependent Variable: Δ employment						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ foreign	1.297***	0.847**	0.784***	4.421***	4.138***	2.989***	2.350**
	(0.347)	(0.330)	(0.301)	(1.127)	(1.144)	(1.065)	(0.935)
Δ domestic		0.219***	0.108*		0.126*	0.637***	0.371**
		(0.075)	(0.060)		(0.076)	(0.197)	(0.186)
Secular Trend			×				×
Instrument				Foreign	Foreign	Both	Both
Estimation Method	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
N	657	657	657	657	657	657	657
AP Fstat Foreign				40.14	40.52	51.29	50.07
AP Fstat Domestic						23.80	19.19

Notes: This table reports results of regression for employment as an outcome using various versions of the empirical specification. The dependent variable is the change in the employment of the county between 2004 and 2016 scaled by the population of the county in 2004. The main explanatory variables are changes in enrollment between 2004 and 2016 scaled by the population of the county in 2004. "Secular Trend" row denotes if the secular trend control has been included. Secular trend control includes the growth rate of the outcome between 1996 and 2001. "Instrument" row denotes what instruments have been used. Foreign is for $\Delta\ foreign^{IV}$ and Both is for both $\Delta\ foreign^{IV}$ and $\Delta\ domestic^{IV}$. "Estimation Method" row denotes whether we use OLS or 2SLS method for estimation. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: EFFECT OF CHANGE IN STUDENT ENROLLMENT ON LOCAL LABOR MARKET AND LOCAL BUSINESS OUTCOMES

	Δ employment	Δ tradable employment	Δ nontradable employment	Δ log adjusted wage	Δ business establishment
	(1)	(2)	(3)	(4)	(5)
Δ foreign	2.350**	0.613***	2.102**	1.917**	0.084***
	(0.935)	(0.216)	(0.885)	(0.939)	(0.030)
Δ domestic	0.371**	-0.046	0.267	-0.012	0.015**
	(0.186)	(0.042)	(0.186)	(0.277)	(0.007)
N	657	655	657	657	656
AP Fstat Foreign	50.07	49.77	54.92	48.87	52.24
AP Fstat Domestic	19.19	23.98	18.69	23.59	19.21

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,2,3 and 5 are scaled by 2004 population. Wages are in thousands of dollars and are denominated in 2010 dollars. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 4: EFFECT OF CHANGE IN STUDENT ENROLLMENT ON DEMOGRAPHY AND HOUSING MARKET OUTCOMES

	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)
Δ foreign	1.983	1.173***	1.204
	(1.590)	(0.337)	(0.937)
Δ domestic	0.125	0.029	-0.168
	(0.398)	(0.101)	(0.216)
N	657	657	657
AP Fstat Foreign	50.54	58.05	48.93
AP Fstat Domestic	17.89	15.34	23.36

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1 and 2 are scaled by 2004 population. Rent is in thousands of dollars and are denominated in 2010 dollars. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5: EFFECT OF CHANGE IN STUDENT ENROLLMENT ON COUNTY OUTCOMES USING SPLIT PERIODS

	Δ employment	Δ business establishment	Δ non-student population
	(1)	(2)	(3)
Δ foreign	2.918***	0.081***	2.626*
	(0.954)	(0.027)	(1.377)
Δ domestic	0.106	0.012***	-0.178
	(0.124)	(0.004)	(0.222)
Secular Trend	×	×	×
Time Period Dummy	×	×	×
N	1314	1312	1314
AP Fstat Foreign	53.26	52.70	53.78
AP Fstat Domestic	34.24	35.78	38.74

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using specification 4. All outcome variables are scaled by 2004 population. "Secular Trend" row denotes if the secular trend control has been included. "Time Period Dummy" row denotes if the time period dummy has been included. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 6: EFFECT OF CHANGE IN STUDENT ENROLLMENT ON COUNTY OUTCOMES: HETEROGENEITY WITH POPULATION DENSITY

