The Local Economic Impact of International Students: Evidence from US Commuting Zones*

Tung Dang*

[a] *University of Sydney and ARC Centre of Excellence for Children and Families Over the Life Course, Camperdown, 2050, NSW, Australia*

Abstract

This paper examines the impact of international students on local labor markets and establishments in the United States. Identification rests on a shift-share instrument strategy that exploits supply-driven changes in foreign enrollments in non-US destinations. I find that one additional student per thousand working-age residents increases the employment-to-population ratio by 0.19 percentage points and average hourly wages by 0.48 percent. Increases in foreign enrollment also lead to substantial labor reallocations toward potentially more productive establishments, particularly within non-tradable industries. Heterogeneity analyses suggest that these effects are primarily driven by demand-side factors related to student spending, while labor supply contributions from student employment play a limited role. Overall, these findings point to sizable economic benefits linked to foreign student inflows through increased local income and business dynamism, and suggest that rising trade tensions and restrictive immigration policies may impose substantial costs by slowing or reversing recent enrollment trends.

Keywords: International students, Local labor markets, Job flows, Immigration policy
JEL classification: F22, I23, J23, J61

1. Introduction

Despite rising attendance costs, international students' enrollment in US higher education has increased substantially over the past few decades. Rapid economic growth, particularly in China and many other emerging markets, has led to a remarkable surge in the number of students who can afford an education overseas (Bound et al. 2020; Bound et al. 2021; Khanna et al. 2023). Indeed, as Fig. 1 demonstrates, the rise in the number of self-funded students accounted for almost all of the growth in foreign enrollment in US higher education in recent years. Besides generating more tuition and fee revenue for the higher education sector, such changes in the number and composition of students from abroad have the potential to fuel demand for local goods and services and result in substantial economic impacts on local economies (Peri 2016).[1]

In this paper, I examine the effects of international students on local labor markets and establishments. Such effects differ fundamentally from those of other immigrant groups due to several important institutional constraints. Notably, US visa restrictions severely limit international students' ability to participate in local labor markets during their stud-

*I am grateful to Nancy Chau, Ravi Kanbur, and Mallika Thomas for their guidance and support. I also thank Cynthia Bansak, Arnab Basu, Chris Barrett, Deborah Cobb-Clark, Oleg Firsin, Todd Geraden, John Hoddinott, Benjamin Leyden, Shanjun Li, Mike Lovenheim, Samreen Malik, Evan Riehl, Ivan Rudik, Chad Sparber, Julia Zhu and seminar participants for helpful comments and suggestions.

*Corresponding author at: The University of Sydney, Australia

Email address: tung.dang@sydney.edu.au (Tung Dang)

[1] Foreign students generated $47.3 billion in education revenue alone in 2018, almost equivalent to US export of passenger cars in the same period (Bureau of Economic Analysis 2022).

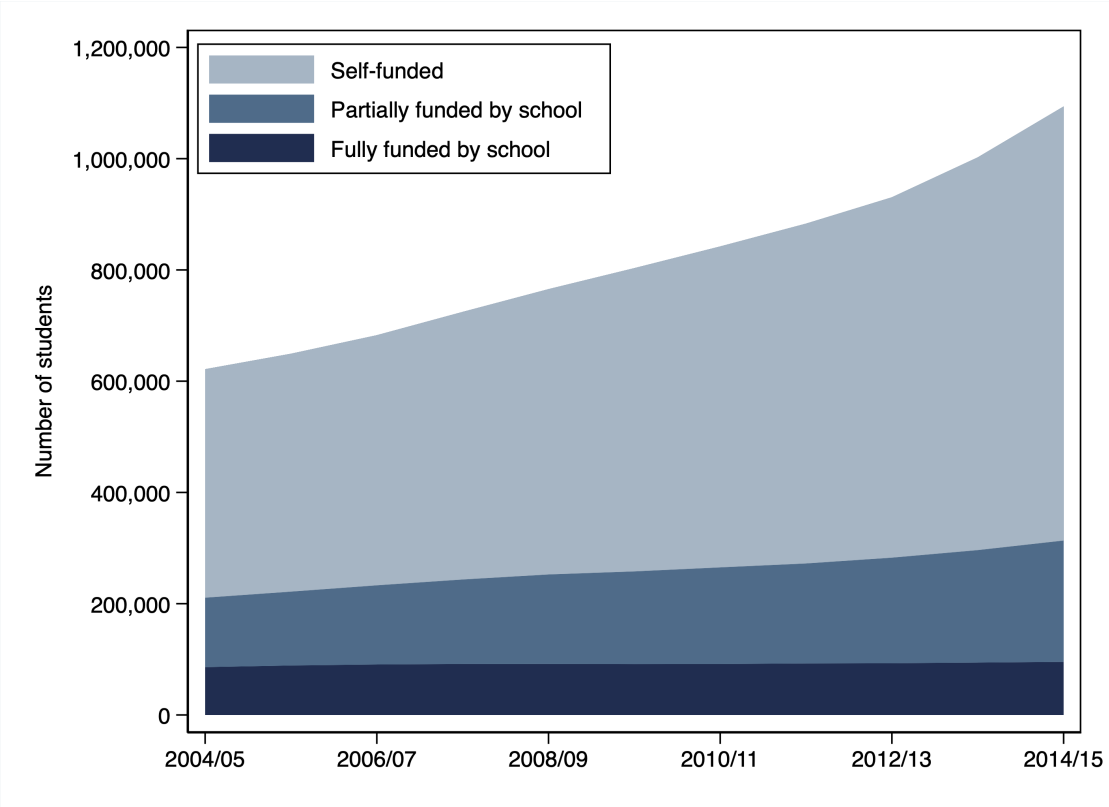


Fig. 1 Trends in International Student Enrollment in US Higher Education by Funding Status.
Source: Author's calculations based on administrative data from US Department of Homeland Security.

ies, positioning them primarily as consumers within the local economy. At the same time, the Curriculum Practical Training (CPT) and Optional Practical Training (OPT) programs permit limited, field-related labor market participation during school and shortly after graduation. Recent work by Beine et al. (2023) shows that a modest share of international students eventually transition into the U.S. workforce through OPT, particularly in high-skilled sectors. Building on these institutional details, this paper provides the first comprehensive evidence on the short-run economic impact of international students on local economies, and uses rich administrative data to disentangle the extent to which this impact reflects students' spending on local goods and services (demand channel) versus their participation in the labor market (supply channel).

My empirical analysis draws on several data sources and uses the concept of commuting zones to approximate local labor markets. At its core is a rich administrative dataset covering all international students enrolled in US higher education under F-1 student visa status between 2003 and 2015. The data allow me to precisely measure enrollment at the commuting zone level and utilize spatial variation in the distribution of international students to study their local economic impact. More importantly, available information on each student's country of origin enables a shift-share instrumental variable estimation approach, which I use to address key identification challenges. As with many studies in the immigration literature, a major concern with the spatial correlation approach in this setting is the existence of potentially unobserved pull factors that may influence both the inflows of international students and local labor market conditions. For instance, Bound et al. (2020) show that declines in state appropriations for higher education, particularly after an economic recession, led public research universities to respond to budget shocks by enrolling increasing numbers of students from overseas who could readily afford out-of-state tuition. In such cases, deteriorating local economic conditions may increase universities' reliance on international students for tuition revenue, potentially

leading to a downward bias in OLS estimates of the effects of increased foreign enrollment on local labor markets and firms.

My identification strategy circumvents potential biases caused by unobserved local pull factors by exploiting changes in the outflows of international students across countries of origin into other top English-speaking destinations. These shocks help isolate plausibly exogenous, supply-push components of the variation in foreign enrollment, which I combine with the tendency of students to apply to US programs where previous cohorts from the same countries of origin have attended to construct my instrument. Through a series of falsification tests, I show that the variation in foreign enrollment predicted by the instrument is conditionally uncorrelated with pre-determined changes in local economic conditions.

To examine the net impact of international students on local labor demand, I combine administrative data on international students with employment, wage, and demographic data from the American Community Survey. My results suggest that an increase in foreign enrollment leads to significant increases in local employment and earnings. At the commuting zone level, an increase in enrollment by one student per thousand working-age residents raises the employment-to-population ratio by 0.19 percentage points and average hourly wages by 0.48%. These effects are economically substantial and indicate that the overall growth in foreign enrollment in US higher education between 2005 and 2015 led to the creation of over 1.2 million jobs, an impact equivalent in magnitude to 49–59% of the displacement effect caused by rising import competition from China (Acemoglu et al. 2016). These sizable estimates likely reflect both the direct employment supported by student expenditures and broader general equilibrium effects, such as increased local demand stemming from higher native earnings and housing wealth. As detailed in Section 4, applying local income multipliers from plausibly exogenous place-based spending shocks in the range of 1.7–2.0 (Serrato and Wingender 2016), the implied cost of creating a job-year in response to international student inflows is roughly 33,000–38,000, comparable to benchmark estimates in the local fiscal multiplier literature.

To disentangle the relative importance of the demand and labor supply channels in generating these local labor market effects, I leverage detailed administrative data that allow me to measure students' potential contributions to local economies through their demand for local goods and services, as well as their direct labor market participation via CPT and OPT employment authorizations. I find that employment gains are larger and more pronounced in commuting zones experiencing above-median increases in students' reported financial resources, reflecting stronger local demand shocks driven by student expenditures. In contrast, heterogeneity analyses by local OPT intensity, measured by the number of full-time equivalent OPT participants per working-age resident, reveal no meaningful differences in local employment effects between commuting zones experiencing above- versus below-median changes in student-driven labor supply. Consistent with the predominant role of the demand channel, employment effects are concentrated in the non-tradable sector, particularly in construction and services. Importantly, I show that these labor market effects reflect an expansion in the capacity of US higher education to attract international students, rather than displacement of domestic students from local labor markets.[2]

To better understand the sizable local employment effects documented above, I next examine the underlying job flow dynamics using Business Dynamics Statistics data as well as establishment microdata from the Your-Economy Time Series (YTS) database. The YTS tracks establishments across the US and contains detailed information on employment, industry affiliation, and sales, allowing me to measure how increases in foreign enrollment affect gross job creation and destruction. My analysis shows that the net increase in local employment conceals substantial churn at the establishment level, with significant job creation from entry and expansion alongside substantial job destruction due to exit and contraction. Importantly, gross job creation arises mainly from entry and expansion

[2] I document a small decline in first-time, first-year domestic enrollment at two-year programs, likely driven by improved labor market conditions that raise the opportunity cost of attending community colleges.

in service-oriented industries that tend to have relatively low barriers to entry. Using average annual sales growth to proxy for establishment performance, I further show that these dynamics reflect a reallocation of labor toward higher-performing establishments: expansions occur disproportionately among higher-performing firms, while job losses are concentrated among the lowest-performing. These patterns are consistent with general equilibrium models featuring heterogeneous firms (e.g., Melitz 2003; Bernard et al. 2007; Melitz and Ottaviano 2008), which predict that positive local demand shocks, such as those induced by student spending, heighten competition and trigger reallocation toward more efficient producers. Thus, the presence of international students may not only raise local employment and earnings but also enhance aggregate productivity by reallocating labor and market shares to potentially more productive firms.

My findings contribute to three separate strands of literature. First, this paper contributes to the broader debate on the economic consequences of immigration by providing evidence of the positive effects of immigrant consumption on natives' labor market outcomes. Much of the discussion in this area has focused exclusively on the potentially negative impact of an immigration-induced labor supply shock while neglecting the fact that immigrants could also stimulate local labor demand through their spending on non-tradable goods and services.[3] Recent evidence using expenditure data to measure immigrant-driven demand exposure more directly finds that demand shocks can have sizable effects on native earnings (Galaasen et al. 2025). I contribute to this demand-side perspective by studying a large and growing group of foreign-born individuals in the U.S. whose ability to participate in the labor market is limited by visa restrictions. To the extent that their local spending generates employment, these effects may partially offset any labor supply pressures, potentially helping explain why many empirical studies have found relatively modest impacts of immigration on natives' employment and wages.[4]

Second, existing studies on the impact of international students have primarily focused on outcomes within the higher education sector, including school finance (Bound et al., 2020), domestic enrollment (Shih, 2017; Zhu, 2025), academic innovation (Chellaraj et al., 2008; Stuen et al., 2012), and domestic students' major and occupational choices (Anelli et al., 2023). Beyond education-specific outcomes, recent work has begun to explore spillovers into other local markets. Mocanu and Tremacoldi-Rossi (2023), for example, show that international student inflows increase local rents and home prices. Beine et al. (2023) document that only a modest share of international graduates, particularly those in STEM fields, enter the US workforce through OPT, highlighting the important yet limited scale of their short-run labor supply contributions. Building on this growing literature, my paper shifts attention to the broader short-run economic consequences of foreign enrollment, especially the role of international students in driving local labor demand and shaping within-industry resource reallocation. My findings therefore speak directly to current policy concerns about the potential local economic costs of declining enrollment due to trade tensions (Khanna et al., 2023) and increasingly restrictive immigration policies (Peri et al., 2020; Feeney et al., 2023).

Lastly, this paper also relates to a body of literature that assesses how competition can spur efficiency. In particular, a Darwinian selection process through which resources are reshuffled toward more efficient producers has been linked to heightened intra-market competition (Disney et al. 2003; Syverson 2004;

[3] Some indirect evidence on the demand channel exists. Bodvarsson et al. (2008) examine the 1980 "Mariel boatlift" and find strong increases in local spending and labor demand in Miami's retail sector following the massive, sudden influx of Cuban immigrants. Olney (2015) studies remittances as a source of variation in immigrants' spending in local economies and identifies negative effects of remittance outflows on natives' wages in Germany. Hong and McLaren (2015) document positive effects of immigration on the diversity of local services offered, as well as employment and wages in the local non-tradable sector in the US. Lastly, Dustmann et al. (2017) suggest that when the demand channel is suppressed, such as in the case of Czech workers who commuted across the Germany-Czech border to work and did not live and consume in affected areas, an immigration-induced increase in local labor supply could result in significant negative effects on natives' employment and wages in the short-run.

[4] For recent reviews of this literature, see Blau and Kahn (2015), Dustmann et al. (2016), and Blau and Mackie (2017).

Foster et al. 2006) and trade liberalization (Pavcnik 2002; Trefler 2004; Bernard et al. 2006; McCaig and Pavcnik 2018). My findings reinforce the notion that competition can have productivity-enhancing effects (Syverson 2011) and underscore the significance of firm dynamics in shaping local economic adjustments to immigration (Glennon 2024).

The rest of the paper proceeds as follows. Section 2 describes the data. Section 3 outlines the empirical approach and, in particular, an instrumental variable estimation strategy that seeks to address identification challenges. Section 4 presents results on the effects of international students on local employment and wages, and explores underlying mechanisms. Section 5 examines the effects on local job flows and their distributional implications. Section 6 concludes.

