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Non-Resident Postsecondary Enrollment Growth and the Outcomes of In-State Students

Diyi Li

Cheng Qian

Cory Koedel

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Diyi Li
University of Missouri-Columbia

Cheng Qian
University of Missouri-Columbia

Cory Koedel
University of Missouri-Columbia / CALDER

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Abstract

We study the effects of exposure to non-resident students on the outcomes of undergraduate in-state students during a period of high non-resident enrollment growth at the University of Missouri-Columbia. Our models leverage within-major, cross-time variation in non-resident exposure for identification. We find no evidence that increased exposure to domestic non-residents affects in-state student outcomes and our null results are precisely estimated. We find evidence of modest negative impacts on in-state students when their exposure to foreign students increases using our preferred specification. However, the identifying variation in exposure to foreign students in our data is limited and this result is not robust in all of our models.

1. Introduction

Historically large numbers of non-resident students have matriculated into public universities across the United States in the last decade, drawing attention from the media and sparking policy debates over who should attend these schools. Public universities have traditionally prioritized in-state resident students, with the rationale that state appropriations are a primary source of revenue. However, there has been a shift away from state appropriations as a funding source for public universities and non-resident students have constituted an increasing fraction of enrollment (Bound et al., 2016; Jaquette and Curs, 2015; Jaquette et al., 2016). For example, between 2004 and 2014, the number of in-state students attending one of the 50 state flagship universities grew by just 3 percent, while during this same period the number of out-of-state domestic students increased by 47 percent and the number of foreign students increased by 244 percent.[1] Policymakers have shown contrasting preferences with regard to increases in non-resident enrollment. In California and Virginia, state legislators have pressured public universities to limit non-resident enrollment with the rationale of protecting state taxpayers (Bellows, 2017; Watanabi, 2017). In Missouri, public universities are encouraged to increase non-resident enrollment to generate revenue (Huguelet, 2017).

The literature on how undergraduate residents are impacted by increases in non-resident enrollment is thin and focuses mostly on the effect at entry—i.e., on whether expansions in non-resident enrollment crowd out resident enrollment.[2] Curs and Jaquette (2017) and Shen (2016) show that non-resident enrollment does not crowd out resident enrollment overall, but does crowd

[1] Based on the authors' calculation using the Integrated Postsecondary Education Data System (IPEDS). The flagship university for each state is defined as the highest ranked university according to the *U.S. News and World Report* rankings in 2017.

[2] There is also a related literature on foreign enrollment effects at the graduate level—e.g., see Borjas (2007), Bound et al. (2009), and Shih (2017).

out enrollment at the most selective public universities.[3] Anelli et al. (2017) is the only study of which we are aware that examines how non-resident enrollment affects in-state students after the point of entry into college. These authors show that more exposure to foreign students in introductory math courses reduces the likelihood that domestic students graduate in STEM fields.

We contribute to the literature by examining how a recent, rapid increase in non-resident enrollment at the University of Missouri-Columbia (MU) has impacted in-state students. MU initiated efforts to increase out-of-state domestic enrollment beginning in 2008, then later extended its recruitment efforts to foreign students in 2011. In percentage terms, both types of non-resident enrollment increased substantially after expansion efforts began, although like other state flagship universities, in absolute terms domestic non-resident enrollment growth has been much larger at MU. As in Anelli et al. (2017), we focus on how in-state students are impacted by exposure to non-residents after the point of entry into college. Importantly, and consistent with the findings of Curs and Jaquette (2017) and Shen (2016), the non-resident enrollment expansion at MU has not been accompanied by detectable changes in in-state student matriculation patterns.[4] The fraction of graduating high school seniors in Missouri who enroll at MU has remained steady as have the pre-entry academic qualifications of resident entrants.

Our empirical analysis is based on administrative microdata provided by the Missouri Department of Higher Education (DHE) covering cohorts of MU entrants from 2004-2014. We leverage variation over time in the non-resident enrollment share within intended majors—which students specify prior to arriving on campus at MU—to identify exposure effects on in-state

[3] Relatedly, Machin and Murphy (2017) find no evidence of foreign enrollment crowding out native undergraduate students in the United Kingdom. Focusing on a related but different question, Winters (2012) shows that larger resident cohorts crowd out non-resident students at selective public universities in the U.S. (which does not imply the reverse).
[4] MU is not highly-selective according to the definitions used by Curs and Jaquette (2017) and Shen (2016).

students via two-way fixed effects models (with fixed effects for majors and years). Our approach is akin to a difference-in-differences design, but with continuous rather than discrete measures of treatment. Tests designed to uncover violations of the identifying assumptions of our models give no indication of violations. In an extension, we discretize the non-resident exposure treatments to facilitate standard difference-in-differences and event-study specifications.

Increases in non-resident enrollment can affect in-state students through two broad channels. The first channel is through peer effects, which are multi-faceted. How an influx of non-resident peers will affect in-state students depends on (a) non-residents' relative academic qualifications and preferences for fields of study, which could influence how they compete with in-state students over grades and majors, and (b) their proclivity to engage in the campus environment, which could affect the college experiences of in-state students more generally. Additionally, with regard to foreign students specifically, differences in English proficiency and factors deriving from these differences may also be important (Anelli et al., 2017). For example, weaker English proficiency among foreign students could divert instructor attention and limit foreign-student engagement with resident students inside and outside the classroom (e.g., by limiting their participation in class discussions, which could reduce positive peer spillovers). Moreover, if language skill gaps give foreign students a comparative advantage in some fields—e.g., STEM fields—an increasing presence of foreign students could result in differences in resident students' fields of study as they respond to these conditions.

The second broad channel through which non-residents can affect resident outcomes is by impacting institutional revenue. Non-resident students pay more in tuition and fees, which can benefit all students by improving per-student resources (Bound and Turner, 2007). Regarding the resources channel, given that we leverage variation in exposure to non-residents at the major level for identification, it must be the case that the additional revenue created by non-resident students "trickles down" to academic departments (at least partially) in order for our models to pick up resource-based effects. However, MU's budget model during the timespan of our study was not designed to facilitate resource pass-through to the department level and we confirm this empirically. The implication is that our findings should be interpreted as informative about how non-residents impact in-state students via the peer effects channel only.

We find no evidence that differential exposure to non-resident students overall affects postsecondary persistence or performance outcomes for in-state students. This result is driven by null effects of exposure to non-resident domestic students. Our null findings for domestic non-residents are precisely estimated and noteworthy because the total non-resident population at MU consists primarily of domestic non-residents. As we show below, domestic non-residents also comprise the bulk of non-resident enrollment at other state flagship universities in the U.S. Regarding exposure to foreign students, we find modest negative effects on postsecondary persistence outcomes for in-state students using our preferred specification, although we interpret this result cautiously because it is based on thin identifying variation and not robust in all of our models.

2. Non-resident enrollment growth at MU

MU actively sought to increase out-of-state domestic enrollment beginning in fall-2008, starting with the appointment of regional representatives dedicated to recruiting high school students from specific geographic areas outside the state. The first representatives were assigned to cover two nearby areas, Chicago and Dallas, and today MU has more than ten regional representatives. A policy MU leverages in its recruitment efforts is the lenient Missouri residency requirement, which allows non-resident students to establish Missouri residency as soon as 12 months after arrival (Missouri Department of Education, 2017). They can then pay in-state tuition, substantially reducing the total cost to complete a MU degree. While the Missouri residency policy limits the amount of tuition revenue that can be generated from out-of-state students, MU still benefits financially from enrolling more of them and the policy makes MU more competitive on the national market for non-resident students.

For foreign student recruiting, MU established the office of international admissions in 2011 as part of its non-resident enrollment growth plan. It then began to regularly send international recruiting representatives to foreign countries (namely China, which exports a large number of students into the U.S.). Similarly to the recruitment of out-of-state domestic students, MU offers financial incentives to entice foreign students. In addition to merit-based scholarships, MU prices foreign tuition at the same rate as tuition for out-of-state domestic students, whereas in many other states foreign students pay more (although foreign students are not eligible for Missouri residency during their stay). Foreign high schoolers are also not required to take the ACT or SAT to apply. Admission depends on English-language tests and the most recent four years of coursework. With these appealing features for foreign students, MU has experienced substantial growth in foreign enrollment since 2010.