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	1.670*	1.964**	0.076***	1.601	1.122***	1.032
	(0.916)	(0.968)	(0.029)	(1.475)	(0.329)	(0.964)
Δ domestic	0.246	0.154	0.013*	-0.002	0.013	-0.129
	(0.185)	(0.267)	(0.007)	(0.380)	(0.103)	(0.222)
Δ foreign × PD	2.646***	1.316**	0.037	0.833	0.208	1.353*
	(0.725)	(0.592)	(0.026)	(0.957)	(0.185)	(0.692)
N	657	657	656	657	657	657
AP Fstat Foreign	62.76	59.75	64.19	61.46	69.28	59.63
AP Fstat Domestic	17.66	20.41	17.55	16.24	13.65	20.02
AP Fstat Interaction	62.52	64.66	70.85	63.71	63.43	62.78

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using specification 7. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. "PD" is demeaned log of population density of the county. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. "AP Fstat Interaction" row reports the Angrist Pischke first stage F statistics for the interaction term. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: CORRELATION BETWEEN ENROLLMENT IV AND CONFOUNDERS

	log(f(Δ foreign IV)		log(f(Δ domestic IV)	
	(1)	(2)	(3)	(4)
Log(f(Employment Growth (1996-01)))	0.009***	0.015***	-0.001	-0.002
	(0.002)	(0.003)	(0.004)	(0.005)
Log(f(Nontradable Employment Growth(1996-01)))	-0.001	-0.001	0.003	0.001
	(0.002)	(0.003)	(0.003)	(0.003)
Log(f(Tradable Employment Growth(1996-01)))	0.000	-0.001	-0.001	-0.001
	(0.000)	(0.001)	(0.001)	(0.001)
Δ Log Wage(1996-01)	-0.007**	-0.008**	0.002	0.003
	(0.003)	(0.004)	(0.003)	(0.004)
Log(f(Business Establishment Growth(1996-01)))	-0.002	-0.000	-0.003	-0.005
	(0.003)	(0.003)	(0.004)	(0.004)
Log(f(Non Student Population Growth(1996-01)))	-0.002	-0.002	-0.001	0.007
	(0.003)	(0.003)	(0.005)	(0.004)
Log(f(Houseunits Growth (1990-00)))	0.001	0.005	0.011***	-0.001
	(0.002)	(0.004)	(0.003)	(0.006)
Δ Log Median Rent(1990-00)	-0.000	-0.002	-0.003	-0.001
	(0.001)	(0.002)	(0.002)	(0.002)
More Controls		×		×
N	654	654	654	654
R^2	0.03	0.09	0.07	0.13

Notes: This table reports results of regression of the instrument variables on the variables controlling for secular trend in the earlier regressions. Logarithmic transformation of the variables has been used for straighforward interpretation. Before applying logarithmic transformation to non-logarithmic variables, I add 1.1 to the variables which is denoted by function f in the table. Columns 2 and 4 include the quadratic and cubic terms of the controls as well, which is indicated in the "More Controls" row. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX

“The Local Economic Impacts of Foreign Students”

A Appendix Tables

Table A.1: SUMMARY STATISTICS

	Mean	SD	25th Perc	50th Perc	75th perc
	Counties with at least 5% Student Population				
Δ foreign	0.00262	0.00768	0	0.000820	0.00269
Δ domestic	0.00582	0.0656	-0.0139	0.000415	0.0156
Foreign Enrollment in 1000s (2004)	0.653	1.835	0.0150	0.0850	0.444
Foreign Enrollment in 1000s (2016)	1.170	3.520	0.0300	0.156	0.799
Domestic Enrollment in 1000s (2004)	16.87	31.74	2.850	6.821	19.24
Domestic Enrollment in 1000s (2016)	19.06	39.80	2.602	7.002	21.42
Non-student Population in 1000s (2004)	183.6	496.8	26.46	56.25	159.7
Non-student Population in 1000s (2016)	201.2	520.8	27.34	59.39	175.8
Share of White People (2000)	0.812	0.175	0.729	0.880	0.946
Share of Black People (2000)	0.109	0.155	0.00961	0.0386	0.148
Share of Female (2000)	0.510	0.0146	0.503	0.512	0.518
Share of College Degree Holders (2000)	0.277	0.0885	0.210	0.263	0.330
Share of Working-Age Population (2000)	0.497	0.0362	0.477	0.500	0.522
Share of Elderly Population (65+) (2000)	0.132	0.0309	0.111	0.133	0.151
Observations	657				
			All Counties		
Non-student Population in 1000s (2004)	88.95	287.6	10.89	24.72	60.92
Non-student Population in 1000s (2016)	97.74	311.3	10.77	25.01	64.18
Share of White People (2000)	0.846	0.164	0.770	0.912	0.967
Share of Black People (2000)	0.0859	0.144	0.00269	0.0158	0.0958
Share of Female (2000)	0.504	0.0198	0.499	0.508	0.515
Share of College Degree Holders (2000)	0.221	0.0852	0.161	0.205	0.262
Share of Working-Age Population (2000)	0.509	0.0352	0.486	0.510	0.530
Share of Elderly Population (65+) (2000)	0.148	0.0417	0.121	0.144	0.171
Observations	3082				