2. Data

This paper draws on multiple data sources to measure foreign enrollment and construct individual and establishment outcomes at the local labor market level. In this section, I briefly discuss each data source and summarize the most relevant features for my analysis. As a starting point, I use the concept of commuting zones developed by Tolbert and Sizer (1996) to approximate local labor markets. These geographic units represent clusters of US counties characterized by strong commuting ties within each cluster and have the advantage of being nationally comprehensive. This is important because alternative measures of local labor markets that have been used in the immigration literature, such as metropolitan statistical areas (MSAs), typically focus on large population centers and thus exclude small rural college towns where demand shocks generated by international students might prove relatively more impactful.[5] Furthermore, weak between-cluster commuting ties ensure that both the incidence and the effects of local demand shocks generated by international students are more likely to be contained within a commuting zone, especially if increases in local demand primarily affect the non-tradable sector. Accordingly, my empirical analysis focuses on 722 commuting zones that cover the entire US continental territory.

2.1. *International students*

Data on international students come from administrative records provided by the US Department of Homeland Security (DHS) via a Freedom of Information Act (FOIA) request. These I-20 records cover the universe of F-1 visa holders enrolled in US higher education between 2003 and 2015 and include detailed student-level information, including country and city of origin, program level, field of study, school name and location, program start and end dates, and sources of financial support (e.g., personal funds, family support, school-based aid, or government sponsorship).

Using program start and end dates, I construct annual commuting-zone-level measures of international student enrollment, defined as the number of students enrolled at any point during the year in institutions located within each commuting zone. I also use the reported financial support information to create a measure of average funding per student in each zone and year. This variable serves as a proxy for students' potential spending power and is used for heterogeneity analyses, capturing differences in students' potential spending power. In addition, I draw on a separate dataset of Optional Practical Training (OPT) authorizations available through the ICE FOIA library. These records include employer names, locations, and start and end dates of employment. I use this information to construct a measure of OPT intensity, converted to full-time-equivalent units and assigned to commuting zones based on employer address, which allows me to explore the potential contribution of international students to local labor supply in the short run.

As discussed in the next section, I use a shift-share instrumental-variable strategy to address concerns that changes in international student enrollment may be correlated with local economic conditions across commuting zones and over time. The strategy isolates variation in origin-specific student inflows to the US using postsecondary enrollment shocks observed in Australia, Canada, and the United King-

[5] Examples of recent migration studies that use commuting zones as the units of analysis include Smith (2012) and Derenoncourt (2022).

dom. Data on origin-specific enrollment in these countries come from the Australian Department of Home Affairs (DHA), Immigration, Refugees and Citizenship Canada (IRCC), and the UK Higher Education Statistics Agency (HESA).

2.2. *Local labor market and education outcomes*

For my main analysis, I use American Community Survey (ACS) data from 2005 to 2016, extracted from the Integrated Public Use Microdata Series (IPUMS), to construct local labor market outcomes (Ruggles et al. 2022). Focusing on working-age individuals (16–64) who are not living in institutionalized group quarters, I first identify commuting zones of residence based on respondents' county of residence, which is available for over half the IPUMS sample. For respondents without county identifiers, I assign commuting zones using Public Use Microdata Area (PUMA) information. Because a PUMA may cross commuting zone boundaries, I use a statistical procedure employed by Smith (2012) and David and Dorn (2013) to obtain consistent estimates of commuting zone outcomes. This procedure involves duplicating observations from PUMAs that overlap with multiple commuting zones and re-weighting these observations according to the fraction of the PUMA population estimated to reside within each commuting zone.

I focus on the (working-age) employment-to-population ratio and average hourly wages among those working at least 35 hours per week as my main outcomes. Total wage and salary earnings in the previous 12 months as well as the product of the number of weeks worked and the usual number of hours worked per week are first aggregated to the commuting-zone level. Average hourly wages are then calculated by dividing total wage and salary earnings by the estimated number of hours worked in a commuting zone. All wages are expressed in 2020 dollars using the Bureau of Labor Statistics' Consumer Price Index.

In addition to employment and wages, I examine whether changes in local labor-market opportunities induced by international students affect natives' incentives to invest in education, focusing on college enrollment among young adults. For this exercise, I use data from the Integrated Postsecondary Education Data System (IPEDS). Specifically, at the commuting zone level, I construct fall enrollment per capita for first-time, first-year, degree-seeking domestic students, separately for two-year and four-year institutions, by dividing counts by the local 18-25 population.[6] In addition, I use IPEDS data to construct measures of higher-education resources and spending, including state appropriations per public FTE and total institutional expenditures, which I use in heterogeneity and validation analyses. Finally, I use ACS data to construct a set of time-varying commuting-zone covariates to control for changes in local demographic and economic conditions.

2.3. *Job flows*

To measure local job flows, I leverage both aggregate data from US Census Business Dynamics Statistics and annual establishment-level time-series data from the Your-Economy Time Series database, the latter of which is maintained by the Business Dynamics Research Consortium (BDRC) at the University of Wisconsin. The YTS links establishments longitudinally at their unique locations across the US and provides annual establishment-level information on employment and sales for both public and private firms.[7] An important advantage of the YTS data lies in the availability of establishment-level sales and employment information, which allows me to conduct heterogeneity analyses by establishment performance. To this end, I restrict my YTS sample to all for-profit establishments that were in operation at some point between 2004 and 2016 and observed for at least two years in the database. Additionally, I exclude those with less than two employees to avoid nonemployer businesses. Further details on variable construction are discussed in Section 5.

[6] Commuting-zone population counts are drawn from the Surveillance, Epidemiology, and End Results (SEER) program.

[7] YTS is constructed from the Infogroup Historic Datafiles and focuses on "in-business" establishments by filtering out entities created for tax purposes or merely holding companies. For additional details, see https://wisconsinbdrc.org. Recent studies using YTS include Ghent (2021), Campello et al. (2024), and Miller et al. (2025).

3. Empirical Methodology

My empirical analysis exploits variation in the distribution of international students across US commuting zones between 2005 and 2015 to study their effects on local labor markets and establishments. Fig. 2 depicts the cross-sectional distribution of students in 2005 (Panel A) and the average annual change in enrollment over the entire 2005-2015 period (Panel B) across commuting zones.[8] As shown, there are considerable spatial differences in the number of students attending universities and colleges in each commuting zone. Within the study period, commuting zones that were initially popular destinations were more likely to sustain strong enrollment growth subsequently. In this section, I first describe the estimation equation and discuss the challenges associated with the spatial correlation approach. I then introduce an instrumental variable estimation strategy aimed at addressing these issues and provide evidence that supports the validity of the approach.

3.1. Estimation equation

To examine how local labor markets and establishments respond to an increase in foreign enrollment, I estimate specifications of a stacked first-difference model that has been used in the immigration literature (e.g., Monras 2020):

$$\Delta y_{c,t+1} = \gamma_t + \beta \frac{\Delta \text{IS}_{c,t}}{\text{Pop}_{c,t-1}} + \Delta X'_{c,t}\Gamma + \Delta \epsilon_{c,t} \qquad (1)$$

where $t \in [2006, 2015]$, $\Delta z_t = z_t - z_{t-1}$, and γ_t denotes a vector of year fixed effects. The dependent variable, $\Delta y_{c,t+1}$, is the one-year change in the outcome from t to $t+1$, such as changes in the employment-to-population ratio or in log average wages. The main explanatory variable of interest, $\Delta \text{IS}_{c,t}/\text{Pop}_{c,t-1}$, is the period change in the number of international students enrolled in postsecondary institutions in commuting zone c scaled by the size of the commuting zone's working-age population at the beginning of the period. This specification thus allows the effects of changes in international student enrollment to vary by the size of the local economy while avoiding the potential pitfalls that arise when there are changes in the local population due to migratory responses by natives.[9] Furthermore, the lag structure of the independent variables accommodates a short delay before the effects of international students on workers and establishments can be observed.

Since I estimate my econometric model in stacked first differences, any unobserved time-invariant heterogeneity across commuting zones will be removed without imposing more restrictive assumptions on the error structure.[10] However, commuting zones may still differ systematically in time-varying characteristics that could predict unobserved shocks to local economic conditions. For instance, areas with a stronger international student presence may have younger, more educated populations or a higher share of foreign-born residents. To further account for such differences, I control for a set of time-varying population characteristics, X_{ct}, including (log) population; the share of females; the share of residents aged 65 and older; the shares of the population by education (some college, college or professional degree, and advanced degrees); and the share of non-citizen workers.[11] Lastly, as discussed below, in IV specifications where changes in foreign enrollment are predicted by a shift-share instrument, I also include the sum of exposure shares interacted with year fixed effects as controls. Unless otherwise noted, all regressions are weighted by commuting zone population in 2005.[12]

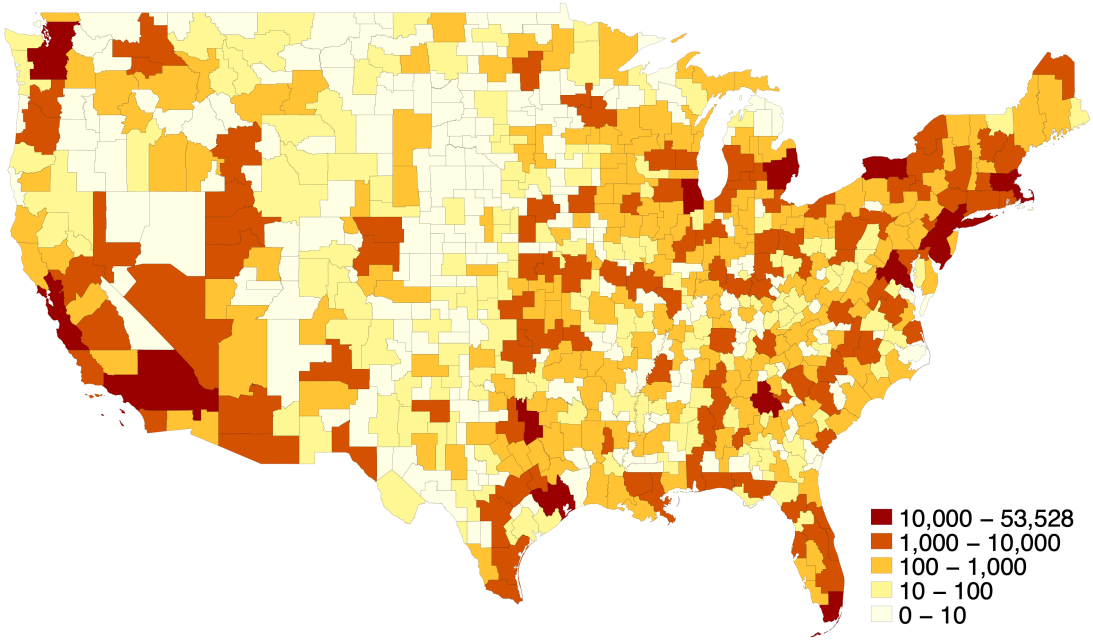
[8] See Appendix Table B1 for a tabulation of summary statistics.

[9] An alternative specification that has also been used in the literature regresses changes in the outcome on changes in the *population share* of immigrants (or international students in this case), though results will be mechanically biased if there are migratory responses by natives to immigration (Card and Peri 2016).

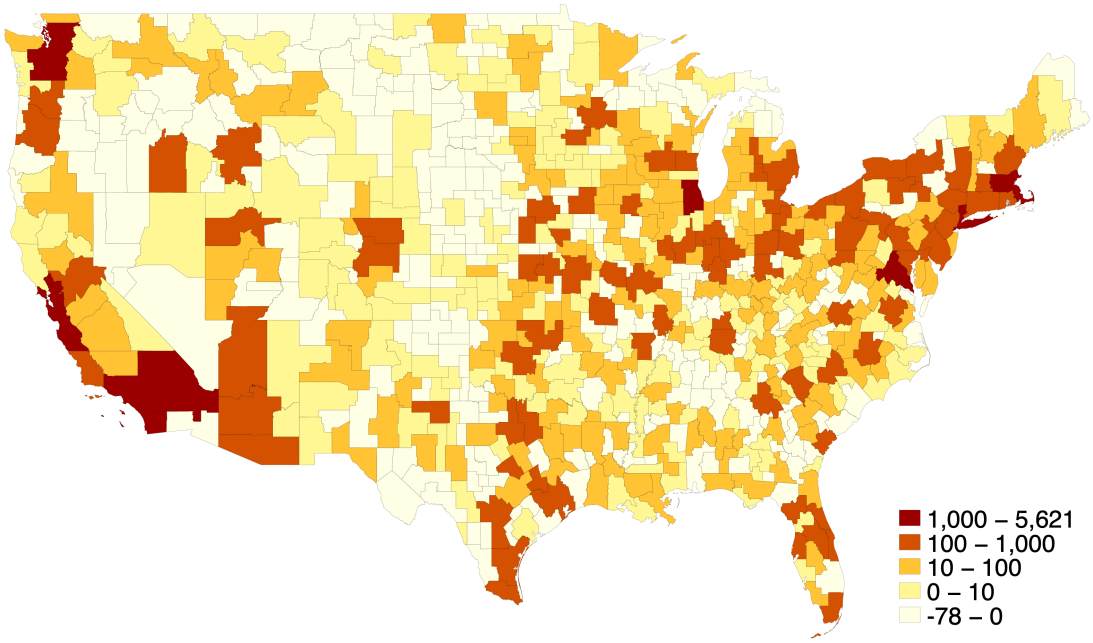
[10] A fixed-effect specification assumes no serial correlation in the error term while first-difference estimators are more efficient if the errors follow a random walk (Wooldridge 2010). In practice, I cluster standard errors on commuting zones to obtain estimates robust to either structure.

[11] As shown below, my baseline estimates are similar with and without these controls.

[12] Following common practice in the local labor markets literature, regressions are weighted by commuting-zone population to correct for population-size-related heteroskedasticity in the error terms (see Solon et al. 2015 for a discussion).



(a) International student enrollment, 2005



(b) Average annual growth in enrollment, 2005-2015

Fig. 2 Spatial distribution of international students across commuting zones.

3.2. Identification challenges

The main difficulty in estimating β, which captures the short-run effects of international students on local labor markets and establishments, is to account for bias associated with the potentially endogenous distribution of international students across commuting zones and time. For example, international student enrollment could be driven by negative local economic shocks. Recent studies have identified economic recessions and the resulting declines in state support for higher education as strong drivers of international enrollment (Bound et al. 2020; Bound et al. 2021). Bound et al. (2020) find that a 10 percent decrease in state appropriations results in a 16 percent increase in the enrollment of students from overseas at public research universities and a 22 per-

cent increase at the more resource-intensive Association of American Universities (AAU) institutions. To the extent that areas hardest hit by a recession also experienced the sharpest declines in state support for higher education, OLS estimates of the effects of international students on local economies will be biased downward.