Figure 1 provides an overview of first-time, degree-seeking, full-time freshman enrollment at MU for entering cohorts during our study period between 2004 and 2014. Panel A shows trends in enrollment counts and Panel B shows trends in enrollment shares. The data are broken out by student residency status. The figure demonstrates that the overall increase in enrollment at MU between 2004 and 2014 is predominately driven by non-resident enrollment growth, and out-of-state domestic enrollment growth in particular. Over this timespan the number of out-of-state freshman grew substantially, with their enrollment share increasing from less than 20 percent to almost 40 percent of incoming freshman by the end of our data panel. During this same period there was no trend in the level of enrollment of in-state students, despite modest annual fluctuations. Foreign enrollment began to experience steady growth in 2011, nearly quadrupling over a 5-year period from 2010-2014, although this is difficult to see in the first two panels of the figure because foreign enrollment growth is changing from a very low base.[5] Panel C zooms in on the foreign enrollment trend to highlight the change during our sample period.

Figure 1 makes clear that our setting is best-suited to examine the effects of domestic non-resident enrollment growth on in-state student outcomes. Although foreign enrollment grew at a high rate during the later years of our data panel, the baseline level was low and as a result the variation in resident-student exposure to foreign students is limited. Below we show that MU is similar to other state flagship universities in terms of the ratio of the domestic and foreign non-resident enrollment shares (Table 2).

The lack of a trend in the number of in-state students enrolling at MU in Figure 1 is consistent with the absence of crowd-out at entry of in-state students during the non-resident expansion period, but it is not conclusive because the figure is conditional on enrollment. We investigate the possibility of crowd-out of in-state students more carefully in two ways. First, Figure 2 reports the total number of resident freshmen who enrolled at MU between 2004 and 2014 as a share of Missouri high school graduates from the previous academic year. The figure shows that the in-state share of high school graduates matriculating to MU is flat between 2004 and 2014. This is true overall and when we split students into demographic categories by race and gender. Next, Figure 3 plots trends in the average pre-entry academic qualifications of in-state students,

[5] We do not draw strong inference from the pre-2011 fluctuations in foreign enrollment because they are small in absolute terms and conversations with MU officials indicate that there were no policy efforts during this period specific to foreign recruitment.

which are also fairly stable over the sample period. The average high school class rank fluctuates some, but there is no clear pattern and no evidence of a shift coinciding with the rapid increase in non-resident enrollment beginning in 2008. ACT math and English scores change little over the sample period, exhibiting a modest and persistent upward trend between 2004 and 2014. Together, Figures 2 and 3 give no indication that the non-resident enrollment expansion was accompanied by changes in the matriculation patterns of in-state students, which facilitates our investigation of how non-resident enrollment growth has affected in-state students during college.

3. Data

The administrative data made available for this project by the Missouri DHE contain student-level demographic characteristics, pre-entry academic qualifications, and in-college outcomes. We restrict our analytic sample to first-time, degree-seeking, full-time students who entered MU between fall-2004 and fall-2014 as college freshmen. We can track educational outcomes for these students through 2016.

We define three student residency groups: in-state, out-of-state domestic, and foreign. A student's residency group is assigned based on geographic origin at the time of initial admission. Table 1 shows descriptive statistics by residency group. In-state students are the "core" analytic sample—the data on out-of-state domestic and foreign students are used to construct the treatment variables, which capture the exposure of in-state students to non-residents.

We highlight three takeaways from the descriptive statistics in Table 1. First, out-of-state domestic students are modestly more-qualified academically prior to college entry than in-state students as measured by ACT scores and high school class ranks, on average, but they are generally similar and there is no difference between the two groups in terms of first-semester college performance as measured by GPA (which is residualized in the table using a regression with major and year fixed effects to account for different grading standards across academic departments and over time).[6] Second, in terms of other characteristics, out-of-state students differ from in-state students along several dimensions—specifically, they are more likely to be female, more diverse in terms of race/ethnicity, and less likely to initially enroll in a STEM field. The latter result is likely driven in part by the gender disparity, and in addition may reflect the fact that MU has several prominent non-STEM departments that draw national interest (most notably Journalism). Third, while it is difficult to compare foreign students to domestic students using pre-entry academic qualifications due to the large amount of missing data for foreign students (recall that MU is test-optional for foreign undergraduate applicants), it is clear based on first-semester GPAs that foreign students are academically stronger than their domestic peers.[7] Foreign students are also much more likely to declare a STEM major and Arcidiacono and Koedel (2014) show that students who choose STEM majors are positively selected. The sorting patterns of domestic non-resident and foreign students into STEM and non-STEM majors also has potential implications for our identification strategy, which we discuss below.

We measure the exposure of in-state students to non-residents by the non-resident enrollment share in the initial intended major and year of entry. Majors are identified using the 4-digit Classification of Instructional Programs (CIP) designation developed by the U.S. Department of Education's National Center for Education Statistics (NCES). In total there are 54 different majors of incoming freshman from 2004-2014.

[6] Previous studies show similar results using institutional-level SAT data (Groen and White, 2004; Jaquette et al., 2016).
[7] Foreign students have residualized GPAs that are 0.10 points higher, on average, than domestic students. The strong academic preparation of foreign students documented here is consistent with Anelli et al. (2017), who show that foreign students have higher average SAT math scores than their domestic peers using administrative data from a public university in California.

We assess five third-year educational outcomes of in-state students. Three of these are binary persistence indicators for (1) remaining enrolled in the same major at MU, (2) remaining enrolled at MU, and (3) remaining enrolled at any Missouri public university (there are 13 public universities statewide). The other two outcomes we consider are performance measures that capture (1) cumulative credit hours and (2) cumulative GPA.

The persistence indicators are set to one for individuals who remain in the system rather than exit, and among these individuals, they differentiate between those who experience more and fewer disruptions within the system, such as switching colleges or majors. College and major switches typically involve frictions that increase the cost of college completion (e.g., meeting different course requirements for a new major), although they need not be uniformly bad. For example, students who switch majors in response to more non-resident exposure could in principle trade up to more prestigious fields. However, in results relegated to the appendix for brevity, we illustrate that in practice this is not the case by showing that major switches are selectivity neutral.[8]

All of the outcome data are retrieved at the beginning of students' third years in the Missouri public system. Outcomes for dropouts are assessed using data leading up to dropout—e.g., a dropout during year-2 will be assigned values for cumulative GPA and cumulative credit hours based on these outcomes at the point of dropout. As noted above, dropouts are coded as failing to persist for all three persistence measures. We focus on third-year outcomes rather than final college outcomes because the shorter time horizon allows us to examine more cohorts of students exposed to the enrollment shifts at MU, and in particular the increase in exposure to foreign students, which began in 2011. Longer-term college outcomes are highly correlated with

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[8] As measured by entering ACT scores of resident students (see Appendix Table A.8). This finding is consistent with general evidence from Darolia and Koedel (2018) showing that when students switch majors, they tend to move between similarly selective fields.

outcomes by year-3 and we confirm that our findings are substantively similar if we use year-6 outcomes (e.g., graduation) for a subsample of cohorts for whom sufficient time has passed for these outcomes to be available.[9] Table 1 shows sample averages of the year-3 college outcomes for in-state students.

Finally, Table 2 compares MU to other state flagship universities (using IPEDS) in order to contextualize our analysis. We identify each state's flagship as the highest-ranked public university according to the 2017 *U.S. News and World Report* rankings. Table 2 shows that MU is similar to the average flagship campus along many dimensions (note that student demographic differences broadly reflect demographic differences between Missouri and other states). Notably, like MU, the domestic non-resident enrollment share at the average flagship university is roughly an order of magnitude higher than the foreign enrollment share. Growth in the both the non-resident domestic and foreign enrollment shares at MU has exceeded the flagship average over the timespan of our data panel in percentage terms. The nearly 100-percent increase in the non-resident domestic enrollment share at MU is particularly notable; growth in the foreign enrollment share is large in percentage terms, although again the absolute change is small given the low baseline level of foreign enrollment.

4. Empirical strategy

We begin with linear two-way fixed effects models that leverage within-major and cross-time variation in exposure to total non-resident enrollment for identification:

$$Y_{ijt} = \beta_0 + NRS_{jt}\beta_1 + \mathbf{X_{ijt}}\boldsymbol{\beta_2} + \delta_j + \varphi_t + \varepsilon_{ijt} \qquad (1)$$

[9] For entering cohorts between 2004 and 2010, conditional on completing a bachelor's degree, 76 percent of students completed a degree in the major at MU in which they were registered by the beginning of the third year. Third year cumulative GPAs and credit hours are also strong predictors of graduation: the R-squared from a linear regression of the binary graduation indicator on just the third year cumulative GPA and credit-hours variables for entering cohorts in our data between 2004-2010 is 0.43.