Notes: This table shows the summary statistics (average value) of the variables (enrollment and demographics) for the sample counties (top panel) and all the US counties (bottom panel).

Table A.2: COUNTY OUTCOMES: INCLUDING FUNCTIONS OF PRE-PERIOD GROWTH RATE OF THE OUTCOME TO CONTROL FOR SECULAR TREND

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	2.529***	1.931**	0.092***	2.079	1.190***	1.096
	(0.941)	(0.927)	(0.030)	(1.545)	(0.339)	(0.921)
Δ domestic	0.349*	-0.010	0.015**	-0.147	0.026	-0.123
	(0.189)	(0.281)	(0.007)	(0.373)	(0.102)	(0.227)
N	657	657	656	657	657	657
AP Fstat Foreign	53.91	48.24	51.94	49.75	58.93	56.84
AP Fstat Domestic	18.09	23.24	19.16	12.81	15.30	24.56

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. Secular trend control includes the growth rate of the outcome between 1996 and 2001 as well as its quadratic and cubic terms."AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.3: COUNTY OUTCOMES: INCLUDING PRE-PERIOD GROWTH RATE OF ALL THE OUTCOMES TO CONTROL FOR SECULAR TREND

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	2.935***	1.750*	0.088***	1.981*	0.939***	0.680
	(0.900)	(1.019)	(0.030)	(1.087)	(0.296)	(0.924)
Δ domestic	0.209	0.206	0.004	-0.526*	0.056	-0.155
	(0.216)	(0.384)	(0.009)	(0.285)	(0.089)	(0.277)
N	656	656	656	656	656	656
AP Fstat Foreign	57.08	57.08	57.08	57.08	57.08	57.08
AP Fstat Domestic	15.17	15.17	15.17	15.17	15.17	15.17

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. Secular trend control includes the growth rate of all the outcomes between 1996 and 2001."AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.4: COUNTY OUTCOMES: ATLEAST 4% STUDENT POPULATION

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	1.852**	1.337	0.059**	1.416	0.909***	0.622
	(0.870)	(0.965)	(0.029)	(1.523)	(0.333)	(0.831)
Δ domestic	0.525**	0.021	0.021**	0.253	0.058	-0.094
	(0.211)	(0.281)	(0.008)	(0.441)	(0.103)	(0.215)
N	806	806	805	806	806	806
AP Fstat Foreign	64.55	60.98	65.43	62.97	71.47	61.46
AP Fstat Domestic	19.58	23.24	19.36	17.61	16.23	23.27

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. Sample includes all the counties with at least 4% student population. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.5: COUNTY OUTCOMES: ATLEAST 3% STUDENT POPULATION

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	1.930**	2.010**	0.058**	1.485	0.940***	0.746
	(0.848)	(1.017)	(0.028)	(1.509)	(0.326)	(0.838)
Δ domestic	0.490**	-0.049	0.018**	0.214	0.030	-0.154
	(0.207)	(0.288)	(0.008)	(0.439)	(0.099)	(0.220)
N	976	976	975	976	976	976
AP Fstat Foreign	69.84	65.53	70.72	68.13	76.57	68.17
AP Fstat Domestic	21.02	23.92	20.79	18.48	17.73	24.34

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. Sample includes all the counties with at least 3% student population. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.6: COUNTY OUTCOMES: ATLEAST 2% STUDENT POPULATION