On the other hand, the arrival of students from overseas into a commuting zone can also be driven by positive local labor demand shocks. This particular concern has often plagued the immigration literature because areas experiencing strong growth in labor demand also tend to attract more foreign-born workers. If international students anticipate improving local labor market conditions and account for improved access to local training and employment opportunities upon graduation when making enrollment decisions, OLS estimates of their effects on local economies could also be biased upward.[13]

In addition to the systematic sorting of international students across commuting zones, measurement error in the size of the international student population could, in principle, attenuate OLS estimates. As mentioned in the previous section, the administrative data, while the best available source for tracking international students in the US, do not record actual program termination dates. I therefore construct annual enrollment stocks using anticipated program end dates, which may overstate true enrollment if some students leave their programs early. In practice, however, this source of error appears limited: the enrollment series constructed from the administrative data is highly correlated with foreign enrollment measured in IPEDS (correlation = 0.981 in levels over 2005-2015), suggesting that any mismeasurement is unlikely to be quantitatively important.

3.3. Instrumental variable approach

To address biases resulting from the endogenous distribution of international students, I use a shift-share instrumental variable approach that isolates the plausibly exogenous, supply-driven variation in enrollment. I isolate this supply-driven component by using observed changes in the combined number of international students from each country of origin that enrolled in a higher education institution in three other leading English-speaking destinations, Australia, Canada, and the United Kingdom, which collectively host an almost as many international students as the US. The average pairwise correlation coefficient between US inflows and inflows in these three destinations over the 2005-2015 period across origins is about 0.7, which suggests the existence of a common set of factors that exert a strong influence on the total supply of students wishing to study abroad from each source country. For example, these could be underlying changes in demographics, family income, and/or institutional background within each source country. Indeed, Khanna et al. (2023) show that the rise in the number of international students from China, which accounted for much of the increase in global outflow, was largely driven by growth in family income and, hence, students' ability to afford an education abroad. Thus, fluctuations in the number of international students studying in Australia, Canada, and the UK are strong predictors of the realized changes in enrollment in the US across origins but are arguably not related to pull factors that driven by changes in local economic conditions in the US. Furthermore, students from each country of origin tend to apply to the same programs that previous cohorts have attended (Beine et al. 2014; Shih 2017). Accordingly, this network tendency causes supply shocks from each source country to have differential effects across US commuting zones that vary with the strength of the network.

To implement these ideas, I construct my instrument by interacting the distribution of international students by country of origin across commuting zones in 2003 with observed changes in total enrollment of students from each origin in Australia, Canada, and the UK. Specifically, let k denote a country of origin, the predicted change in enrollment

[13] Ruiz (2014) suggests that, among international students who engaged in temporary post-graduation employment through Optional Practical Training (OPT) between 2008 and 2012, about 45 percent remained in the same metropolitan area where they studied. Similarly, Beine et al. (2023) find that foreign graduates who transition into the US labor force typically secure their first job in the same state where they completed their study programs.

in commuting zone c from $t-1$ to t is taken as

$$\widehat{\Delta \text{IS}}_{c,t} = \sum_k \frac{\text{IS}_{c,k,2003}}{\text{IS}_{k,2003}} \times \Delta \text{IS}_{t,k}^{\text{Australia, Canada, UK}} \quad (2)$$

where $\Delta \text{IS}_{t,k}^{\text{Australia, Canada, UK}}$ is the period change in the enrollment of international students from country k in the three mentioned destinations. The share component, $\frac{\text{IS}_{c,k,2003}}{\text{IS}_{k,2003}}$, is the fraction of students from country k enrolled in US higher education institutions located in commuting zone c in 2003. This instrumental variable estimation approach is thus similar in spirit to a growing number of studies in the immigration literature that use supply-push factors as the shift component (Card 2001; Stuen et al. 2012; Peri et al. 2015; Shih 2017; Monras 2020; Derenoncourt 2022), and is most closely related to Stuen et al. (2012) who also use foreign enrollment at non-US destinations to predict enrollment in US institutions.

3.4. *Validity of the instrument*

For the IV approach approach to work, the constructed shift-share instrument must satisfy the relevance and exclusion restrictions. Here, I address these two conditions before briefly discussing issues related to statistical inference.

Relevance.—As mentioned, there is a strong correlation between changes in foreign enrollment across countries of origin between the US and the other three English-speaking destinations, driven by significant underlying increases in the supply of internationally mobile students, particularly from emerging markets (Appendix Fig. A1). In a simple regression not reported here, annual changes in combined total enrollment in Australia, Canada, and the UK explain more than half of the variation in changes in US enrollment across all countries of origin between 2005 and 2015. Fig. 3 and Appendix Table B2 report the first-stage relationship between the predicted and actual changes in international student enrollment, both adjusted by start-of-period commuting zone population. The first-stage F-statistic is 57.2, suggesting that my instrument provides a sufficient source of identifying variation.

Exclusion restriction.—Recent work by Borusyak, Hull, and Jaravel (2022; hereafter BHJ) shows how identification based on shock exogeneity can be achieved with a shift-share research design, as applied in this setting.[14] Specifically, since the sum of exposure shares, $\sum_k \frac{\text{IS}_{c,k,2003}}{\text{IS}_{k,2003}}$, varies across commuting zones and is likely endogenous, BHJ's equivalence results suggest that consistent estimates can be obtained as long as the following two conditions are met: (1) the shifters are "idiosyncratic," and (2) a simple adjustment is made by either controlling for the sum of exposure shares or constructing a recentered instrument that subtracts this sum from the original formula. In other words, with this adjustment, the constructed shift-share instrument can be used to identify causal effects, provided that changes in foreign enrollment in Australia, Canada, and the UK are orthogonal to share-weighted unobserved factors affecting local labor market conditions in the US.

To assess the validity of the identifying assumptions underlying the shift-share design, I implement two complementary falsification tests following the framework of Borusyak et al. (2022). These tests examine whether the variation used in estimation, either the shifters (shocks) or the constructed instrument, predicts pre-determined, past changes in commuting zone characteristics.[15]

Panel A of Table 1 assesses the plausibility of shock orthogonality by testing whether the non-US enrollment shocks are conditionally unrelated to pre-existing trends in commuting-zone characteristics. Following Borusyak et al. (2022), I examine whether share-weighted lagged changes in commuting-zone outcomes are correlated with *future* changes in foreign enrollment in non-US destinations, conditional on the baseline covariates used in Eq. (1). To implement this shock-level procedure, I first residualize lagged outcome changes and future

[14] See Goldsmith-Pinkham et al. (2020) for a discussion of settings in which identification rests on exogenous shares.

[15] I focus on more recent lags (changes from $t-2$ to $t-1$ and from $t-1$ to t) since the instrument's share component is constructed from 2003 enrollment data: extending falsification tests further back would push outcome measurement close to (or before) the share baseline and may introduce mechanical correlations via the share component. Moreover, the ACS 1-year series begins in 2005, so longer horizons reduce the sample and shift identifying variation away from time-varying shocks and toward time-invariant shares, which is less desirable in my setting.

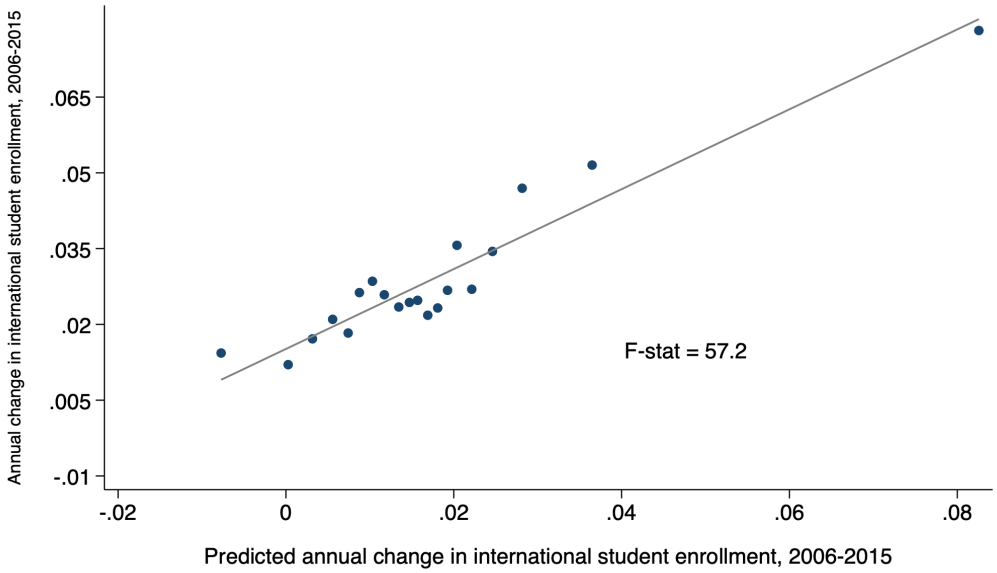


Fig. 3 IV First Stage.

Notes—This binned scatterplot shows the first-stage relationship between predicted and actual annual change in international student enrollment between 2006 and 2015. The right-hand-side variable is grouped into 20 bins. Both left- and right-hand-side variables have been residualized on a set of covariates that include changes in (log) population, the population share of females, the share of the population over 64 years old, the shares of the population by education (some college, college or professional degree, and advanced degrees), the population share of non-citizen workers, and the sum of the share components of the instrument interacted with year fixed effects. Regression is weighted by commuting-zone population in 2005.

non-US enrollment shocks on the control vector in Eq. (1). I then aggregate these residuals to the country-of-origin (shock) level using exposure shares as weights. Finally, I estimate the shock-level regression in which the endogenous variable is the exposure-weighted change in US foreign enrollment and the instrument is the exposure-weighted non-US enrollment shock. Across a range of lagged outcomes—including changes in state appropriations for higher education, the foreign-born high-skilled share, employment rates, and average wages—I find no evidence of a systematic correlation, supporting the plausibility of conditional shock orthogonality.

Next, I test the conditional exogeneity of the shift-share instrument, which follows from shock orthogonality under BHJ's equivalence results. Panel B of Table 1 reports both OLS and IV estimates from regressions of lagged changes in commuting zone outcomes on future changes in foreign enrollment, conditioning on the full set of second-stage covariates. The OLS results show statistically significant correlations: commuting zones with subsequent increases in foreign enrollment tend to have experienced, in prior years, reductions in state higher education funding, increases in high-skilled immigration, rising employment, and falling average wages. These patterns suggest potential bias in naive OLS estimates. In contrast, when foreign enrollment is instrumented using the shift-share strategy, these relationships disappear—the estimated coefficients are near zero and statistically insignificant. This supports the validity of the instrument, consistent with the assumption that shocks to foreign enrollment in non-US destinations are conditionally orthogonal to pre-existing local trends in the US.

A final concern with the shift-share strategy is that enrollment patterns across destination countries may reflect substitution effects among students who apply to programs in multiple destinations. In such cases, country-specific increases in enrollment in one destination may partly reflect declines in US enrollment, complicating the interpretation of the shift-share estimates. In Section 4.2, I address this concern by constructing an alternative shift-share instrument based on enrollment changes in all non-US destinations, using data from the UNESCO Institute

Table 1 Falsification Tests Using Past Changes in Commuting Zone Characteristics, Stacked First Differences.

Outcome variables	OLS		IV	
	Coef. (1)	SE (2)	Coef. (3)	SE (4)
Panel A. Country-of-origin-level regressions				
Δ_t State appropriations per public FTE			0.018	(0.067)
Δ_{t-1} State appropriations per public FTE			-0.030	(0.063)
Δ_t Pop. share of foreign-born workers with a college degree			0.002	(0.003)
Δ_{t-1} Pop. share of foreign-born workers with a college degree			0.000	(0.003)
Δ_t Employment rate			0.005	(0.010)
Δ_{t-1} Employment rate			0.008	(0.010)
Δ_t Average wages			-0.001	(0.022)
Δ_{t-1} Average wages			0.014	(0.016)
Panel B. Commuting-zone-level regressions				
Δ_t State appropriations per public FTE	-0.052***	(0.017)	0.022	(0.045)
Δ_{t-1} State appropriations per public FTE	-0.035*	(0.020)	-0.022	(0.067)
Δ_t Pop. share of foreign-born workers with a college degree	0.003***	(0.001)	0.002	(0.001)
Δ_{t-1} Pop. share of foreign-born workers with a college degree	0.003***	(0.001)	0.000	(0.002)
Δ_t Employment rate	0.010***	(0.003)	0.007	(0.006)
Δ_{t-1} Employment rate	0.010***	(0.003)	0.008	(0.007)
Δ_t Average wages	-0.010	(0.007)	-0.008	(0.014)
Δ_{t-1} Average wages	-0.021***	(0.007)	0.012	(0.016)

Notes—Panel A reports estimates from transformed, shock-level regressions following Borusyak et al. (2022). Lagged outcome changes and changes in US foreign enrollment from $t-1$ to t are first residualized on the covariates in equation 1, then aggregated to the country-of-origin level using exposure shares as weights. The aggregated change in US foreign enrollment is instrumented by the corresponding non-US enrollment shock (i.e., changes in foreign enrollment in non-US destinations). Robust standard errors are reported in parentheses. Panel B reports coefficients from estimating equation 1, where changes in foreign enrollment are instrumented using the shift-share instrument in columns 3 and 4. Standard errors (in parentheses) are clustered at the commuting zone level.

of Statistics. This broader measure of student mobility preserves the supply-driven variation in foreign enrollment while plausibly reducing the influence of substitution effects. The resulting estimates remain similar to the baseline, suggesting that substitution effects are not a major empirical concern in this setting. This makes intuitive sense, as there is a strong correlation (0.81) between enrollment changes in the US and combined changes in Australia, Canada, and the UK across years and countries of origin, reflecting the previously discussed overall increase in the global supply of students seeking to study overseas (Appendix Fig. A1).

Statistical inference.—Adao et al. (2019) demonstrate that a shift-share instrumental variable design, such as the one used in this setting, might yield standard errors that are too conservative if regression residuals are somehow correlated across commuting zones (e.g., among those with similar share profiles). To explore the robustness of conventional clustered standard errors, I follow the randomization procedure as conducted in Adao et al. (2019), where I randomly generate non-US enrollment shocks (i.e., the shift components) using a normal distribution then interact these simulated shocks with the original shares to construct the instrument and re-estimate Eq. (1). I repeat this procedure 5,000 times each for commuting zone employment-to-population ratios and average wages. Reassuringly, I obtain significant estimates at the 5% level in only 9

iterations for employment and 10 iterations for wages. These results suggest that using conventional robust standard errors clustered at the commuting zone level is unlikely to lead to over-rejections in my setting.