In Equation (1), Y_{ijt} is an outcome for in-state student *i* who initially enters MU with major *j* in year *t*. The five different outcomes described in the previous section are assessed. NRS_{jt} is the treatment variable. It measures the non-resident enrollment share among entrants into major *j* in year *t*, which can be written as $(\frac{OOS_{jt}+F_{jt}}{IS_{jt}+OOS_{jt}+F_{jt}})*100$, where IS_{jt} , OOS_{jt}, and F_{jt} denote the number of in-state, out-of-state and foreign students, respectively, in major *j* and year *t*. $\mathbf{X_{ijt}}$ is a vector of individual student characteristics for in-state student *i*, including gender and race indicators (with groups as indicated by Table 1; female and white students are the omitted categories in the models), ACT math and English scores, and the high school percentile rank. For students with missing pre-entry academic qualifications we impute values to the mean and include indicator variables for whether each data element is missing. δ_j and φ_t are major and year fixed effects and ε_{ijt} is an idiosyncratic error term. Standard errors are clustered at the major level throughout our analysis to account for correlated errors within majors (Bertrand, Duflo and Mullainathan, 2004).

We expand on the model in equation (1) by separating the total non-resident enrollment share in cell *jt* into the out-of-state domestic and foreign components. This allows us to explore the potential for effect heterogeneity by non-resident type. The expanded version of the model is as follows:

$$Y_{ijt} = \gamma_0 + OOSS_{jt}\gamma_1 + FS_{jt}\gamma_2 + \mathbf{X_{ijt}}\boldsymbol{\gamma_2} + \varsigma_j + \pi_t + u_{ijt} \qquad (2)$$

Recurring variables and features of equation (2) follow from equation (1) and the identifying assumptions are the same. The two treatment variables in equation (2) are the out-of-state and foreign enrollment shares, $OOSS_{jt}$ and FS_{jt}.

We highlight two primary threats to identification with the models described by equations (1) and (2). First is the potential for endogenous sorting of in-state students to majors in response to major-level changes in non-resident enrollment. Conceptually, such sorting seems unlikely because incoming freshmen specify their majors prior to arriving on campus, which means they are unlikely to possess the information about their major-level peers that would be necessary to sort to initial majors endogenously. We provide empirical support for this claim by looking for evidence that in-state student characteristics at the major-by-year level shift in response to changes in non-resident enrollment along observed dimensions, as in Anelli et al. (2017) and Figlio and Ozek (2017). Specifically, we estimate analogs to equation (1) but where the variables in $\mathbf{X}_{ijt}$ are used as dependent variables. These models allow us to examine whether fluctuations in the non-resident enrollment share predict changes in student characteristics that should not change unless there is endogenous pre-sorting to majors.

The results are reported in Table 3. One coefficient is estimated to be significantly different from zero at the 10 percent level across the eleven regressions of student characteristics. To test the likelihood of observing at least one non-zero coefficient by chance in Table 3, we perform a randomized-inference test following Cullen et al. (2006) and Koedel et al. (2017).[10] This exercise yields a p-value of 0.74, suggesting that the outcome we see in Table 3 is quite likely even with random assignment to treatment. Analogous results for equation (2) are provided in Appendix Table A.1 and are substantively similar (joint p-value: 0.94). Thus, in addition to being unlikely

[10] Specifically, we divide the data panel vertically to split out the major-by-year non-resident enrollment shares (i.e., the treatments) from all other variables. We randomly re-shuffle the vector of non-resident enrollment share variables and reconnect it to the rest of the data so that each in-state student is randomly assigned a treatment level. This process preserves the covariance structure between the student characteristics (which is critical for joint statistical testing) while randomly assigning treatment. We then estimate the model for each student characteristic in Table 3 using the reconstructed sample and store the number of statistically significant estimates at the 10 percent level. We repeat this procedure 3,000 times to construct an empirical placebo distribution of the number of statistically significant estimates in Table 3.

intuitively, there is no empirical evidence that in-state students sort to majors endogenously prior to entry.

The second threat to identification is the possibility of endogenous responses of academic departments. If some departments at MU were better positioned to absorb non-resident students as the university was expanding non-resident enrollment, our estimates could be biased if major-level variation in non-resident enrollment growth is partly driven by endogenous departmental responses along these lines.[11] To address this concern we estimate separate models that exploit just the initial distribution (i.e., during the pre-2008 period) of students across majors by residency status (i.e., in-state, out-of-state and foreign) for identification. Specifically, we instrument for the actual non-resident enrollment share in each major-by-year from 2008 onward by allocating total enrollment growth to the three residency groups in proportion to their major-level presence during the pre-2008 period, which is before the ramp-up in non-resident enrollment at MU began.

To create the instruments we first predict the number of in-state students in major *j* and year *t* by $IS'_{jt} = IS_{j0} * (\frac{IS_t}{IS_0})$. IS_{j0} is the average annual number of in-state students in major *j* over the pre-2008 period, denoted as the initial period by *t=0*, and $(\frac{IS_t}{IS_0})$ captures the increase in in-state students overall at MU between the initial period and year *t*. Following the same logic, the numbers of out-of-state and foreign students in major *j* and year *t* are predicted by

[11] An example of an endogenous response specific to foreign enrollment is that departments could work to change the classifications of their majors so that foreign students will quality for optional practical training (OPT). This would only be possible for some types of majors connected to OPT-eligible fields. This type of response would fall under the broad umbrella of endogenous responses by departments to increases in non-resident enrollment at MU, although it is likely of second-order importance given that the total non-resident enrollment increase is primarily driven by domestic students.

$OOS'_{jt} = OOS_{j0} * (\frac{OOS_t}{OOS_0})$ and $F'_{jt} = F_{j0} * (\frac{F_t}{F_0})$, respectively. With these predictions in hand we estimate the following two-stage analog to equation (1) using data from 2008 onward, during the expansion period of non-resident enrollment at MU:

$$NRS_{jt} = \alpha_0 + IS'_{jt}\alpha_1 + OOS'_{jt}\alpha_2 + F'_{jt}\alpha_3 + \mathbf{X_{ijt}}\boldsymbol{\alpha_4} + \theta_j + \tau_t + e_{ijt} \quad (3)$$

$$Y_{ijt} = \psi_0 + N\hat{R}S_{jt}\psi_1 + \mathbf{X_{ijt}}\boldsymbol{\psi_2} + \phi_j + \rho_t + \omega_{ijt} \quad (4)$$

Again, the recurring variables and features in equations (3) and (4) follow the same definitions as in equation (1). Because treatment in the IV model is predicted using data from before the rapid increase in non-resident enrollment, the estimates in equation (4) will not be biased by endogenous responses of academic departments during the non-resident enrollment expansion period. We do not estimate an IV analog to equation (2) because the instruments in equation (3) are not strong, and would be weakened further if stretched to cover two endogenous variables.[12]

Our IV approach is closely related to the shift share approach used by Card (2001), Card and DiNardo (2000), and Peri et al. (2015). The identifying assumption is that the pre-2008 distribution of students across majors affects educational outcomes of in-state students only by affecting future non-resident enrollment, conditional on other controls in the model. Unfortunately this assumption is not directly testable, and further, our setting is not well-suited to subject the instruments to rigorous interrogation.[13] However, it is intuitive that the initial distribution of

[12] This also prevents the IV strategy from addressing endogenous departmental responses to specific types of non-resident enrollment—e.g., the foreign-student-specific OPT example in the previous footnote. This limitation may not matter much substantively if departments respond primarily to total non-resident enrollment growth in terms of formulating programmatic responses, again noting that most of the non-resident enrollment increase at MU is driven by domestic non-residents.

[13] Most notably, we have a relatively small number of majors (54) and just three student types for which we project enrollment growth. In the typical application of shift-share instruments (e.g., in the industrial organization literature) the sample sizes along both of these dimensions are larger, which strengthens the case for instrument validity and permits a more rigorous inspection of the properties of the instruments (e.g., see Borusyak, Hull, and Jaravel, 2018).

students across majors has no direct impact on in-state students who enter MU in later years conditional on the model controls (and the major and year fixed effects in particular) and we present the IV results as complementary to our primary findings.

Recall from above that there are two primary channels by which the presence of non-resident students is likely to affect in-state students. The first is peer effects and the second is through resource spillovers deriving from non-residents' higher costs of attendance. However, for the resources mechanism to contribute to the identifying variation leveraged by our models, it must be the case that resources follow students down to the major level (at least to some degree). During the time period of our study the budget model used by MU did not include any formal mechanisms to allow for this to occur, although it cannot be ruled out through informal channels.

To gain insight into this question empirically and in the context of our research design, we collected additional data on key indicators of resources at the department level during our sample period: faculty sizes and salaries.[14] We use these data to estimate analogs to equation (2), aggregated to the major-by-year level, where the dependent variables measure departmental resources and departmental resources per enrolled major (of any resident type and in any grade level). Our interest is in whether the non-resident enrollment shares predict departmental resources conditional on the controls in our models. This is a direct test of whether departmental resource changes are linked to the variation in non-resident enrollment we leverage for identification. The results are reported in Appendix Table A.2 and give no indication of such a linkage.