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	2.114**	2.288**	0.067**	1.657	0.941***	0.890
	(0.839)	(1.029)	(0.028)	(1.524)	(0.323)	(0.849)
Δ domestic	0.476**	-0.056	0.018**	0.206	0.044	-0.203
	(0.206)	(0.291)	(0.008)	(0.448)	(0.099)	(0.225)
N	1124	1124	1123	1124	1124	1124
AP Fstat Foreign	73.76	69.25	74.74	71.97	80.46	72.02
AP Fstat Domestic	21.51	24.06	21.28	18.43	18.05	24.62

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. Sample includes all the counties with at least 2% student population. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.7: COUNTY OUTCOMES: ATLEAST 1% STUDENT POPULATION

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	2.179***	2.694***	0.067**	1.522	0.837***	0.928
	(0.839)	(1.045)	(0.028)	(1.559)	(0.318)	(0.840)
Δ domestic	0.504**	-0.086	0.018**	0.219	0.073	-0.211
	(0.206)	(0.293)	(0.008)	(0.459)	(0.101)	(0.225)
N	1238	1238	1237	1238	1238	1238
AP Fstat Foreign	76.34	72.06	77.13	74.25	81.31	73.68
AP Fstat Domestic	22.31	24.30	21.71	19.21	19.45	24.65

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. Sample includes all the counties with at least 1% student population. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.8: NEIGHBORING COUNTY OUTCOMES

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	-0.200	0.162	-0.012	-0.418	0.124*	0.058
	(0.174)	(0.111)	(0.014)	(0.309)	(0.065)	(0.128)
Δ domestic	0.047**	0.002	0.003*	0.055	-0.015**	-0.012
	(0.023)	(0.012)	(0.002)	(0.038)	(0.007)	(0.011)
N	1473	1473	1473	1473	1471	1468
AP Fstat Foreign	22.58	23.62	22.01	22.07	19.88	39.86
AP Fstat Domestic	10.83	11.52	11.00	11.31	9.54	47.47

Notes: This table reports the results of effects of foreign and domestic student enrollment on the various outcomes of neighboring counties without institutions. The outcome variable is depicted in the column head. The sample includes all counties without institutions that neighbor a county with an institution (neighboring counties). The dependent variable is the change in the outcome of the neighboring county between 2004 and 2016. Dependent variables in columns 1,3,4 and 5 are scaled by the 2004 population. Wages and rent are in thousands of dollars and are denominated in 2010 dollars. The two main explanatory variables ((Δ foreign and Δ domestic)) are the 12-year enrollment changes of domestic and foreign students summed over all the adjacent counties with institutions. All the explanatory variables except wages and rent are further scaled by the population of the neighboring county in 2004. All regressions have secular trend control, i.e., the growth rate of the outcome between 1996 and 2001. The estimation method used is 2SLS. "AP Fstat Foreign" row reports the Angrist Pischke first-stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first-stage F statistics for the Δ domestic. N denotes the number of observations. Robust standard errors clustered at the county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A.9: COUNTY OUTCOMES: EXCLUDING INFLUENTIAL COUNTIES

	Δ employment	Δ log adjusted wage	Δ business establishment	Δ non-student population	Δ house units	Δ log median rent
	(1)	(2)	(3)	(4)	(5)	(6)
Δ foreign	1.759**	2.006**	0.085***	2.010	1.162***	1.097
	(0.808)	(1.001)	(0.032)	(1.655)	(0.346)	(0.968)
Δ domestic	0.339*	-0.016	0.014**	0.126	0.025	-0.182
	(0.182)	(0.276)	(0.007)	(0.398)	(0.101)	(0.217)
N	650	650	649	650	650	650
AP Fstat Foreign	47.19	45.30	49.28	47.61	54.88	45.86
AP Fstat Domestic	19.28	23.74	19.37	17.99	15.21	23.39

Notes: This table reports results of regression for various outcomes. The outcome variable is depicted in the column head. All the columns are estimated using the specification in column 7 of Table 2. Outcome variables in column 1,3,4 and 5 are scaled by 2004 population. Wages and Rent are in thousands of dollars and are denominated in 2010 dollars. Sample includes all main sample counties except those in top 1 percentile of total foreign student enrollment in 2004. "AP Fstat Foreign" row reports the Angrist Pischke first stage F statistics for the Δ foreign. "AP Fstat Domestic" row reports the Angrist Pischke first stage F statistics for the Δ domestic. N denotes number of observations. Robust standard errors clustered at county level in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.