4. Effects of International Students on Local Employment and Wages

In this section, I quantify the effects of international student enrollment on local labor markets. I first focus on overall employment and wage responses, then examine heterogeneity across industries and types of workers. To aid readability, I report coefficients in terms of changes in foreign enrollment per 100 working-age residents in all tables, but interpret effect sizes in the text based on changes per 1,000 residents.

4.1. Overall employment and wage effects

Table 2 reports the effects of foreign enrollment on local employment and wage outcomes, estimated using Eq. (1). Focusing on employment effects (Panel A), the OLS estimates in Columns 1 and 2 suggest that an increase in foreign enrollment by one student per thousand working-age residents raises the overall employment-to-population ratio by 0.05 percentage points. These estimates, however, are only significant at the 10 percent level.

As discussed earlier, OLS estimates may be attenuated if changes in foreign enrollment are countercyclical. In particular, universities may expand international admissions in response to adverse local fiscal and labor-market conditions (e.g., declines in public funding following recessions), which would generate a negative correlation between foreign enrollment growth and contemporaneous employment outcomes and bias OLS estimates toward zero (Bound et al. 2020). In line with this interpretation, the corresponding IV estimates in Columns 3 and 4 are larger—0.17 (without controls) and 0.19 (with controls) percentage points—and are statistically significant at the 1 percent level. Given a one standard deviation change in foreign enrollment of 0.79 students per thousand working-age residents, these estimates imply that a one standard deviation increase in foreign enrollment raises the local employment rate by about 0.15 percentage points. Furthermore, over the study period, the overall increase in foreign enrollment may have led to the creation of 1.17 million jobs, which is equivalent in magnitude to about 49–59% of the estimated displacement impact stemming from the increase in import competition from China between 1999 and 2011 (Acemoglu et al. 2016).

The employment effects implied by the estimates are economically meaningful and consistent with the scale of resources that international students bring into local economies. A large share of student spending contributes to school expenditures, which have been shown to generate sizable spillovers in local labor markets (Kantor and Whalley 2014; Hausman 2022). Students also contribute to housing demand, which raises local prices (Mocanu and Tremacoldi-Rossi 2023) and stimulates further labor demand through increased construction and consumption effects (Charles et al. 2018). As such, the estimates likely capture both the direct impact of student expenditures and broader general equilibrium effects tied to earnings and housing values. For context, the Student and Exchange Visitor Information System (SEVIS) reports roughly 1.3 million active F-1 international students enrolled in US higher education and the Bureau of Economic Analysis (international transactions Table 2.1) reports $47.3 billion in education-related services exports in 2018. Combining these figures with my IV estimate of 1.9 job-years per additional international student implies 2.47 million job-years (1.3M $\times$ 1.9) and an implied cost per job-year of roughly $33,000-$38,000 when applying local income multipliers of 1.7-2.0 (Serrato and Wingender 2016).[16] This range encompasses the $36,000 cost per job-year reported by Serrato and Wingender (2016), suggesting that my estimates of the local economic impact of international students, though large, are economically plausible.

Turning to wage effects, Panel B shows that both

[16] $47.3B $\times$ (1.7–2.0)/2.47M $\approx$ $33,000–$38,000 per job-year. Studies of the economic impact of higher-education activity report a wide range of multipliers (Siegfried et al. 2007; Kantor and Whalley 2014). Siegfried et al. (2007), for example, review 67 studies and report multipliers ranging from 1.84 to 26.

Table 2 Effects of International Students on Local Employment and Wages, ACS Estimates, Stacked First Differences, 2006-2015.

	OLS		IV	
	(1)	(2)	(3)	(4)
Panel A. Outcome: Employment rate				
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.005*	0.005*	0.017***	0.019***
	(0.003)	(0.003)	(0.006)	(0.006)
Panel B. Outcome: Log (average wages)				
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.035***	0.033***	0.067***	0.048***
	(0.009)	(0.009)	(0.018)	(0.016)
Panel C. Outcome: Avg. resid. log wages				
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.026***	0.023***	0.057***	0.045***
	(0.007)	(0.006)	(0.016)	(0.015)
First-stage F-stat			58.1	57.2
Characteristics controls	No	Yes	No	Yes
Observations	7,220	7,220	7,220	7,220

Notes—Outcomes are period changes from t to $t+1$. All specifications include year fixed effects. Characteristics controls include current period changes in (log) population, the population share of females, the share of the population over 64 years old, the shares of the population by education (some college, college or professional degree, and advanced degrees), and the population share of non-citizen workers. Specifications (3) and (4) further control for the sum of the share components of the instrument interacted with year fixed effects. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level.

OLS and IV estimates of the impact on commuting-zones (log) average wages are positive and statistically significant. Results from the IV specification with covariates (Column 4) indicate that one additional international student per 1,000 working-age residents increases average wages by 0.48 percent. Given the sizable impact of international students on local employment, some portion of the observed increase in average wages may reflect changes in the composition of local workers rather than the increased returns from working. To address this complication, I consider an alternative measure of wages that explicitly accounts for changes in the composition of local workers. Specifically, I first regress individual log wages on a set of characteristics, including a quadratic in potential experience, educational attainment (some college, college or professional degrees, and advanced degrees), gender, race (white, black, Hispanic, and Asian), and commuting zone fixed effects, then use the aggregated residuals at the commuting zone level as my measure of average wages. As shown in Panel C, both OLS and IV estimates remain very similar to those obtained using unadjusted wages as the outcome. The stability of the wage effects implies that most of the observed impact of international students on local earnings reflects better local labor market conditions rather than compositional shifts in the workforce.

To understand the mechanisms driving the observed labor market effects of international students, in Table 3, I explore heterogeneity along two distinct dimensions: by students' potential contributions to local economies through spending (Panel A) and labor supply (Panel B). Panel A examines whether the impact of foreign enrollment varies with changes in the average amount of financial resources reported per student.[17] As discussed earlier, the growth in foreign enrollment during the study period was primarily driven by an increase in the number of self-

[17] Resources are adjusted for inflation using the Higher Education Price Index (HEPI) and converted to base year 2018.

funded students. To the extent that a student's total funding, as reported in administrative I-20 records, reflects their family's financial capacity and serves as a proxy for potential local spending, this measure captures variation in the strength of demand shocks across commuting zones. The results show that employment and wage effects of an increase in foreign enrollment are more pronounced among commuting zones experiencing above-median increases in average student funding (average increase of $1,459 per student). By contrast, in commuting zones with below-median changes, where student funding declined on average (-$637 per student), enrollment increases have muted, statistically insignificant effects (and negatively signed, in the case of employment).

In Appendix Table B3, I examine the effects of foreign enrollment on university expenditures, as student resources could translate into increased local demand both directly and indirectly through institutional spending.[18] The estimates show no detectable relationship between foreign enrollment shocks and past or contemporaneous expenditure growth: the IV coefficient is statistically indistinguishable from zero for spending changes from t–2 to t–1 and from t–1 to t. By contrast, expenditures rise sharply in the subsequent year, with a large and statistically significant IV effect for spending changes from t to $t+1$, for both core expenditures (Panel A) and total expenditures (Panel B). Overall, these results are consistent with a demand-side interpretation, whereby financially better-resourced students generate stronger local spillovers through their spending on tuition, housing, and other local goods and services.

Having shown that local labor market effects of international students are stronger where student resources rise, I next examine heterogeneity by changes in labor supply exposure, measured as the change in full-time equivalent (FTE) OPT participants per working-age resident.[19] On average, commuting zones hosted approximately 44 OPT FTEs during the study period, with the vast majority accounted for by post-completion participation. Commuting zones with above-median changes saw a small average increase of 0.0336 FTE participants per thousand working-age residents, whereas below-median areas experienced an average decline of 0.0136 participants per thousand working-age residents. In line with these figures, the results in Panel B imply no heterogeneity in employment effects, while wage and residual wage effects are somewhat smaller in commuting zones that experienced above-median increases in OPT intensity. One potential explanation for this pattern is that in these areas, the influx of OPT workers, though small, may compete with high-skilled workers, exert downward pressure on wages in the short run.[20] Taken together, given the limited participation of students in pre-completion training and the documented low transition rates into the local workforce, my results suggest that demand-side forces, particularly student spending and associated institutional activity, are likely the primary drivers of the observed labor market gains, whereas student-driven labor supply plays a more limited role in the short term.

I conclude this section with a brief discussion of issues related to domestic enrollment. A natural question is whether the short-run impact of an increase in foreign enrollment resembles that of an increase in domestic enrollment. There are two reasons why this need not be the case. First, unlike international students, domestic students can supply labor while enrolled, so any local demand effects from higher enrollment may be partially offset by contemporaneous labor supply responses.[21] Second, domestic students, especially in-state students are more

[18] I examine changes in commuting-zone-level (log) university expenditures per FTE, constructed using IPEDS finance data. To minimize measurement error, I exclude private for-profit institutions, which exhibit discontinuities in reported core expenses between 2008 and 2013.

[19] To construct the full-time equivalent measure, I use employment start and end dates to calculate the fraction of each calendar year during which an OPT participant, whether pre- or post-graduation, is employed.

[20] Beine et al. (2023) find that transitions from student status to local employment are relatively modest, and those that do occur are concentrated in STEM fields, suggesting that OPT participants may disproportionately compete with high-skilled native workers.

[21] Keane and Wolpin (2001) find that borrowing constraints primarily affect other margins of adjustment, such as work intensity and consumption while in college, rather than college attendance decisions, highlighting that changes in domestic enrollment are intertwined with labor-supply behavior and are therefore less easily interpreted as pure demand shocks.

Table 3 Effects of International Students on Local Employment and Wages—Mechanisms, ACS Estimates, Stacked First Differences, 2006-2015.

	Emp. Rate (1)	Log Avg. Wages (2)	Avg. Resid. Log Wages (3)
Panel A. Heterogeneity by Period Change in Average Student Funding			
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	-0.007	0.013	0.021
× Below Median Change	(0.016)	(0.028)	(0.023)
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.025***	0.057***	0.051***
× Above Median Change	(0.007)	(0.017)	(0.016)
p-value (Above = Below)	0.064*	0.119	0.171
First-stage F-stat	35.6	35.6	35.6
Observations	7,220	7,220	7,220
Panel B. Heterogeneity by Period Change in OPT Intensity Per Working-Age Resident			
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.019	0.109***	0.063***
× Below Median Change	(0.012)	(0.029)	(0.020)
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.019***	0.028*	0.039**
× Above Median Change	(0.007)	(0.016)	(0.016)
p-value (Above = Below)	0.990	0.013**	0.294
First-stage F-stat	31.8	31.8	31.8
Observations	7,220	7,220	7,220

Notes—This table reports IV estimates from equation (1) in which changes in foreign enrollment are interacted with subgroup indicators and instrumented using corresponding interactions of the shift–share instrument. Outcomes are period changes from t to $t + 1$. Panel A: Student funding includes all sources reported in I-20 records, averaged across total enrollment at the commuting zone level. Panel B: OPT intensity is measured as the number of full-time equivalent OPT participants working in the commuting zone per working-age resident. All specifications include the same set of covariates as described in the footnote of Table 2. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level.

likely to live with parents or maintain pre-existing housing arrangements, implying a smaller incremental housing-demand shock. In Appendix Table B4, I present OLS estimates obtained from regressing labor market outcomes on changes in domestic enrollment in higher education (overall and out-of-state), calculated from ACS data. In line with expectations, point estimates are much smaller than those provided in Table 2 and are not distinguishable from zero in the case of employment.

Lastly, are these observed demand shocks the result of an increase in the capacity of US higher education to tap into a large supply of self-funded foreign students, or does foreign enrollment simply crowd out domestic students? In Appendix Table B5, I explore the effects of international students on first-time, first-year domestic enrollment at two- and four-year programs, separately by sector. While an increase in foreign enrollment does lead to a statistically significant decline in the enrollment of first-time domestic students, this effect concentrates entirely at public, two-year programs, most likely due to improvements in local labor market conditions and thus increases in the opportunity cost of attending community colleges (Charles et al. 2018). At the four-year level, there is a small negative but statistically significant effect on enrollment at private, non-profit institutions, while corresponding point estimates for public institutions and overall are positive, albeit imprecisely estimated. As documented

by recent studies, this latter pattern is most likely attributable to cross-subsidization that takes place within public universities (Shih 2017; Zhu 2025).

4.2. *Robustness checks*

In Appendix Table B6, I assess the robustness of my baseline estimates to an alternative construction of the shift-share instrument and other measures of foreign enrollment. Panel A presents results using an instrument based on changes in international student enrollment across all non-US destinations, using data from the UNESCO Institute of Statistics. This approach addresses concerns that enrollment patterns across major English-speaking destinations—namely, Australia, Canada, and the UK—may reflect student preferences for a relatively narrow set of institutions or regions, leading to substitution effects between these countries and the US. For example, if students from a given origin country (e.g., China or India) tend to apply to a similar group of universities across destinations, an increase in enrollment in one destination country may come at the expense of another. By aggregating enrollment across all destination countries except the US, the alternative instrument preserves the supply-driven variation in foreign enrollment while helping reduce the influence of substitution effects across individual destinations. The resulting IV estimates remain similar in magnitude and significance despite a decline in first-stage strength, suggesting that my main results are not compromised by substitution effects across a narrow set of destinations.

In Panel B, I exclude graduate students from the measure of foreign enrollment. The resulting IV estimates are larger than the baseline, suggesting that the main effects are not driven by high-skilled student labor supply. In Panel C, I exclude a major source country of international students from my foreign enrollment measure, namely students from China.[22] With the caveat that the first stage is weak, the estimates remain positive and statistically significant, indicating that my results are not driven solely by growth in Chinese enrollment.

[22] In this case, I also reconstruct the shift-share instrument and the corresponding sum-of-shares controls to exclude Chinese enrollment.

Appendix Table B7 presents additional robustness checks based on alternative sample restrictions. One potential concern is that migratory responses by native workers could offset the initial effects of the demand shock (Blanchard et al. 1992; Bound and Holzer 2000; Cadena and Kovak 2016; Monras 2020; Notowidigdo 2020). Although such responses are likely limited in the short run, they could attenuate the estimated effects and render them lower bounds. Following Charles et al. (2018), I address this concern by restricting the sample to natives living in their state of birth—individuals less likely to have relocated in response to labor market shocks. Panel A shows that IV estimates for this sample are very similar to the baseline, suggesting that endogenous migration is not a major concern, especially in light of recent evidence on declining geographic mobility in the US (Basso and Peri 2020). In Panels B and C, I further test sensitivity by excluding, respectively, the top 10% of commuting zones with the highest number of international students and those with no international students in 2005. In both cases, the IV estimates for employment and wage effects remain positive and statistically significant, suggesting that the results are not driven by a small set of commuting zones.