The null findings in Appendix Table A.2, which are as expected given the structure of MU's budget model, indicate that our models are not picking up the effect of non-resident students on institutional resources. Therefore, we interpret our analysis as informing the extent to which

[14] Our data on department-level resources are from University of Missouri System annual salary reports.

non-resident students affect in-state students through the peer-effects channel. Building on the discussion in the introduction, the two key factors that fit under the broad umbrella of peer effects are effects via increased academic competition, and especially for foreign students for whom English is not the first language, the possibility of effects on the academic environment in the form of resource diversion and reduced peer-to-peer interactions (Anelli et al., 2017).[15] Along both of these dimensions the potential for negative peer effects seems stronger for foreign students—perhaps most notably, in terms of in-class academic competition Table 1 shows that foreign students perform much better in first-year classes than their (resident and non-resident) domestic peers. Although we cannot disentangle specific mechanisms within the peer-effects channel, our models are well-suited to recover the net effects on resident students of exposure to non-residents.

5. Primary Results

Table 4 shows how changes in the non-resident enrollment share affect in-state student outcomes, estimated separately by equation (1) (Panel A) and equation (4) (Panel B). Each coefficient is from a separate regression and shows the effect of a one-percentage-point increase in the non-resident enrollment share. Coefficients for student characteristics in the *X*-vector are omitted for brevity. Full output from Panel A of Table 4 is reported in Appendix Table A.3 for interested readers.

The coefficients on the non-resident enrollment share in Panel A are small in magnitude and none are statistically significant at conventional levels. For example, the insignificant estimate for persistence in the same major at MU in column 1, if taken at face value, suggests that a one-

[15] Academic competition effects may be more pronounced in majors that have academic requirements for advancement (e.g., the business school at MU requires a minimum grade point average after 45 completed semester hours to be permitted to continue into upper-level coursework). Unfortunately we do not have comprehensive data on which majors have such requirements, how binding they are, and how they have changed over time during our data panel, to assess effect heterogeneity along this dimension empirically.

standard-deviation increase in the non-resident enrollment share (17 percentage points) decreases the likelihood of in-state students remaining in the same major at MU by just 1.4 percentage points (i.e., -0.0008*17=-0.014). The sample average of this outcome is 38 percent, as reported in Table 1. The insignificant point estimates for the other outcomes are similarly small and the standard errors rule out moderate impacts. Overall, there is no evidence to suggest that differences in exposure to non-resident enrollment affect in-state student outcomes.

Panel B of Table 4 shows that the IV models estimated for cohorts from 2008-2014 yield similar null results.[16] A caveat to these estimates is that they are less precise because the instruments are not strong.[17] But noting this limitation, the results in Panel B give no indication that our findings in Panel A are biased by endogenous responses of academic departments.

Table 5 shows results from equation (2), which separates total non-resident enrollment into its out-of-state and foreign components. The estimates for exposure to out-of-state domestic enrollment align closely with the estimates in Panel A of Table 4; i.e., the coefficients in all five models are small and statistically insignificant. This is unsurprising because most non-resident enrollment at MU is out-of-state domestic enrollment.

For exposure to foreign enrollment the coefficients are invariably negative. Moreover, in the models of persistence outcomes, they are statistically distinguishable from zero and in two of three cases they are also statistically distinguishable from the coefficients on out-of-state domestic enrollment. We estimate that a one-standard-deviation increase in the foreign enrollment share (5

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[16] In Panel A of Appendix Table A.4 we report results from non-IV versions of the model using the same years of data as the IV model—i.e., the 2008-2014 subsample—and confirm that the change to the sample composition does not substantively affect the estimates.

[17] In Appendix Table A.5 we report the first-stage F-statistic, which is just above 13 and near the threshold for an acceptable instrument. Stock and Yogo (2005) show that our F-statistic is reasonable from a bias-reduction perspective (it is near the threshold for 5-percent bias relative to OLS), but implies a non-negligible size distortion resulting in statistical tests that over-reject the null hypothesis. We acknowledge this theoretical limitation but as a practical matter, we remain far from rejecting the null hypotheses in our IV models.

percentage points) decreases the likelihood of in-state students remaining enrolled in the same major at MU by 2.5 percentage points. The same increase in foreign enrollment also decreases in-state students' likelihood of persistence at the university and system levels by 1.2 and 1.0 percentage points, respectively. These effects are not large relative to the sample means of these outcomes, but could have potentially important implications with greater foreign enrollment expansion.

6. Robustness & Extensions

6.1 Robustness

Table 6 examines the sensitivity of our findings to basic specification adjustments, focusing on equation (2), for which the main results are shown in Table 5. For ease of comparison we reproduce the main results in Table 6 in column (1). The first robustness test in column (2) modifies the specification to include time-varying student characteristics at the major level. Specifically, we include in-state enrollment, race and gender shares, average ACT math and English scores, and the average high school percentile rank. The results are similar to the main results in column (1), indicating that the findings are robust to including these time-varying, major-level characteristics. A related specification adjustment is to drop individual student characteristics from the model. Column (3) shows that this adjustment also does not affect our estimates substantively, although the standard errors become much larger because the individual student characteristics are strong predictors of outcomes. The lack of sensitivity of our findings to these adjustments is as expected given the evidence in Table 3, which shows that in-state student sorting to majors based on observables is not related to variation in non-resident exposure. These results are consistent with identification resting primarily on the inclusion of the major and year fixed effects in our models.

We also examine whether our results are robust to modifying the analytic sample. We are especially interested in the robustness of the negative finding for foreign-enrollment exposure to sample modifications, given that it is based on thin identifying variation. We test the sensitivity of the findings to sample adjustments in two ways. First, we estimate equation (2) after dropping each individual major in the data in turn to see if a particular major drives the findings. Focusing on the outcome for which the foreign-exposure effect is largest—the "enrolled in the same major at MU" outcome—we find that in 52/54 regressions, the negative and significant coefficient remains. Moreover, in the two instances where the coefficient becomes insignificant—when we drop either economics or communications—it remains substantively similar but the p-value increases above traditional thresholds.[18] This sensitivity test does not suggest that the negative findings for foreign-enrollment exposure are driven disproportionately by a single major.

In addition, we modify the sample by randomly dropping six majors (≈10 percent of the 54 majors in the sample) and re-estimate the models for all outcomes as in Table 5. We repeat this procedure five times and report the results for the five iterations in Appendix Table A.6 (panels A.6.1-A.6.5). The results for foreign-enrollment exposure fluctuate on the margin of statistical significance in some cases, but always remain substantively similar. While the caveat remains that our findings for foreign-enrollment exposure are based on limited identifying variation, the negative results estimated by equation (2) do not seem to be the product of abnormal sampling variability in our data.

[18] When we drop economics and communications individually, the coefficient of interest (and standard error) changes from -0.0050 (0.0025) as shown in Table 5 to -0.0051 (0.0033) and -0.0031 (0.0022), respectively. In the other 52 leave-one-out regressions, the coefficient and standard error combination remains negative and statistically significant.

6.2 Effect Heterogeneity by the Gender and Race of In-State Students

Changes in non-resident exposure could differentially affect in-state students depending on their gender and race. To examine this possibility, we add interaction terms between the non-resident enrollment share and gender and race indicators of in-state students to equation (1). The results are shown in Table 7. The baseline estimates for white males are small and insignificant (captured in row 1). For female and minority in-state students, the differential-effect interaction coefficients are mixed in sign and small in magnitude. Of the fifteen interaction coefficients, only three are statistically significant at the 10 percent level and none are significant at the 5 percent level. Overall, Table 7 provides no evidence of meaningful effect heterogeneity by the gender and race of in-state students.

6.3 Effect Heterogeneity between STEM and non-STEM Fields

Table 1 shows that foreign students disproportionately enroll in STEM fields and domestic non-residents disproportionately enroll in non-STEM fields. Noting this, a potential explanation for the effect heterogeneity between exposure to domestic and foreign students implied by our results in Table 5 is effect heterogeneity between STEM and non-STEM fields, regardless of non-resident type. To test for effect heterogeneity between STEM and non-STEM fields, we return to the specification in equation (2) and add interaction terms between the non-resident enrollment shares (by type) and an indicator variable that identifies STEM fields.[19]

The results are reported in Appendix Table A.7. The interaction-term coefficients with STEM are mostly negative, for both the non-resident domestic and foreign enrollment share variables, but also mostly insignificant. Our summary assessment of these results is that they do not provide clear evidence that effect heterogeneity between STEM and non-STEM fields is a key

[19] STEM majors are as designated by the Department of Homeland Security. The five largest STEM majors are biology, engineering (general), animal science, biochemistry/biophysics, and mechanical engineering. The level effect of STEM majors is absorbed by the major fixed effects in the interacted model.

driver of our differential findings for domestic and foreign non-resident exposure. However, the results are at least suggestive that non-resident exposure (of either type) is more harmful to resident students in STEM fields. To the extent that this influences the effect heterogeneity between foreign and non-resident domestic students, our view is that it is part of the treatment we study. Put another way, the effects of non-resident enrollment increases should be viewed as inclusive of effects driven by differences the fields pursued by different types of non-residents.