Lastly, Appendix Table B8 examines whether the IV estimates vary by metropolitan status and by changes in state appropriations per public FTE. Overall, the estimated effects remain positive across groups, with no evidence that the baseline results are driven disproportionately by booming metropolitan areas or by funding-related selection into foreign enrollment. If anything, the margins of adjustment differ by metro status: employment responses are larger in metropolitan areas, while wage responses are smaller, with the opposite pattern in non-metropolitan areas. This pattern is consistent with lower commuting frictions and a more elastic local labor supply in metropolitan areas, allowing labor demand shocks to translate more readily into employment growth rather than wage growth (Monte et al. 2018).

4.3. *Effects by industry*

Which industries are most likely to benefit from the increases in local demand spurred by interna-

tional students? Construction seems to be a natural candidate, given the increase in housing needs that would stimulate the construction and renovation of rental housing. Furthermore, spending on personal items, groceries, entertainment, and social gatherings, in addition to education and healthcare, should further contribute to labor demand in retail, transportation, and other local services.

Fig. 4 shows the effects of international students on local employment in different industries, both overall and separately for men and women. I provide point estimates and confidence intervals obtained from IV specifications that are similar to the one estimated in Column 2 of Table 2, with the outcomes here being changes in the industry-specific employment share of the population. In line with expectations, construction accounts for a large portion of the impact of international students on local employment. The IV estimate suggests that an increase of one additional international student per thousand working-age residents leads to a 0.10 percentage point increase in the share of working-age population employed in construction. The remaining portion of the employment effect can be attributed to service industries including education and healthcare (0.08 points), leisure and hospitality (0.07 points), professional and business services (0.04 points), and finance, real estate, and insurance (0.02 points), though some of the latter estimates lack precision due to the small cell sizes in the one-year ACS. Note that the combined increase in employment shares in these industries exceeds the net effect of international students on local employment reported in section 4.1 because of some between-industry reallocation of labor away from manufacturing.[23] Overall, these results demonstrate that the observed positive impact of foreign enrollment on local employment is driven almost entirely by labor demand shocks in the non-tradable sector.

4.4. Effects by education and age

The observed effects of international students on local industry employment suggest that both college- and non-college-educated workers should experience an improvement in labor market conditions. Positive labor demand shocks in construction and personal services would likely translate into substantial employment and wage gains among workers without a college degree. Likewise, increased labor demand in education, healthcare, professional, and business services, which collectively employ about half of college-educated workers, should also result in better labor market outcomes among college-educated workers.

Fig. 5 summarizes the effects of international students on local employment and wages for workers with and without a bachelor's degree. While the results confirm the above intuitions, the point estimates are slightly larger for college-educated workers, even though increases in foreign enrollment primarily raise labor demand in construction and other non-tradable services. There are at least three potential explanations. First, part of the non-tradable employment expansion may be offset by contraction in other sectors that are also intensive in non-college labor (e.g., manufacturing), limiting net gains for less-educated workers. Second, as shown in Section 5, enrollment-induced demand shocks generate substantial within-industry labor reallocation from lower- to higher-performing establishments. If higher-performing establishments employ relatively more skilled labor (Engbom and Moser 2017) or skilled workers face lower adjustment costs (Dix-Carneiro 2014), such reallocation could contribute to the higher net increase in employment among college-educated workers. Third, improvements in local labor market opportunities may induce some young natives to shift away from two-year college enrollment toward labor market activity (Appendix Table B5). To the extent that this margin increases the effective supply of less-educated labor, it could dampen wage growth for non-college workers in the short run.

Turning to the employment and wage effects by age groups, I consider young (16-29), middle-aged (30-49), and older workers (50 and above). The results summarized in Fig. 6 indicate that an increase in foreign enrollment has similar effects on employment and wages across these three groups.

Overall, the broad pattern of results discussed in

[23] I discuss the effects of international students on between-industry and within-industry labor reallocations in detail in section 5.

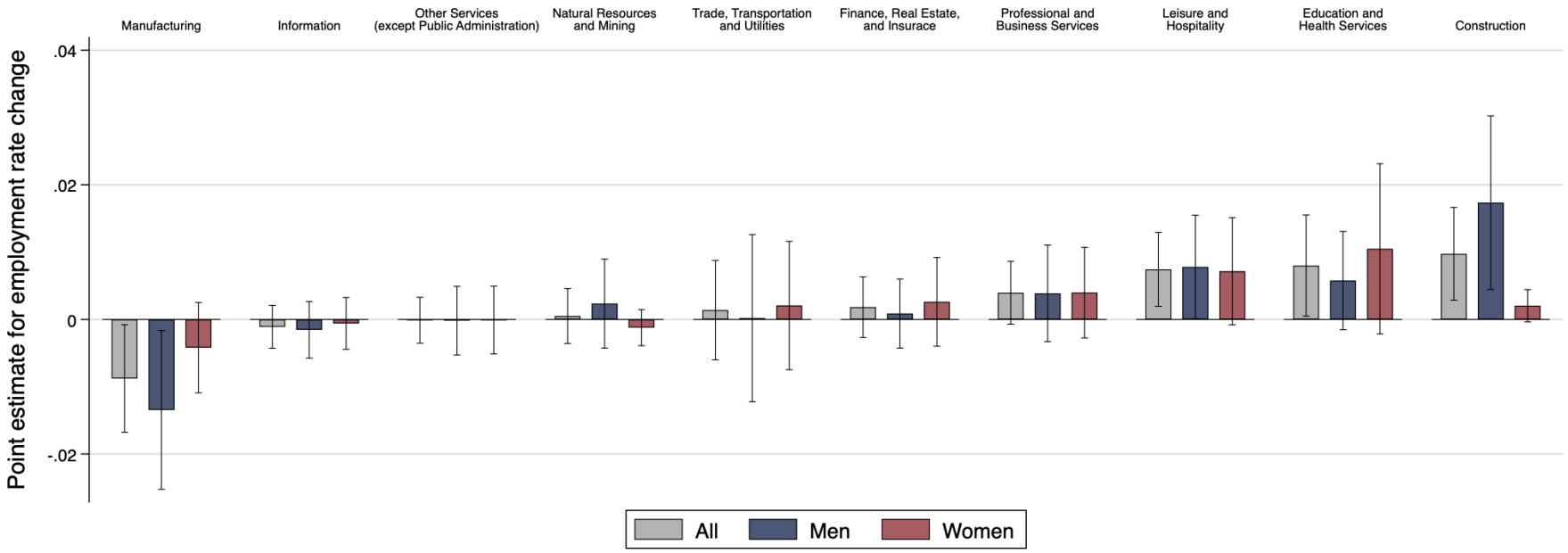


Fig. 4 Industry employment effects.

Notes—This figure presents estimates of the effects of international students on changes in industry employment-to-population ratios. The capped lines provide 95% confidence intervals. Estimates are obtained from stacked-differences IV specifications as in Column 2 of Table 2.

this section provides strong evidence of positive local labor demand shocks induced by increases in the enrollment of international students. These shocks are concentrated in the non-tradable sector and present across different groups of workers. While these findings highlight the immediate economic benefits associated with rising international student enrollment—through increased local employment and earnings—they also raise questions about potential longer-term effects. Specifically, the observed labor market dynamics may trigger changes in local business environments with implications for aggregate productivity. I now turn to examine these dynamics in the next section.

5. Effects of International Students on Local Job Flows

Given the sizable employment and wage effects documented in the previous section, which are largely driven by enrollment-induced local demand shocks, a natural question is whether these shocks also generate aggregate productivity gains by expanding market size and intensifying competition.[24] One channel through which such gains may arise is a selection mechanism, in which labor and market share are reallocated toward more efficient establishments as increased demand heightens competition in both product and labor markets.[25] In particular, spending on local goods and services by international students would likely spur entry and expansion among establishments most capable of taking advantage of local demand shocks. Increased competition for market share and labor leads to a reduction in average mark-ups (Melitz and Ottaviano 2008) as well as a rise in real wages (Melitz 2003), forcing the least productive establishments to shrink or exit altogether. Motivated by these theoretical possibilities, this section examines the effects of international students on local job flows and discusses their distributional implications.

I begin by decomposing the net employment impact of international students documented in Section 4 into effects on gross job flows. To do so, I use aggregate data from the BDS as well as establishment-level data from the YTS to measure annual commuting-zone-level changes in employment due to establishment entry, exit, expansion, and contraction. Ignoring a small amount of employment changes due to establishments relocating across commuting zones, these job flow components can be related to net employment growth via the following identity

$$\frac{\Delta \mathrm{E}_{c,t}}{\bar{P}_{c,t}} = \underbrace{\frac{\mathrm{E}^{\text{entry}}_{c,t}}{\bar{P}_{c,t}} - \frac{\mathrm{E}^{\text{exit}}_{c,t}}{\bar{P}_{c,t}}}_{\text{Extensive margin}} + \underbrace{\frac{\mathrm{E}^{\text{expansion}}_{c,t}}{\bar{P}_{c,t}} - \frac{\mathrm{E}^{\text{contraction}}_{c,t}}{\bar{P}_{c,t}}}_{\text{Intensive margin}} \tag{3}$$

where $\bar{P}_{c,t} = (P_{c,t-1} + P_{c,t})/2$ is the midpoint non-institutionalized population aged 16 and above (excluding group quarters) of commuting zone c between $t-1$ and t, constructed using ACS data to match the age coverage of the job-flows measures. $E^{\text{entry}}_{c,t}$ and $E^{\text{exit}}_{c,t}$ are gross job creation and destruction along the extensive margin due to establishment entry and exit, respectively, and $E^{\text{expansion}}_{c,t}$ and $E^{\text{contraction}}_{c,t}$ analogously defined along the intensive margin due to establishment expansion and contraction. Similar to the analysis in the previous section, I first estimate Eq. (1) using net employment growth and each of the four components in Eq. (3) as the outcomes. I then explore heterogeneity by industry and establishment performance.

5.1. *Overall effects on local job flows*

Table 4 presents OLS and IV estimates of the effects of an increase in foreign enrollment on net employment growth (Row 1) and local job flows (Rows 2-5), where each reported coefficient comes from a separate regression. By construction, the coefficients on foreign enrollment from job-flow regressions sum up to those from the net growth regressions. Columns 1-4 report estimates of the effects of an increase in foreign enrollment on local net employment growth and gross job flows across all in-

[24] Recent studies highlight that immigration can influence firm entry, productivity, and reallocation mechanisms, and suggest that firm-level responses are a key component of local adjustments (e.g., Waugh 2018; Glennon 2024).

[25] Aggregate productivity gains could also occur through within-establishment efficiency improvements, though documenting such dynamics is beyond the scope of this study. See Syverson (2011) for a recent discussion of this literature.

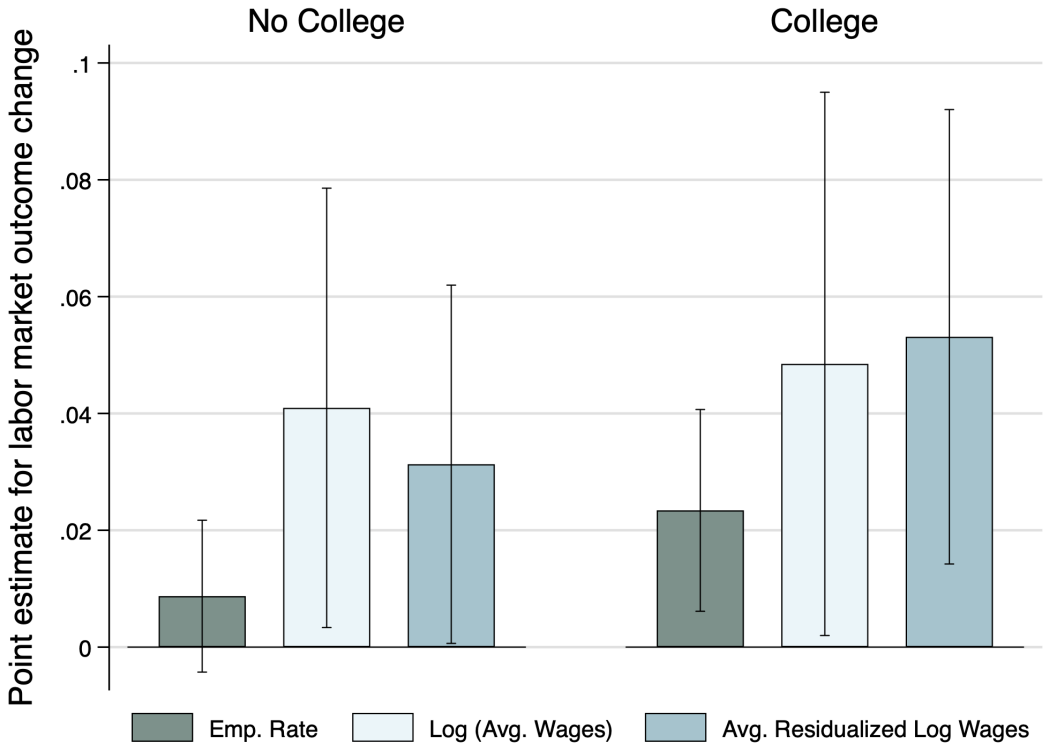


Fig. 5 Effects of International Students on Employment and Wages by Education, ACS Estimates.

Notes—This figure presents estimates of the effects of international students on changes in employment and wage outcomes of natives with different education levels (no college, college degree). The capped lines provide 95% confidence intervals. Estimates are obtained from stacked-differences IV specifications as in Columns 2, 4, and 6 of Table 2.

dustries. Both OLS and IV estimates for net employment change, based on BDS (Columns 1 and 3) and YTS (Columns 2 and 4) data, are statistically significant and similar in magnitude to the employment effects estimated in the previous section using ACS data. Here again, IV coefficients are larger than their OLS counterparts and imply that one additional international student per thousand working-age residents leads to a net increase in local employment equivalent to 0.17-0.20 percent of the population.

Turning to the overall effects on local job flows, the results suggest that international students have a large and positive impact on local business dynamism in the short run. The IV estimates indicate that an increase in foreign enrollment results in not only job creation due to establishment entry and expansion but also substantial job destruction due to establishment exit and contraction. These coefficients are generally larger in magnitude than the net growth coefficients, and indicate that international students lead to gross job reallocations that are 6-15 times larger than the net effects. These findings are consistent with the existing literature, which has shown that net employment changes can mask substantial labor market activity (Davis et al. 1996; Davis et al. 2012).

The positive and significant impact of international students on both job creation and destruction indicates that enrollment-induced local demand shocks reallocate a substantial number of workers across establishments. A natural question to ask is whether workers are being reallocated from less-exposed industries to those most impacted by these demand shocks or, rather, from within industries and among establishments that produce broadly similar products and services. As mentioned, within-industry reshufflings of labor may reflect general equilibrium dynamics that have potentially important consequences for the composition of local businesses and aggregate productivity.

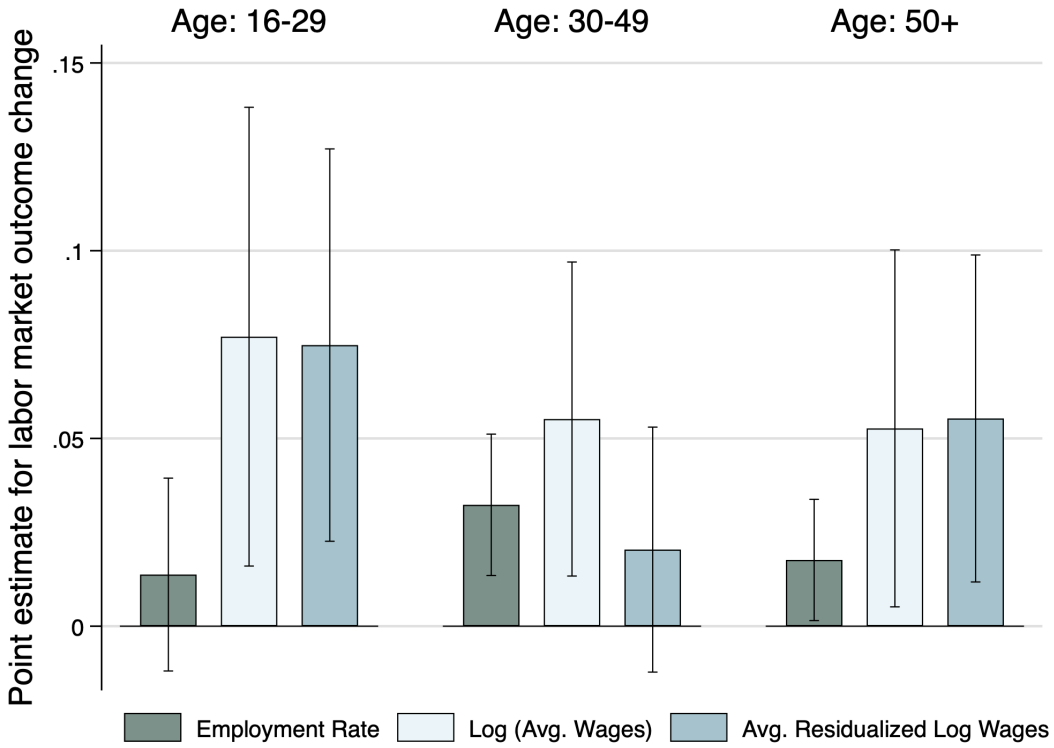


Fig. 6 Effects of International Students on Employment and Wages by Age, ACS Estimates.

Notes—This figure presents estimates of the effects of international students on changes in employment and wage outcomes of natives in different age groups. The capped lines provide 95% confidence intervals. Estimates are obtained from stacked-differences IV specifications as in Columns 2, 4, and 6 of Table 2.

In Columns 5 and 6, I consider the effects of international students on local employment growth and job flows separately for the traded sector (*Traded*) and the local sector (*Local*), using industry classifications from the US Cluster Mapping Project (Delgado et al. 2016).[26] As shown, the IV estimate for net employment growth in the traded sector is indistinguishable from zero, suggesting that enrollment-induced demand shocks do not generate meaningful employment growth in traded industries. An increase in foreign enrollment has modest effects on job creation and destruction in this sector. On the other hand, the impact on business dynamism within the local sector is much more pronounced. Here, the estimates concerning gross job-flow components are all strongly significant and substantially larger in magnitude.

[26]These classifications, which are applied to 6-digit NAICS, separate industries in which establishments serve external markets from those in which establishments tend to sell goods and services to local markets.

5.2. *Effects by industry*

A key takeaway from these results is that the sizable gross job flows associated with foreign enrollment arise largely within the local (non-traded) sector, with little evidence of a broad reallocation of activity away from traded industries. This sectoral pattern is consistent with demand shocks that primarily expand and intensify competition in locally oriented markets and suggests that the extent of reallocation should depend on the magnitude of the demand shock and the costs of adjustment faced by establishments and workers, which likely vary across industries even within the local sector.

To shed light on this issue, I examine heterogeneity in the effects of international students on local job flows across more narrowly defined industries. Fig. 7 plots coefficients obtained from regressing industry-specific job-flow components on an increase in foreign enrollment using BDS data. The results display a notable pattern: Industries that ex-

Table 4 Effects of International Students on Local Job Flows, Stacked First Differences, 2006-2015.

Independent variable:	Overall				By Sector	
					Traded	Local
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	OLS	OLS	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Net employment growth	0.006**	0.004**	0.017*	0.020***	0.001	0.019***
	(0.003)	(0.002)	(0.010)	(0.006)	(0.002)	(0.004)
Job flows						
Entry	0.002	0.010***	0.036**	0.024***	0.005**	0.019***
	(0.003)	(0.003)	(0.016)	(0.009)	(0.002)	(0.007)
Expand	0.017**	0.017***	0.096***	0.044***	0.010***	0.034***
	(0.007)	(0.004)	(0.034)	(0.013)	(0.004)	(0.010)
Exit	0.001	0.015***	0.027*	0.028**	0.008*	0.020**
	(0.003)	(0.005)	(0.014)	(0.013)	(0.004)	(0.009)
Contract	0.012**	0.008***	0.088***	0.020***	0.006***	0.014***
	(0.005)	(0.002)	(0.031)	(0.007)	(0.002)	(0.005)
Source	BDS	YTS	BDS	YTS	YTS	YTS
First-stage F-statistic			57.2	57.2	57.2	57.2
Observations	7,220	7,220	7,220	7,220	7,220	7,220

Notes—Outcomes are period changes from t to $t+1$. All specifications include year fixed effects and current period changes in (log) population, the population share of females, the share of the population over 64 years old, the shares of the population by education (some college, college or professional degree, and advanced degrees), and the population share of non-citizen workers. Specifications (3)–(6) further control for the sum of the share components of the instrument interacted with year fixed effects. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level.

perience larger effects of international students on job creation (through establishment entry and expansion) also tend to experience larger effects on job destruction (through establishment exit and contraction). These effects concentrate in services and retail, industries likely to be most exposed to local demand shocks and characterized by low entry barriers and/or high labor turnover. Results based on YTS data tell a similar story and are presented in Appendix Fig. B2. These patterns are consistent with findings from prior literature showing that a large fraction of labor reallocation occurs within industries (e.g., Davis and Haltiwanger 1999; Foster et al. 2001) and point to heightened competition as the driving force that causes within-industry reallocations among competing establishments.

5.3. Effects by establishment performance

What explains the heterogeneity in establishment responses to local demand shocks generated by international students? In particular, why do some establishments enter and expand while others in the same industry contract or exit following an increase in foreign enrollment? One possible explanation is that establishments differ in their ability to profit from the induced demand shock. An establishment's ability to benefit from local market expansion may depend on its location, product and service offerings, and the costs of scaling up production. As a result, entrants and expanding establishments are likely to be relatively more productive, while heightened competition for market share and labor reallocates activity away from less productive producers.

In this section, I construct a measure of establish-

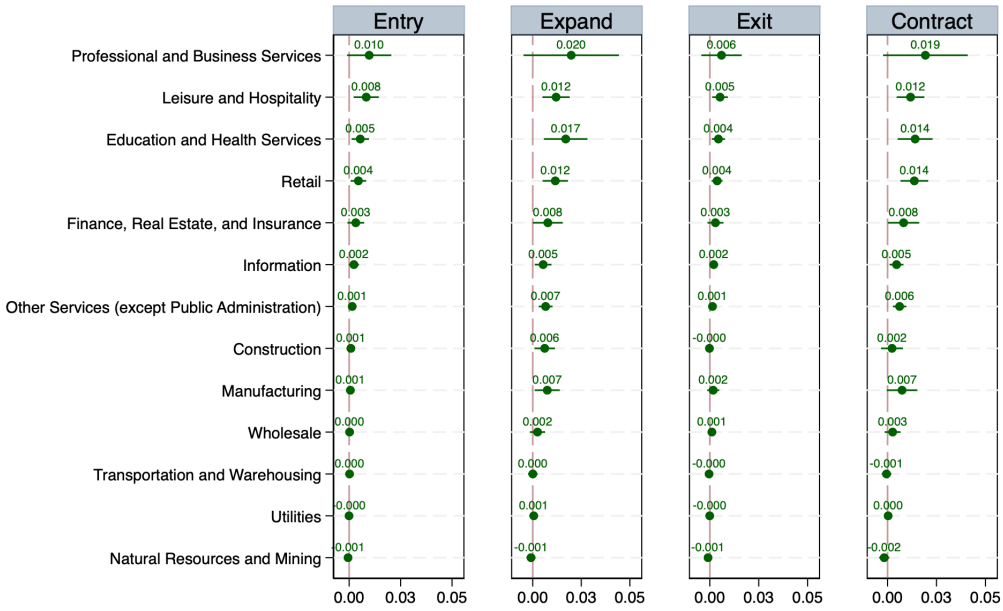


Fig. 7 Effects of International Students on Job Flows by Industry, BDS Estimates.

Notes—This figure presents estimates of the effects of international student enrollment on changes in job flows in each industry at the commuting zone level. The capped lines provide 95% confidence intervals. Estimates are obtained from stacked-differences IV specifications as in Column 3 of Table 4.

ment performance based on YTS sales data and examine whether the heterogeneous responses to local demand shocks by establishments within the same industry are driven by differences in their performance. My primary objective is to determine whether the observed effects of international students on local job flows are productivity-enhancing via a between-establishment selection process through which the most productive ones survive. In the absence of ideal data to construct a measure of establishment productivity, such as total factor productivity or value-added per worker, I rely on establishment-level growth in total sale volume, which is available for an establishment each year it appears in the YTS data, to measure performance. This measure most likely reflects an establishment's profitability, which is ultimately what selection should be on (Foster et al. 2006; Foster et al. 2008), rather than productivity per se, though to the extent that an establishment's profitability is correlated with its underlying productivity the evidence presented in this section will provide indirect evidence on the impact of international students on aggregate productivity.

To allow comparability across establishments within an industry, I define each establishment's performance to be the average annual growth rate in total sale volume, calculated using all the years in which an establishment exists in my sample.[27] Specifically, the performance of establishment i is constructed as

$$\text{Performance}_i = \frac{1}{\bar{t} - \underline{t}} \sum_{j=\underline{t}}^{\bar{t}} \frac{\text{sales}_{i,j} - \text{sales}_{i,j-1}}{\text{sales}_{i,j-1}} \quad (4)$$

where $\underline{t}$ and $\bar{t}$ denote the earliest and latest year in which establishment i exists in the sample, respectively.[28] Based on this measure, I sort establishments within each industry-commuting zone-year into three terciles, where industries are defined by 3-digit NAICS codes, and aggregate job flows in each performance tercile to the commuting zone-year level. This approach thus assumes a single,

[27] This measure of performance thus assumes it takes time for establishments to realize their productivity (Asquith et al. 2019).

[28] Following the literature, I set the growth rate between t and $t+1$ to -1 if an establishment exits during this period (e.g., Lentz and Mortensen 2008; Kosova 2010).

time-invariant measure of performance for each establishment but allows its ranking to potentially vary across years due to changes in the composition of local businesses.

Table 5 reports IV estimates obtained from regressing job flows in each performance tercile on changes in international student enrollment. Column 1 first reproduces the overall effects of international students on job flows as reported in Column 4 in Table 4.

Focusing on the effects of international students on job creation due to establishment entry, the results indicate no clear pattern. Specifically, an increase in foreign enrollment results in job creation through establishment entry uniformly across the three performance terciles. This could be because establishments face ex-ante uncertainty about their productivity, which nevertheless can be learned over time through the process of production (Davis and Haltiwanger 1992; Melitz 2003; Melitz and Ottaviano 2008). On the other hand, job creation due to expansions is driven entirely by high-performance incumbents. The IV estimate suggests that one additional student per thousand working-age residents results in a 0.36 percentage point increase in the rate of job creation due to expansion among establishments in the highest performance tercile. This effect is significant at the 1 percent level and explains 82% (0.036/0.044) of the overall effect of international students on job creation through establishment expansion. In stark contrast, the impact of an increase in foreign enrollment on job destruction is driven mostly by deaths and contractions among low-performance establishments. The IV estimates for exit and contraction in the lowest performance tercile are 0.029 and 0.009, explaining all and 45% of the overall effects, respectively.

Taken together, the various results discussed in this section demonstrate that the growing presence of international students in local US economies may also have led to Melitz-type local aggregate productivity gains in the non-tradable sector. In particular, only a selective set of potentially the most efficient firms seemed able to reap the benefits from enrollment-induced positive demand shocks, whereas increases in competition in possibly both the product market and the labor market forced the least productive firms to shrink or exit altogether. The local labor market effects of an increase in international student enrollment are therefore *not* without distributional consequences. For example, to the extent that more educated, highly skilled workers are more likely to be employed at or reallocated to the most productive firms (Engbom and Moser 2017; Gilje et al. 2022) or face lower adjustment costs (Dix-Carneiro 2014) the overall positive impact of international students on local jobs and earnings might also have accentuated the recent rise in wage inequality across workers.[29]

6. Conclusion

Rapid growth in per capita income and the concurrent surge in demand for quality education in many emerging economies have led to a dramatic rise in the global number of students pursuing higher education outside their home countries, from 2.1 million students in 2000 to 6 million students in 2019 (UNESCO Institute for Statistics 2021). As the leading destination, the US has absorbed a significant portion of this supply shock, currently receiving over a million students and more than 40 billion dollars in higher education revenue from abroad each year. These trends have attracted growing attention from both economists and policymakers, yet little research has been done to systematically assess the broader effects of international students on local economies surrounding US universities and colleges.

Using large-scale administrative and survey data, this paper seeks to address this gap by investigating the short-run effects of international students on local labor markets and establishments. I implement an instrumental variable strategy that isolates supply-driven variation in US enrollment using changes in origin-country outflows to other major English-speaking destinations. Through a series of falsification tests, I demonstrate that this strategy isolates variation in foreign enrollment that is not driven by local economic conditions. My results suggest that international students substantially increase local employment and earnings. In particular,

[29] For recent reviews on the topic of wage inequality, see Katz and Autor (1999), Lemieux (2008), Autor et al. (2008), and Card et al. (2018).

Table 5 Effects of International Students on Local Job Flows by Establishment Performance Tercile, YTS Estimates, Stacked First Differences, 2006-2015.