6.4 Difference-in-Differences and Event Study Models

Our two-way-fixed-effects approach is akin to a difference-in-differences design, with the key difference being that treatment in our models is not binary. We can modify the treatment variables to emulate the typical difference-in-differences structure by redefining them as binary variables that identify majors at MU that experienced particularly large increases in non-resident enrollment. We do so using the following specification:

$$Y_{ijt} = \lambda_0 + (Post_t^{OOS} * Q_j^{OOS})\lambda_1 + (Post_t^F * Q_j^F)\lambda_2 + \mathbf{X_{ijt}}\boldsymbol{\lambda_3} + \kappa_j + \zeta_t + v_{ijt} \qquad (5)$$

In Equation (5) we separate domestic and foreign non-resident enrollment growth, as in equation (2). $Post_t^{OOS}$ is an indicator set to one for 2008 and after to represent the post-treatment period for out-of-state domestic enrollment growth. Similarly, $Post_t^F$ is an indicator set to one for 2011 and after for foreign enrollment growth. Q_j^{OOS} is a binary variable set to one if major *j* is in the top quartile of out-of-state enrollment growth between the pre-2008 and post-2008 periods; similarly, Q_j^F is set to one if major *j* is in the top quartile of foreign enrollment growth between the pre-2011 and post-2011 periods. The major and year fixed effects subsume the level effects of majors and time in the model.

The identifying assumptions for equation (5) are the same as for equation (2). The key difference between the models is that equation (5) facilitates larger contrasts in out-of-state and foreign enrollment "treatments" by isolating top-quartile majors and comparing them to other majors. In fact, equation (5) can be characterized as simply relaxing the linear treatment effect assumption in equation (2). By comparing majors that experienced the largest differences in out-of-state and foreign enrollment growth to other majors, the model is able to pick up potentially non-linear treatment effects that the continuous-treatment model would miss.

The standard difference-in-differences specification can be further expanded into an event-study model by replacing the interaction terms involving the post-treatment period with interactions for each time period (year), as in equation (6):

$$Y_{ijt} = \xi_0 + (Q_j^{OOS} * \mathbf{D_t})\boldsymbol{\xi_1} + (Q_j^F * \mathbf{D_t})\boldsymbol{\xi_2} + \mathbf{X_{ijt}}\boldsymbol{\lambda_3} + \mu_j + \varphi_t + e_{ijt} \quad (6)$$

Overlapping variables in equations (5) and (6) are defined in equation (5). $\mathbf{D_t}$ in equation (6) is a vector of indicator variables for each year *t*, which allows us to map out the full trend of outcome gaps between majors in the top quartile of non-resident enrollment growth (by type) and other majors over the course of our data panel. This gain in flexibility comes at the cost of lost precision in the treatment-by-year effects ($\boldsymbol{\xi_1}$ and $\boldsymbol{\xi_2}$) relative to their year-aggregated analogs in equation (5) (λ_1 and λ_2). While this is a limitation, equation (6) serves as a useful complement to the more-powerful but less flexible standard difference-in-differences specification, especially because the treatments in our application are not binary events, but rather evolving processes per Figure 1.

The results from equation (5) are presented in Table 8. For out-of-state domestic exposure, all five point estimates are positive and two are statistically significant. The implied effect sizes remain small, although they are somewhat larger than in Table 5.[20] Overall, the results for out-of-

[20] We can use the fact that the difference in non-resident enrollment growth between top quartile majors and the other majors in Table 8 is 12 percentage points on average to convert the estimates in Table 8 to a form that is comparable to the estimates in Table 5. For instance, the point estimate for persistence at MU in Table 8 can be translated to an effect size of 0.14 percentage points for a one-percentage-point increase in the out-of-state enrollment share, i.e. 0.0162/12=0.0014. Overall, if we attempt to linearize the estimated effects from all models in

state domestic exposure in Table 8 are similar to Table 5, and if anything give some indication that increased exposure *improves* the outcomes of in-state students. For foreign enrollment the findings are also qualitatively consistent to what we show in Table 5, although the estimates are noisy and none are statistically distinguishable from zero.

The event study output from equation (6), using the five different outcome variables, is shown in Figure 4. Results for each outcome are shown in a separate panel for each type of non-resident enrollment. We omit two interaction terms for each non-resident type, for the two years immediately preceding the beginning of the type-specific non-resident enrollment increase (i.e., 2006 and 2007 for non-resident domestic exposure; 2009 and 2010 for foreign enrollment exposure). The omission of two years rather than one year is in order to recover some of the statistical power lost in the event-study models. Specifically, it improves the precision of the omitted group, which in turn improves the precision of the other event-study coefficients, and reduces the influence of year-to-year sampling variability over the omitted group value.

The output is reported in the form of annual estimates of the coefficients for top-quartile majors compared to other majors, where "zero" in the figures is interpreted as the difference between top-quartile and other majors during the omitted 2-year period. Per above, imprecision in the individual year-by-year estimates makes interpretation challenging, but holistically, it is difficult to see any clear pattern in the event-study estimates.

Starting with the findings for exposure to domestic non-residents, there is no indication in Figure 4 that resident students in high-impact majors were affected when non-resident enrollment began to expand at MU in 2008, or further into the expansion period. The pattern of event-study

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Table 8 in this way, the implied magnitudes of the estimates are larger than the corresponding estimates reported in Table 5, but so are the standard errors. This is perhaps suggestive of non-linear effects, but we do not make a strong claim about whether effects are non-linear because we do not have enough statistical power to be definitive.

estimates over years and outcomes is consistently flat, corroborating our null findings for this treatment thus far. For exposure to foreign students, the summary takeaway from the event-study models is similar—specifically, there is not clear evidence that resident students in majors with high foreign-enrollment growth were impacted at the onset of foreign-enrollment expansion efforts, or during the (shorter) expansion period. In fact, although the estimates are very imprecise, there is some indication of a pre-trend in the outcome for which we find the strongest negative effects of foreign-enrollment exposure in our primary specification—the "Enrolled in the Same Major at MU" outcome—in Panel A of Figure 4. This raises further questions about the robustness of that finding, although we also note that there is no indication of pre-trends elsewhere in Figure 4, including panels B and C, which also report on outcomes for which we find negative and significant foreign-enrollment exposure effects in Table 5.

In summary, the difference-in-differences and event-study models corroborate the null findings from our preferred specification for exposure to domestic non-residents. However, the negative findings for exposure to foreign students from our preferred specification are not robust in these models. One reason is that the latter findings are identified using fairly limited variation to begin with, and the models in this section use the available variation in treatment less efficiently, reducing statistical power. However, noting this weakness of the models, it is still informative that the foreign exposure findings are not robust. If nothing else, the lack of robustness highlights the fragility of the results, which is fundamentally driven by the limited variation in exposure to foreign students among resident students at MU.

6.5 Effects on Graduation Outcomes

The analysis thus far has focused on third-year educational outcomes of in-state students, which allows us to incorporate more cohorts who have been exposed to the recent influx of non-resident students, and foreign students in particular. However, a concern with focusing on third-year outcomes is that there may be fewer interactions with same-major peers during the first two years of college relative to later years, as freshmen and sophomores tend to take general education courses in addition to courses that are required for their respective majors. This could dilute the major-by-year "treatment" as we've measured it and contribute to our modest findings.

To test the sensitivity of our findings to this issue, in Table 9 we reproduce results comparable to what we show in Panel A of Table 4, but restrict the analysis to students from the 2004-2010 cohorts for whom we can track college outcomes for six years (recall that the last year we can observe outcomes is 2016). This allows us to look at graduation outcomes and what are effectively "full career" credit hour and GPA outcomes, which is appealing because these outcomes will embody the effects of exposure to non-resident students beyond the first two years of college. Note that we only estimate these models using total non-resident exposure as in Table 4, and do not attempt to split out-of-state domestic and foreign exposure. This is because the cohorts from 2004-2010 entered MU prior to the period of foreign-enrollment expansion.

If students have limited exposure to their same-major peers during the first two years of college and this is attenuating our estimates in Table 4, we would expect the estimates using graduation outcomes to be less attenuated because same-major peers should increasingly overlap later in the college career. However, the results in Table 9 are substantively similar to what we show in Table 4. The coefficients are small in an absolute sense and none are statistically significant at conventional levels.[21] The similarity of results is not consistent with the hypothesis that our main findings are attenuated due to a lack of meaningful exposure to in-major peers early in the college career.

[21] The coefficient on credit hours in nominally much larger in Table 9, although it is also estimated much less precisely. Moving to 6-year outcomes results in much more variation in this variable, most of which is unexplained by the model.

7. Conclusion

We leverage a period of high growth in non-resident domestic and foreign enrollment at the University of Missouri-Columbia to study the effects of exposure to non-resident students on persistence and performance outcomes during college for in-state students. Our models rely on variation within majors over time in the exposure of in-state students to non-residents for identification. We find that non-resident exposure overall does not affect outcomes for in-state students, driven by null effects of domestic non-resident exposure. When looking specifically at exposure to foreign students we find some evidence of negative effects on in-state students, which is consistent with related evidence from Anelli et al. (2017). However, we view our findings in this regard as suggestive only, as they are not robust in all of our specifications and are identified using thin variation.

The two broad channels through which non-resident students are likely to affect in-state students are by (1) peer effects and (2) providing additional resources. Because we use major-level variation for identification and the MU budget model does not permit extra resources generated by non-resident students to "trickle down" to academic departments, our results are silent about the resources mechanism. Turning to the peer effects mechanism, the null effects of the major non-resident group—domestic non-residents—indicate that MU has been able to absorb these students without causing detectable harm to in-state students along the dimensions we measure. The suggestively negative peer effects of foreign students, while not fully robust, are consistent with several peer-effect channels, which our models are not suited to disentangle. That said, we show that foreign students perform much better academically than their domestic peers on average (Table 1) and one possibility is that they are stronger classroom competitors. It is worth noting that while domestic non-residents are similar to in-state students in terms of academic preparation, implying the competitive threat is weaker, *a priori* there are still ways that they could negatively affect in-state students via competition. For example, the infusion of similarly-qualified domestic competitors could affect in-state students by squeezing them out of popular majors if there are constraints on the numbers of students admitted. But we find no evidence that this has occurred at MU despite a very large and rapid increase in non-resident domestic enrollment during the period we study.

Our findings help to inform ongoing debates about universities' non-resident enrollment policies at a time when these policies are under great scrutiny. Revenue from state appropriations has constituted a smaller fraction of university budgets over time and administrators continue to look elsewhere for resources. Non-resident students are an appealing revenue source but the literature is thin with regard to how expansions in non-resident enrollment affect in-state students. Our findings at MU, a moderately- but not highly-selective state flagship university, indicate that domestic non-resident enrollment expansion does not harm in-state students, which makes expanding access to these students appealing. Our results for foreign students, while not conclusive, suggest more caution and highlight a potential tradeoff associated with the additional revenue that these students generate.

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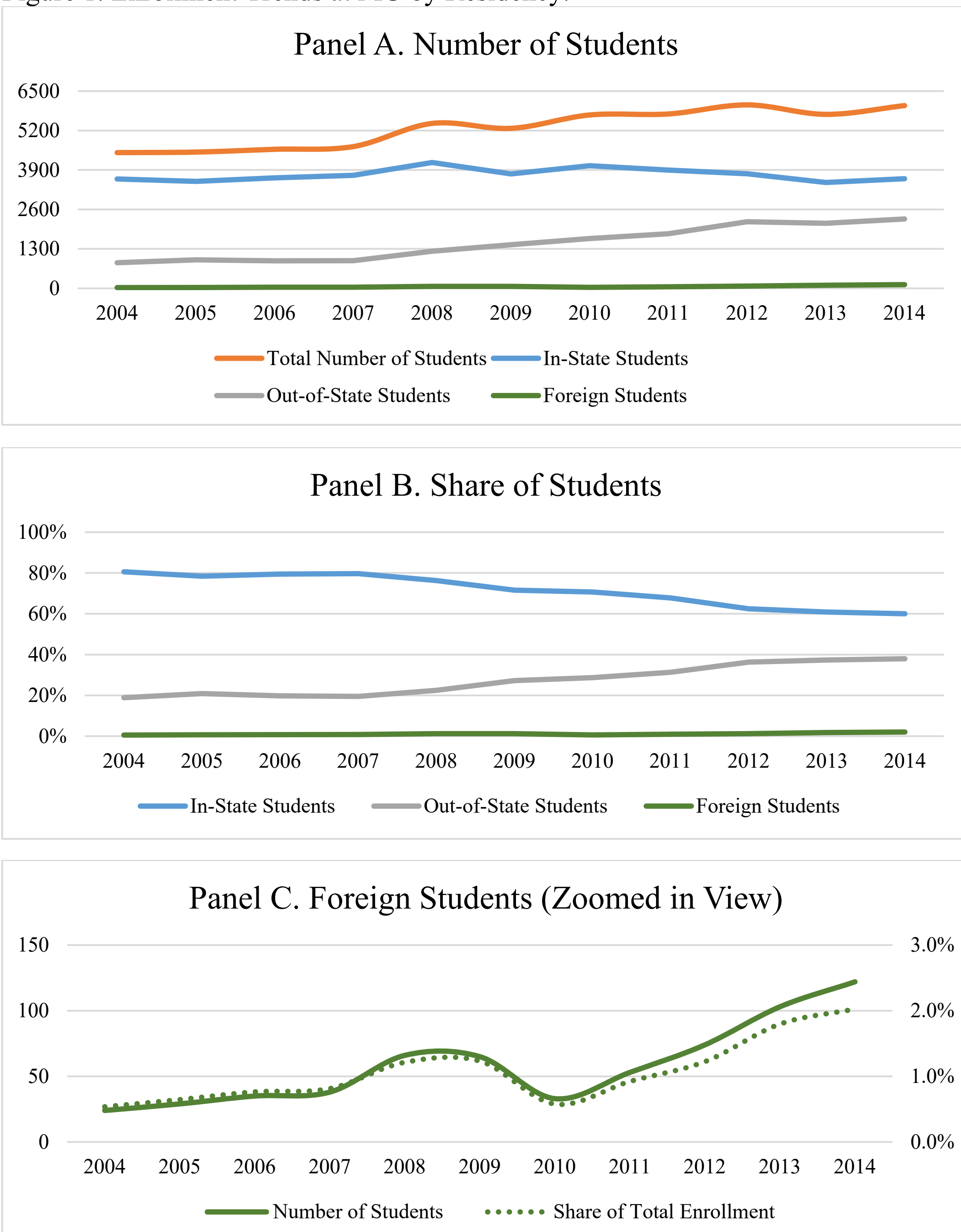
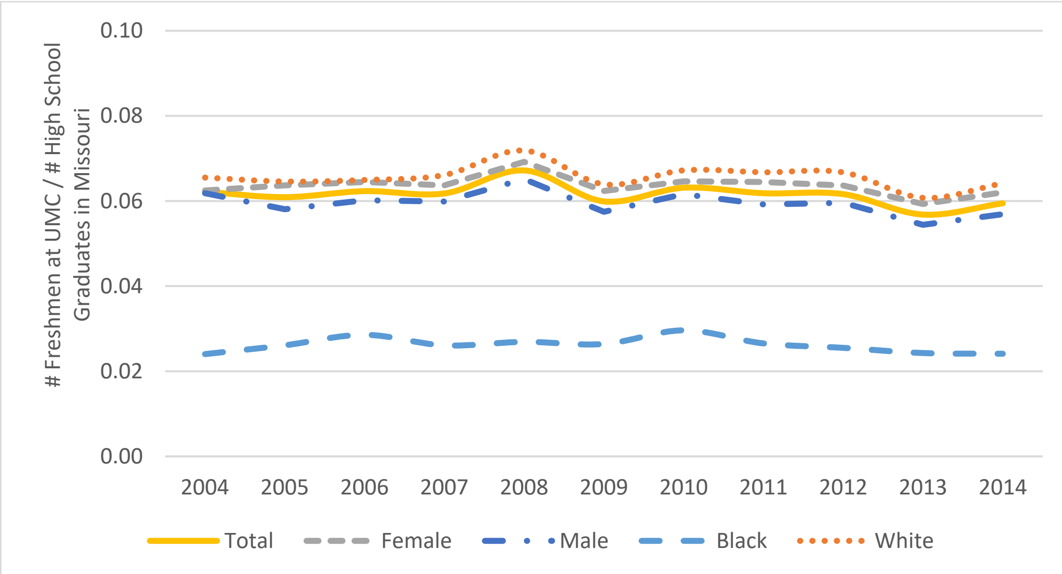
Figures and Tables

Figure 1. Enrollment Trends at MU by Residency.