Independent variable: $\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	Overall (1)	Lowest Tercile (2)	Middle Tercile (3)	Highest Tercile (4)
Entry	0.024***	0.010***	0.006**	0.008***
	(0.009)	(0.004)	(0.002)	(0.003)
Expand	0.044***	0.002***	0.006***	0.036***
	(0.013)	(0.001)	(0.002)	(0.011)
Exit	0.028**	0.029***	-0.000	-0.000
	(0.013)	(0.010)	(0.001)	(0.003)
Contract	0.020***	0.009***	0.005***	0.006***
	(0.007)	(0.003)	(0.002)	(0.002)
First-stage F-statistic	57.2	57.2	57.2	57.2
Observations	7,220	7,220	7,220	7,220

Notes—Outcomes are period changes from t to $t+1$. All specifications include year fixed effects and current period changes in (log) population, the population share of females, the share of the population over 64 years old, the shares of the population by education (some college, college or professional degree, and advanced degrees), the population share of non-citizen workers, and the sum of the share components of the instrument interacted with year fixed effects. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level.

one additional student per thousand working-age residents raises the employment-to-population ratio by 0.19 percentage points and average wages by 0.48%. These effects are concentrated in the non-tradable sector, particularly in construction and services, and largely reflect increases in local demand for goods and services.

Further analysis shows that increased foreign enrollment also drives within-industry reallocation of labor toward higher-performing establishments, consistent with models featuring firm heterogeneity and market competition. These findings indicate that international students not only boost short-run labor market outcomes but may also generate long-run aggregate productivity gains. As such, they underscore the potentially high economic costs of rising trade tensions and restrictive immigration policies, which could slow or reverse recent enrollment growth.

It is worth emphasizing that my analysis focuses on the short-term effects of an increase in foreign enrollment, which may be larger than long-term effects because of adjustments from workers and establishments. For example, to the extent that enrollment-induced local demand shocks are persistent in some areas, native workers' migratory responses could be more pronounced over the long term, which would counteract the initial effects of these local shocks (Monras 2020). Firms facing tighter local labor markets might also start investing in labor-saving technology (Clemens et al. 2018; San 2023). Most importantly, many international students eventually transition into the US workforce, particularly in high-skilled sectors, highlighting a potentially important labor supply channel in the medium to long run (Hunt and Gauthier-Loiselle, 2010; Peri et al., 2015; Hanson et al., 2018; Beine et al., 2023). These longer-term dynamics, while beyond the scope of this paper, merit closer attention in future work.

References

Acemoglu, D., Autor, D., Dorn, D., Hanson, G.H., Price, B., 2016. Import competition and the great us employment sag of the 2000s. Journal of Labor Economics 34, S141–S198.

Adao, R., Kolesár, M., Morales, E., 2019. Shift-share designs: Theory and inference. The Quarterly Journal of Economics 134, 1949–2010.

Anelli, M., Shih, K., Williams, K., 2023. Foreign students in college and the supply of stem graduates. Journal of Labor Economics 41, 511–563.

Asquith, B., Goswami, S., Neumark, D., Rodriguez-Lopez, A.,

2019. Us job flows and the china shock. Journal of International Economics 118, 123–137.

Autor, D.H., Katz, L.F., Kearney, M.S., 2008. Trends in us wage inequality: Revising the revisionists. The Review of Economics and Statistics 90, 300–323.

Basso, G., Peri, G., 2020. Internal mobility: The greater responsiveness of foreign-born to economic conditions. Journal of Economic Perspectives 34, 77–98.

Beine, M., Noël, R., Ragot, L., 2014. Determinants of the international mobility of students. Economics of Education Review 41, 40–54.

Beine, M., Peri, G., Raux, M., 2023. International college students' impact on the us skilled labor supply. Journal of Public Economics 223, 104917.

Bernard, A.B., Jensen, J.B., Schott, P.K., 2006. Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of us manufacturing plants. Journal of International Economics 68, 219–237.

Bernard, A.B., Redding, S.J., Schott, P.K., 2007. Comparative advantage and heterogeneous firms. The Review of Economic Studies 74, 31–66.

Blanchard, O.J., Katz, L.F., Hall, R.E., Eichengreen, B., 1992. Regional evolutions. Brookings Papers on Economic Activity 1992, 1–75.

Blau, F.D., Kahn, L.M., 2015. Immigration and the distribution of incomes, in: Handbook of the Economics of International Migration. Elsevier. volume 1, pp. 793–843.

Blau, F.D., Mackie, C., 2017. The Economic and Fiscal Consequences of Immigration. National Academies Press.

Bodvarsson, Ö.B., Van den Berg, H.F., Lewer, J.J., 2008. Measuring immigration's effects on labor demand: A reexamination of the mariel boatlift. Labour Economics 15, 560–574.

Borusyak, K., Hull, P., Jaravel, X., 2022. Quasi-experimental shift-share research designs. The Review of Economic Studies 89, 181–213.

Bound, J., Braga, B., Khanna, G., Turner, S., 2020. A passage to america: University funding and international students. American Economic Journal: Economic Policy 12, 97–126.

Bound, J., Braga, B., Khanna, G., Turner, S., 2021. The globalization of postsecondary education: The role of international students in the us higher education system. Journal of Economic Perspectives 35, 163–84.

Bound, J., Holzer, H.J., 2000. Demand shifts, population adjustments, and labor market outcomes during the 1980s. Journal of Labor Economics 18, 20–54.

Bureau of Economic Analysis, 2022. International transactions, international services, and international investment position tables. International Data. https://apps.bea.gov/iTable/iTable.cfm?ReqID=62&step=1#reqid=62&step=9&isuri=1&6210=4 (accessed January 3, 2023).

Cadena, B.C., Kovak, B.K., 2016. Immigrants equilibrate local labor markets: Evidence from the great recession. American Economic Journal: Applied Economics 8, 257–90.

Campello, M., Kankanhalli, G., Muthukrishnan, P., 2024. Corporate hiring under covid-19: Financial constraints and the nature of new jobs. Journal of Financial and Quantitative Analysis 59, 1541–1585.

Card, D., 2001. Immigrant inflows, native outflows, and the local labor market impacts of higher immigration. Journal of Labor Economics 19, 22–64.

Card, D., Cardoso, A.R., Heining, J., Kline, P., 2018. Firms and labor market inequality: Evidence and some theory. Journal of Labor Economics 36, S13–S70.

Card, D., Peri, G., 2016. Immigration economics by george j. borjas: A review essay. Journal of Economic Literature 54, 1333–49.

Charles, K.K., Hurst, E., Notowidigdo, M.J., 2018. Housing booms and busts, labor market opportunities, and college attendance. American Economic Review 108, 2947–94.

Chellaraj, G., Maskus, K.E., Mattoo, A., 2008. The contribution of international graduate students to us innovation. Review of International Economics 16, 444–462.

Clemens, M.A., Lewis, E.G., Postel, H.M., 2018. Immigration restrictions as active labor market policy: Evidence from the mexican bracero exclusion. American Economic Review 108, 1468–87.

David, H., Dorn, D., 2013. The growth of low-skill service jobs and the polarization of the us labor market. American Economic Review 103, 1553–97.

Davis, S.J., Faberman, R.J., Haltiwanger, J., 2012. Labor market flows in the cross section and over time. Journal of Monetary Economics 59, 1–18.

Davis, S.J., Haltiwanger, J., 1992. Gross job creation, gross job destruction, and employment reallocation. The Quarterly Journal of Economics 107, 819–863.

Davis, S.J., Haltiwanger, J., 1999. Gross job flows. Handbook of Labor Economics 3, 2711–2805.

Davis, S.J., Haltiwanger, J.C., Schuh, S., et al., 1996. Job creation and destruction.

Delgado, M., Porter, M.E., Stern, S., 2016. Defining clusters of related industries. Journal of Economic Geography 16, 1–38.

Derenoncourt, E., 2022. Can you move to opportunity? evidence from the great migration. American Economic Review 112, 369–408.

Disney, R., Haskel, J., Heden, Y., 2003. Restructuring and productivity growth in uk manufacturing. The Economic Journal 113, 666–694.

Dix-Carneiro, R., 2014. Trade liberalization and labor market dynamics. Econometrica 82, 825–885.

Dustmann, C., Schönberg, U., Stuhler, J., 2016. The impact of immigration: Why do studies reach such different results? Journal of Economic Perspectives 30, 31–56.

Dustmann, C., Schönberg, U., Stuhler, J., 2017. Labor supply shocks, native wages, and the adjustment of local employment. The Quarterly Journal of Economics 132, 435–483.

Engbom, N., Moser, C., 2017. Returns to education through access to higher-paying firms: Evidence from us matched employer-employee data. American Economic Review 107, 374–78.

Feeney, M.K., Jung, H., Johnson, T.P., Welch, E.W., 2023. Us

visa and immigration policy challenges: Explanations for faculty perceptions and intent to leave. Research in higher education 64, 1031–1057.

Foster, L., Haltiwanger, J., Krizan, C.J., 2006. Market selection, reallocation, and restructuring in the us retail trade sector in the 1990s. The Review of Economics and Statistics 88, 748–758.

Foster, L., Haltiwanger, J., Syverson, C., 2008. Reallocation, firm turnover, and efficiency: Selection on productivity or profitability? American Economic Review 98, 394–425.

Foster, L., Haltiwanger, J.C., Krizan, C.J., 2001. Aggregate productivity growth: Lessons from microeconomic evidence, in: New Developments in Productivity Analysis. University of Chicago Press, pp. 303–372.

Galaasen, S., Kostøl, A.R., Monras, J., Vogel, J., 2025. The Labor Supply Curve is Upward Sloping: The Effects of Immigrant-Induced Demand Shocks. Working Paper 33930. National Bureau of Economic Research. doi:10.3386/w33930.

Ghent, A.C., 2021. What's wrong with pittsburgh? delegated investors and liquidity concentration. Journal of Financial Economics 139, 337–358.

Gilje, E.P., Taillard, J.P., Zeng, L., 2022. Human capital reallocation across firms: Evidence from idiosyncratic shocks. NBER Working Paper 29782.

Glennon, B., 2024. Skilled immigrants, firms, and the global geography of innovation. Journal of Economic Perspectives 38, 3–26.

Goldsmith-Pinkham, P., Sorkin, I., Swift, H., 2020. Bartik instruments: What, when, why, and how. American Economic Review 110, 2586–2624.

Hanson, G.H., Kerr, W.R., Turner, S., 2018. High-Skilled Migration to the United States and Its Economic Consequences. University of Chicago Press.

Hausman, N., 2022. University innovation and local economic growth. Review of Economics and Statistics 104, 718–735.

Hong, G., McLaren, J., 2015. Are Immigrants a Shot in the Arm for the Local Economy? Technical Report. National Bureau of Economic Research.

Hunt, J., Gauthier-Loiselle, M., 2010. How much does immigration boost innovation? American Economic Journal: Macroeconomics 2, 31–56.

Kantor, S., Whalley, A., 2014. Knowledge spillovers from research universities: Evidence from endowment value shocks. Review of Economics and Statistics 96, 171–188.

Katz, L.F., Autor, D.H., 1999. Changes in the wage structure and earnings inequality. In *Handbook of Labor Economics*. Vol. 3A, edited by Orley Ashenfelter and David E. Card, 1463–1555. Amsterdam: Elsevier B.V.

Keane, M.P., Wolpin, K.I., 2001. The effect of parental transfers and borrowing constraints on educational attainment. International Economic Review 42, 1051–1103.

Khanna, G., Shih, K., Weinberger, A., Xu, M., Yu, M., 2023. Trade liberalization and chinese students in us higher education. Review of Economics and Statistics , 1–46.

Kosova, R., 2010. Do foreign firms crowd out domestic firms? evidence from the czech republic. The Review of Economics and Statistics 92, 861–881.

Lemieux, T., 2008. The changing nature of wage inequality. Journal of Population Economics 21, 21–48.

Lentz, R., Mortensen, D.T., 2008. An empirical model of growth through product innovation. Econometrica 76, 1317–1373.

McCaig, B., Pavcnik, N., 2018. Export markets and labor allocation in a low-income country. American Economic Review 108, 1899–1941.

Melitz, M.J., 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica 71, 1695–1725.

Melitz, M.J., Ottaviano, G.I., 2008. Market size, trade, and productivity. The Review of Economic Studies 75, 295–316.

Miller, S., Wagner, G.A., Plemmons, A., 2025. Employment effects of minimum wage indexing: Establishment evidence from oregon restaurants. Economic Inquiry 63, 681–714.

Mocanu, T., Tremacoldi-Rossi, P., 2023. The impact of international students on housing markets. Canadian Journal of Economics/Revue canadienne d'économique 56, 647–675.

Monras, J., 2020. Immigration and wage dynamics: Evidence from the mexican peso crisis. Journal of Political Economy 128, 3017–3089.

Monte, F., Redding, S.J., Rossi-Hansberg, E., 2018. Commuting, migration, and local employment elasticities. American Economic Review 108, 3855–3890.

Notowidigdo, M.J., 2020. The incidence of local labor demand shocks. Journal of Labor Economics 38, 687–725.

Olney, W.W., 2015. Remittances and the wage impact of immigration. Journal of Human Resources 50, 694–727.

Pavcnik, N., 2002. Trade liberalization, exit, and productivity improvements: Evidence from chilean plants. The Review of Economic Studies 69, 245–276.

Peri, G., 2016. Immigrants, productivity, and labor markets. Journal of Economic Perspectives 30, 3–30.

Peri, G., Shih, K., Sparber, C., 2015. Stem workers, h-1b visas, and productivity in us cities. Journal of Labor Economics 33, S225–S255.

Peri, G., Shih, K., Sparber, C., 2020. The devastating economic consequences of pushing foreign students out of the country. Policy Brief.

Ruggles, S., Flood, S., Goeken, R., Schouweiler, M., Sobek, M., 2022. Ipums usa: Version 12.0 [dataset]. Minneapolis, MN: IPUMS. https://doi.org/10.18128/D010.V12.0.

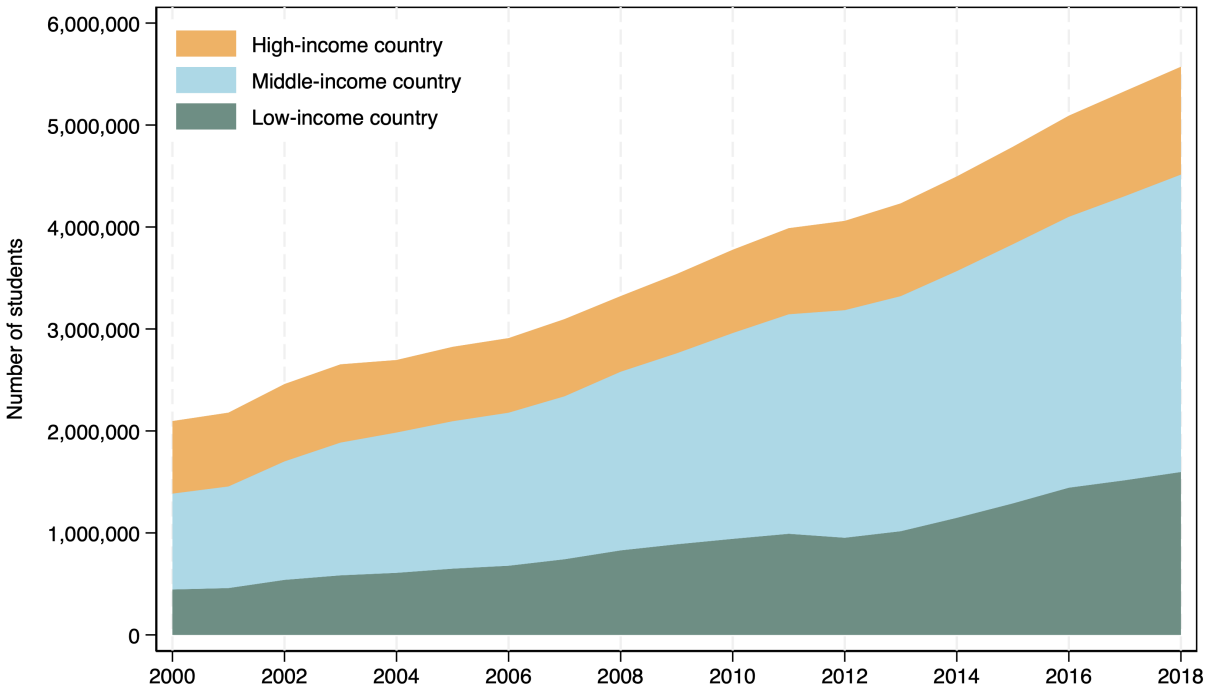
Ruiz, N.G., 2014. The geography of foreign students in us higher education: Origins and destinations. Report, Global Cities Initiative.

San, S., 2023. Labor supply and directed technical change: Evidence from the termination of the bracero program in 1964. American Economic Journal: Applied Economics 15, 136–63.

Serrato, J.C.S., Wingender, P., 2016. Estimating Local Fiscal Multipliers. Working Paper 22425. National Bureau of Economic Research. doi:10.3386/w22425.

Shih, K., 2017. Do international students crowd-out or cross-

subsidize americans in higher education? Journal of Public Economics 156, 170–184.
Siegfried, J.J., Sanderson, A.R., McHenry, P., 2007. The economic impact of colleges and universities. Economics of Education Review 26, 546–558.
Smith, C.L., 2012. The impact of low-skilled immigration on the youth labor market. Journal of Labor Economics 30, 55–89.
Solon, G., Haider, S.J., Wooldridge, J.M., 2015. What are we weighting for? Journal of Human Resources 50, 301–316.
Stuen, E.T., Mobarak, A.M., Maskus, K.E., 2012. Skilled immigration and innovation: Evidence from enrolment fluctuations in us doctoral programmes. The Economic Journal 122, 1143–1176.
Syverson, C., 2004. Market structure and productivity: A concrete example. Journal of Political Economy 112, 1181–1222.
Syverson, C., 2011. What determines productivity? Journal of Economic Literature 49, 326–65.
Tolbert, C.M., Sizer, M., 1996. Us commuting zones and labor market areas: A 1990 update. Economic Research Service Staff Paper Number 9614.
Trefler, D., 2004. The long and short of the canada-us free trade agreement. American Economic Review 94, 870–895.
UNESCO Institute for Statistics, 2021. Education data. http://data.uis.unesco.org. (accessed November 10, 2021).
Waugh, M.E., 2018. Firm dynamics and immigration. High-Skilled Migration to the United States and Its Economic Consequences 205.
Wooldridge, J.M., 2010. Econometric Analysis of Cross Section and Panel Data. MIT press.
Zhu, L., 2025. Comparative Immigration Policies and the Effect of International Students in U.S. Higher Education. Working Paper Series 20251202. Center for Health Economics and Policy Studies.



Appendix Fig. A1 Internationally Mobile Students by Country of Origin, 2000-2018.
Source: UNESCO Institute for Statistics.
Notes—Income assignments are based on World Bank 2000 classifications.

Appendix Fig. A2 Effects of International Students on Job Flows by Industry, YTS Estimates.

Notes—This figure presents estimates of the effects of international student enrollment on changes in job flows in each industry at the commuting zone level. The capped lines provide 95% confidence intervals. Estimates are obtained from stacked-differences IV specifications as in Column 4 of Table 4.

Appendix Table B1. Growth in Foreign Enrollment Across Commuting Zones, 2005-2015.

	Mean	p10	p25	p50	p75	p90	p95	p99
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Number of international students								
2005	1,254	5	30	181	777	2,817	5,427	18,578
2015	2,279	5	51	276	1,473	4,668	10,440	34,729
Δ	+1,125	+0	+21	+95	+696	1,851	5,013	16,151
Panel B. Population share of international students (%)								
2005	0.209	0.007	0.034	0.098	0.252	0.517	0.798	1.680
2015	0.342	0.007	0.048	0.155	0.391	0.827	1.188	3.520
Δ	+0.08	+<0.001	+0.014	+0.057	+0.140	+0.310	+0.390	+1.840

Source: Author's calculations from administrative data from U.S. Department of Homeland Security.
Notes—Tabulations on 722 commuting zones. The sample includes all international students enrolled in a U.S. higher education institution (undergraduate and graduate level) under F-1 visa status for any portion of the year in 2005 and 2015.

Appendix Table B2. First-stage regression.

	Dependent variable: $\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	
	Coef.	SE
	(1)	(2)
$\widehat{\Delta IS}_{c,t}/Pop_{c,t-1} \times 100$	0.794^{***}	(0.105)
$\Delta \log(Pop_{c,t})$	−0.022	(0.099)
$\Delta FemaleShare_{c,t}$	−0.111	(0.094)
$\Delta NonCitizenShare_{c,t}$	0.100	(0.109)
$\Delta Age65PlusShare_{c,t}$	0.044	(0.092)
$\Delta SomeCollegeShare_{c,t}$	−0.032	(0.041)
$\Delta CollegeShare_{c,t}$	0.075	(0.066)
$\Delta GradShare_{c,t}$	0.122	(0.091)
Year fixed effects		Yes
Sum of exposure shares × year fixed effects		Yes
Excluded instrument F-statistic		57.2
Observations		7,220
R^2		0.412

Notes—Regression is weighted by commuting zone population in 2005. Robust standard errors are clustered at the commuting zone level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix Table B3. International Students and CZ-Level School Expenditures, 2006-2015.

	Outcome: Changes in School Expenditures per FTE					
	OLS			IV		
	$t-2$ to $t-1$	$t-1$ to t	t to $t+1$	$t-2$ to $t-1$	$t-1$ to t	t to $t+1$
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Core Expenditures						
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.008	-0.001	-0.005	-0.062	0.036	0.167***
	(0.016)	(0.017)	(0.019)	(0.106)	(0.050)	(0.058)
First-stage F-statistic				40.3	49.7	52.7
Observations	5,577	5,579	5,570	5,577	5,579	5,570
Panel B. Total Expenditures						
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.009	0.010	-0.011	0.028	0.017	0.144***
	(0.014)	(0.014)	(0.014)	(0.078)	(0.044)	(0.054)
First-stage F-statistic				41.5	50.8	53.3
Observations	5,612	5,614	5,605	5,612	5,614	5,605

Notes—Outcomes are period changes in (log) commuting-zone-level school expenditures per FTE. School expenditures are constructed from IPEDS finance data and exclude private for-profit institutions. Core expenditures are defined as the sum of IPEDS functional expense categories for instruction, research, public service, academic support, student services, institutional support, and operations and maintenance. IV specifications instrument changes in international student enrollment using the shift-share instrument described in the main text and include the same set of controls as the baseline specifications. Robust standard errors in parentheses are clustered at the commuting-zone level.

Appendix Table B4 Effects of Domestic Students on Local Employment and Wages, OLS Estimates, Stacked First Differences, 2006-2015.

	Employment Rate (1)	Log (Avg. Wages) (2)	Avg. Resid. Log Wages (3)
Panel A. Total domestic enrollment			
ΔDomestic Students$_{c,t}$/Pop$_{c,t-1} \times 100$	0.000	0.002***	0.002***
	(0.000)	(0.001)	(0.000)
Panel B. Out-of-state domestic enrollment			
ΔDomestic Students$_{c,t}$/Pop$_{c,t-1} \times 100$	0.000	0.003***	0.002***
	(0.000)	(0.001)	(0.001)
Observations	7,220	7,220	7,220

Notes—Outcomes are period changes from t to $t+1$. Domestic enrollment is constructed from ACS microdata, with out-of-state enrollment proxied by currently enrolled domestic students whose state of residence differs from their state of birth. All specifications include year fixed effects and current period changes in (log) population; the population share of females; the share of the population over 64 years old; the shares of the population by education (some college, college or professional degree, and advanced degrees); and the share of the population that are working foreign-borns. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix Table B5 Effects of International Students on Natives' College Attendance, IV Estimates, Stacked First Differences, 2006-2015.

	First-Time, First-Year Domestic Enrollment	
	2-Year	4-Year
	(1)	(2)
Panel A. All Colleges and Universities		
	−0.018**	0.006
	(0.009)	(0.006)
Panel B. Public		
	−0.016*	0.008
	(0.008)	(0.006)
Panel C. Private, Non-Profit		
	−0.001	−0.002**
	(0.001)	(0.001)
Panel D. Private, For-Profit		
	−0.001	0.000
	(0.002)	(0.000)
First-stage F-statistic	41.4	41.4
Observations	5,330	5,330

Notes—Observations = 533 commuting zones ×10 years. Outcomes are period changes (from t to $t + 1$) in first-time, first-year domestic enrollment constructed using IPEDS data and adjusted by commuting-zone population ages 18–25. All specifications include year fixed effects and current period changes in (log) population; the population share of females; the share of residents aged 65 and older; the shares of the population by education (some college, college or professional degree, and advanced degrees); the population share of non-citizen workers; and the sum of the share components of the instrument interacted with year fixed effects. Regressions are weighted by commuting-zone population ages 18–25 in 2005. Robust standard errors in parentheses are clustered at the commuting-zone level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix Table B6 Robustness Checks—Baseline IV Estimates with Alternative Measures of Foreign Enrollment, ACS.

	Emp. Rate (1)	Log (Avg. Wages) (2)	Avg. Resid. Log Wages (3)
Panel A. Alternative instrument			
	0.019**	0.054**	0.061***
	(0.008)	(0.022)	(0.018)
First-stage *F*-statistic	35.4	35.4	35.4
Observations	7,220	7,220	7,220
Panel B. Exclude international graduate students			
	0.028***	0.070***	0.065***
	(0.010)	(0.025)	(0.024)
First-stage *F*-statistic	25.1	25.1	25.1
Observations	7,220	7,220	7,220
Panel C. Exclude Chinese students			
	0.060**	0.338***	0.290***
	(0.025)	(0.089)	(0.085)
First-stage *F*-statistic	17.8	17.8	17.8
Observations	7,220	7,220	7,220

Notes—Outcomes are period changes from t to $t+1$. Panel A constructs the shift-share instrument using changes in foreign enrollment in all non-U.S. destinations as shocks (UNESCO Institute for Statistics). In Panel B, the endogenous foreign enrollment measure excludes international graduate students. In Panel C, both the endogenous foreign enrollment measure and the shift-share instrument (and the sum of exposure shares × year fixed effects controls) are re-constructed to exclude Chinese students. All specifications include year fixed effects and current period changes in (log) population; the population share of females; the share of the population over 64 years old; the shares of the population by education (some college, college or professional degree, and advanced degrees); the population share of non-citizen workers; and the sum of the share components of the instrument interacted with year fixed effects. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix Table B7 Robustness Checks—Baseline IV Estimates with Alternative Sample Restrictions, ACS.

	Emp. Rate (1)	Log (Avg. Wages) (2)	Avg. Resid. Log Wages (3)
Panel A. Same state of birth workers			
	0.021***	0.068***	0.059***
	(0.008)	(0.021)	(0.018)
First-stage *F*-statistic	57.2	57.2	57.2
Observations	7,220	7,220	7,220
Panel B. Exclude top destination CZs			
	0.031**	0.094***	0.073***
	(0.013)	(0.028)	(0.026)
First-stage *F*-statistic	59.4	59.4	59.4
Observations	7,120	7,120	7,120
Panel C. Exclude CZs with no international students in 2005			
	0.019***	0.052***	0.048***
	(0.006)	(0.017)	(0.015)
First-stage *F*-statistic	55.8	55.8	55.8
Observations	5,530	5,530	5,530

Notes—Outcomes are period changes from t to $t + 1$. All specifications include year fixed effects and current period changes in (log) population; the population share of females; the share of the population over 64 years old; the shares of the population by education (some college, college or professional degree, and advanced degrees); the population share of non-citizen workers; and the sum of the share components of the instrument interacted with year fixed effects. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Appendix Table B8 Heterogeneity by Metropolitan Status and State-Funding Shocks, IV Estimates, Stacked First Differences, 2006-2015.

	Emp. Rate (1)	Log Avg. Wages (2)	Avg. Resid. Log Wages (3)
Panel A. Heterogeneity by Metropolitan Status			
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.008	0.069***	0.060***
× Non-metro	(0.007)	(0.020)	(0.019)
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.024***	0.040**	0.039**
× Metro	(0.008)	(0.019)	(0.018)
p-value (Metro = Non-metro)	0.072*	0.234	0.368
First-stage F-stat	11.0	11.0	11.0
Observations	7,220	7,220	7,220
Panel B. Heterogeneity by State Appropriations per Public FTE			
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.014*	0.065***	0.050***
× Below Median Change	(0.008)	(0.020)	(0.017)
$\Delta IS_{c,t}/Pop_{c,t-1} \times 100$	0.031***	0.029	0.047**
× Above Median Change	(0.012)	(0.024)	(0.022)
p-value (Above = Below)	0.239	0.211	0.906
First-stage F-stat	26.7	26.7	26.7
Observations	5,276	5,276	5,276

Notes—This table reports IV estimates from equation (1) in which changes in foreign enrollment are interacted with subgroup indicators and instrumented using corresponding interactions of the shift–share instrument. Outcomes are period changes from t to $t+1$. Metropolitan status is defined using 2003 Rural-Urban Continuum Codes (RUCC), where a commuting zone is classified as metro if more than 50% of its population resides in metropolitan counties. All specifications include year fixed effects and current period changes in (log) population; the population share of females; the share of the population over 64 years old; the shares of the population by education (some college, college or professional degree, and advanced degrees); the population share of non-citizen workers; and the sum of the share components of the instrument interacted with year fixed effects. Regressions are weighted by commuting zone population in 2005. Robust standard errors in parentheses are clustered at the commuting zone level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.