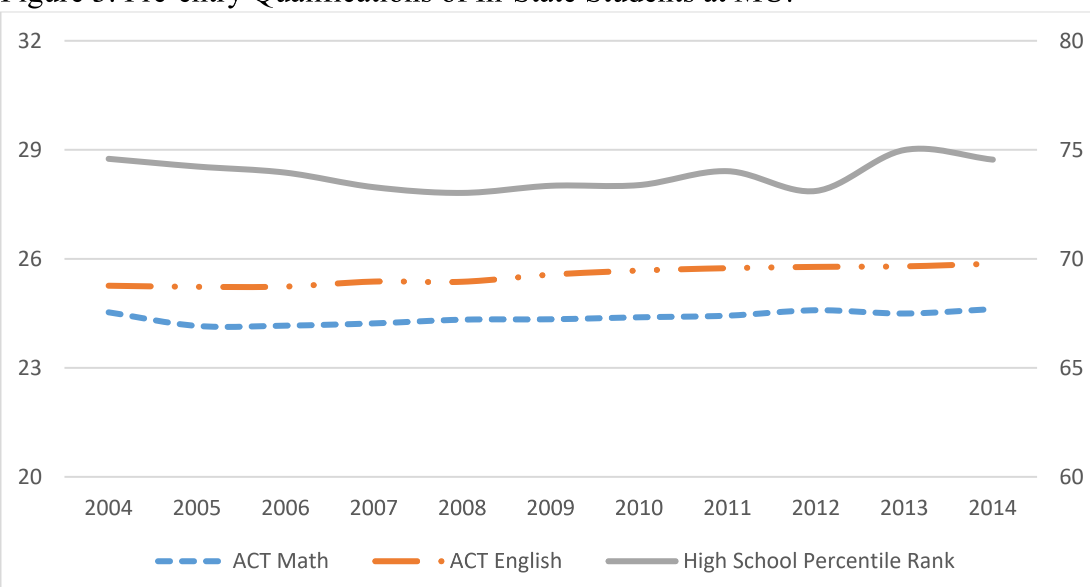
Notes: These graphs display enrollment trends at University of Missouri-Columbia (MU) by residency using data of first-time, full-time, degree-seeking students entering MU as college freshmen from 2004 to 2014. Panel A shows the numbers of students and panels B shows the enrollment shares. Panel C zooms in on the foreign enrollment growth trends because they are otherwise obscured by the small baseline values in panels A and B.

Figure 2. Ratio of In-state Enrollment at MU and the Number of High School Graduates in Missouri.



Notes: This graph depicts the time trend of the ratio of first-time, degree-seeking, full-time in-state students at MU to number of high school graduates in Missouri. The solid line represents the ratio for all in-state students. The dashed lines show the ratio separately for each race and gender. The data for high school completers is retrieved from the Western Interstate Commission for Higher Education (2016) and includes both public and private high schools; by-gender and by-race data are available only for public schools in Missouri. Asian/ Pacific Islander, Hispanic and Other Race students are omitted because of small sample sizes.

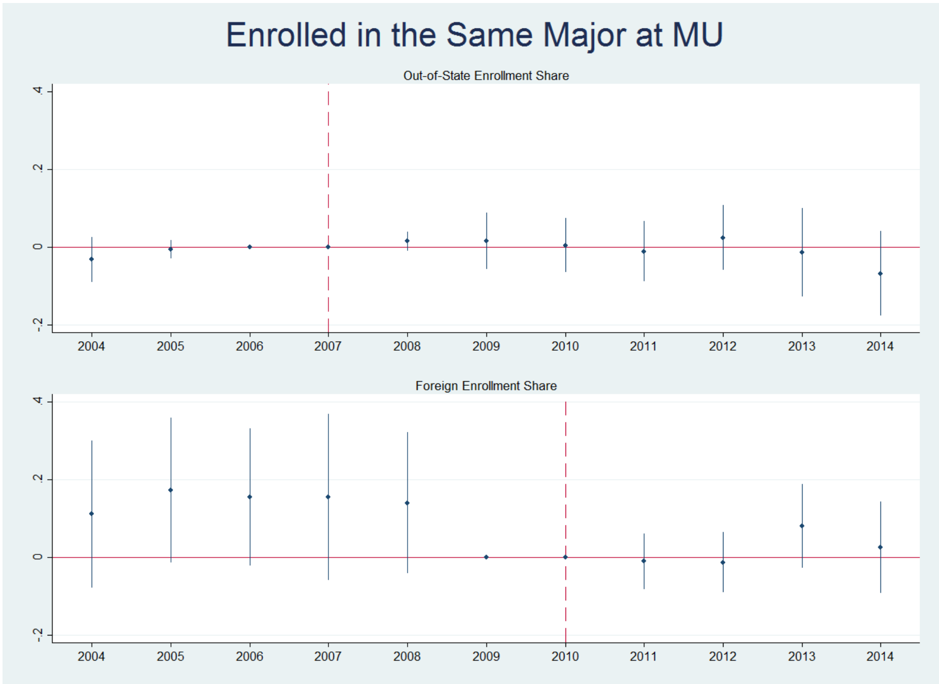
Figure 3. Pre-entry Qualifications of In-State Students at MU.



Notes: This graph depicts time trend of the average of three pre-entry academic qualifications of first-time, degree-seeking, full-time in-state entrants to MU from 2004 to 2014—the ACT math score, ACT English score, and high school percentile rank. The left axis scales ACT scores and the right axis scales the high school percentile rank.

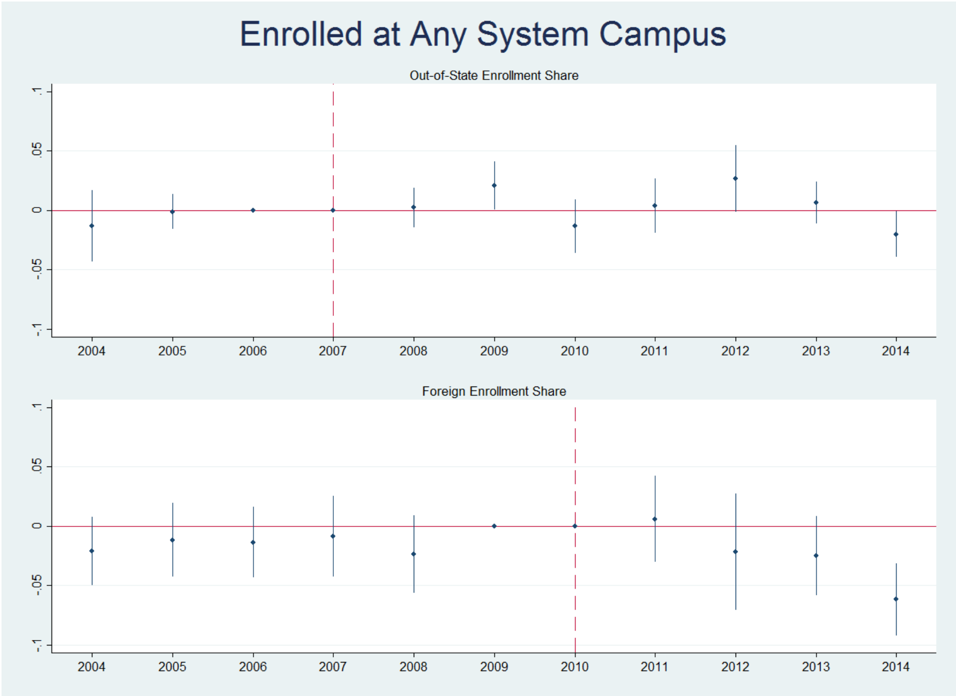
Figure 4. Event-Study Estimates.

Panel A

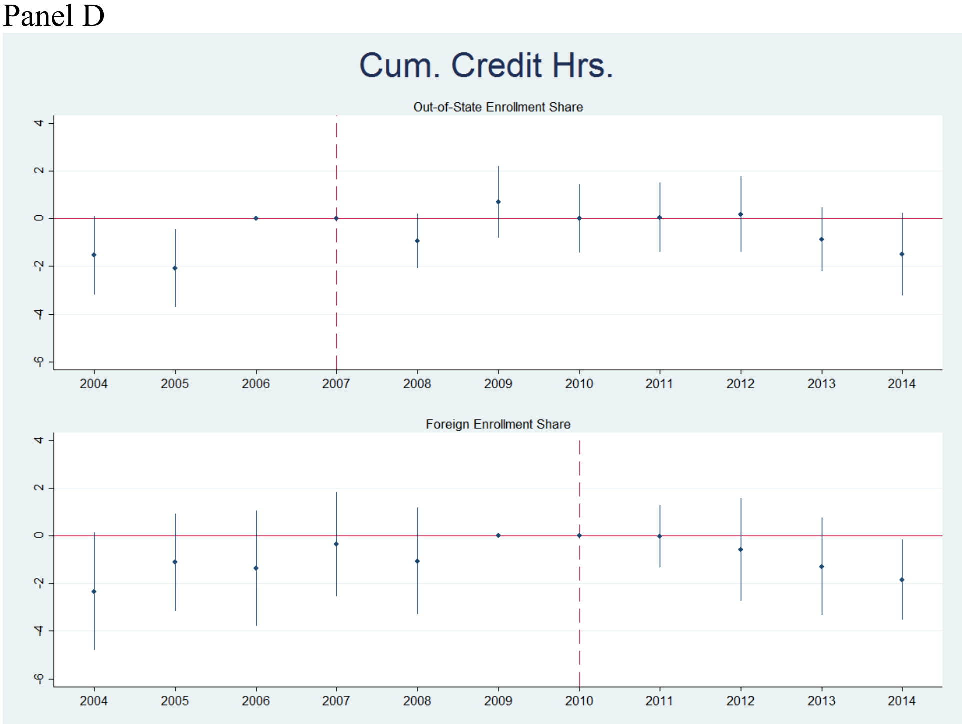


Panel B

Panel C



Panel D



Panel E

Notes: The graphs display coefficients and 95 percent confidence intervals on interaction terms between year dummies and the top-quartile non-resident growth indicator, by non-resident type as in equation (6). The interaction terms involving the indicators for years 2006 and 2007, and 2009 and 2010, are omitted for top-quartile domestic and foreign non-resident enrollment growth majors, respectively. This is denoted in the figure by the zero values reported for these years in the graphs. As discussed in the text, we omit two year interactions for each treatment type in order to improve the precision of the estimates and reduce the influence of year-to-year sampling variability for the comparison condition.

Table 1. Descriptive Statistics of Each Residency Group.

	In-State Students Mean (St Dev)	Out-of-State Students Mean (St Dev)	Foreign Students Mean (St Dev)
Female	0.52 (0.50)	0.58 (0.49)	0.51 (0.50) *
Male	0.48 (0.50)	0.42 (0.49)	0.49 (0.50) *
Asian/ Pacific Islander	0.02 (0.15)	0.02 (0.14)	-
Black	0.07 (0.25)	0.14 (0.35)	-
Hispanic	0.01 (0.11)	0.02 (0.14)	-
White	0.85 (0.36)	0.75 (0.43)	-
Other Races	0.05 (0.21)	0.07 (0.25)	-
ACT Math	24.39 (4.10)	24.83 (3.64)	24.87 (2.03)
ACT Math Missing Indicator	0.01(0.09)	0.10 (0.30)	0.83 (0.38) *
ACT English	25.53 (4.51)	26.11 (4.08)	25.43 (2.30) *
ACT English Missing Indicator	0.01 (0.09)	0.10 (0.30)	0.83 (0.38) *
High School Percentile Rank	73.81 (18.10)	71.56 (17.24)	72.79 (7.21) *
High School Percentile Rank Missing Indicator	0.19 (0.39)	0.31 (0.46)	0.90 (0.30) *
Residual First Semester GPA	-0.00 (0.81)	0.00 (0.74)	0.10 (0.84) *
First Semester GPA Missing Indicator	0.02 (0.13)	0.02 (0.12)	0.05 (0.23) *
STEM Major	0.27 (0.45)	0.16 (0.37)	0.40 (0.49) *
Third-year Outcomes:			
Remaining Enrolled in the Same Major at MU	0.38 (0.49)	-	-
Remaining Enrolled at MU	0.77 (0.42)	-	-
Remaining Enrolled at Any System Campus	0.86 (0.34)	-	-
Cumulative Credit Hours	58.83 (24.29)	-	-
Cumulative GPA	2.91 (0.74)	-	-
Major-level Enrollment	69.23 (126.64)	27.44 (69.02)	1.07 (2.88)
N	40,638	16,108	627

Notes: Racial designation is not available for foreign students as they are coded as "Non-Resident Alien" in the administrative data. Other Races combine students identified as "American Indian/Alaska Native", "Two or More Races" and "Other/Unknown" in the data. Residual first semester GPA is the residual generated from regressing first semester GPA on major and year fixed effects. * Indicates statistically significant differences between out-of-state and foreign students at the 10 percent level or better.

Table 2: Comparison between characteristics of MU and other State Flagships

	MU		Other state flagships	
	2004	2014	2004	2014
Share of white students[1]	0.853	0.790	0.751	0.658
Share of black students[1]	0.064	0.085	0.047	0.045
Share of female[1]	0.527	0.530	0.529	0.525
Share of out of state students[1]	0.187	0.366	0.270	0.326
Share of foreign students[1]	0.005	0.028	0.017	0.044
ACT math 25th percentile score[1]	22	23	20.86	23.00
ACT math 75th percentile score[1]	27	28	27.06	28.74
ACT English 25th percentile score[1]	22	23	21.00	23.10
ACT English 75th percentile score[1]	29	29	27.39	29.72
Total undergraduate enrollment	20883	27642	19894	22704
In-state average tuition for full-time undergraduates	6276	8220	4481	8509
Out-of-state average tuition for full-time undergraduates	15723	23247	14250	24754

[1] Based on first time, degree seeking undergraduate entrants.

Notes: This table compares MU to the 49 other state flagship universities. Data for all universities are from IPEDS. The non-resident enrollment shares reported for MU in this table differ slightly from what we show in Figure 1 because the data sources are different. Also note that Figure 1 shows enrollment trends for full time students only (which is a condition for inclusion in our sample).

Table 3. Results from Regressions of Student Characteristics on the Major-by-Year Non-Resident Enrollment Share.

	Male	Asian	Black	Hispanic	Other Races	ACT Math	ACT Math Missing	ACT English	ACT English Missing	HS. Pctile. Rank	HS. Pctile. Rank Missing
Non-Resident Enrollment Share	0.0011	-0.0001	0.0006*	-0.0000	0.0000	-0.0090	0.0001	-0.0071	0.0000	-0.0287	0.0006
	(0.0007)	(0.0001)	(0.0004)	(0.0001)	(0.0002)	(0.0085)	(0.0001)	(0.0104)	(0.0001)	(0.0402)	(0.0005)
Joint P-value	0.74										
Major Fixed Effects	X	X	X	X	X	X	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X	X	X	X	X	X	X
R-squared	0.20	0.01	0.01	0.01	0.01	0.14	0.01	0.08	0.01	0.07	0.06
N	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638

Notes: This table displays estimates from tests designed to detect observable student sorting in response to changes in the major-level non-resident enrollment share. The joint p-value is based on a randomized inference test and gives the likelihood of observing at least one statistically significant coefficient across the 11 student-characteristic regressions by chance (see text for details). Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Table 4. Estimated Effects of the Non-Resident Enrollment Share on Third-Year Outcomes for In-State Students.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Panel A. Standard Model					
Non-Resident Enrollment Share, 0-100 scale	-0.0008	0.0004	0.0001	0.0228	0.0006
	(0.0016)	(0.0004)	(0.0003)	(0.0280)	(0.0007)
R-squared	0.13	0.06	0.04	0.21	0.30
N	40,638	40,638	40,638	40,638	40,638
Panel B. IV Model					
Non-Resident Enrollment Share, 0-100 scale	-0.0050	0.0008	0.0016	-0.0633	0.0004
	(0.0164)	(0.0019)	(0.0013)	(0.0716)	(0.0052)
R-squared	0.15	0.06	0.04	0.21	0.28
N	26,368	26,368	26,368	26,368	26,368
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X

Notes: The coefficients for student characteristics are excluded for brevity and are reported for Panel A in Appendix Table A.3. As described in the text, the IV model is only estimated from 2008 forward, which is why the sample size is different. Comparable non-IV results for the same sample period are available in Appendix Table A.4. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Table 5. Estimated Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Third-Year Outcomes for In-State Students.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0004	0.0006	0.0003	0.0265	0.0010
	(0.0017)	(0.0004)	(0.0003)	(0.0284)	(0.0007)
Foreign Enrollment Share, 0-100 Scale (γ_2)	-0.0050**	-0.0024*	-0.0019*	-0.0216	-0.0034
	(0.0025)	(0.0014)	(0.0010)	(0.0626)	(0.0021)
P-value for $H_0 : \gamma_1 = \gamma_2$	0.144	0.039	0.030	0.434	0.037
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.13	0.06	0.04	0.21	0.30
N	40,638	40,638	40,638	40,638	40,638

Notes: H_0: γ_1=γ_2 is in reference to Equation (2), the null hypothesis is that the coefficients on out-of-state and foreign enrollment shares are equal. The coefficients for student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Table 6. Estimated Effects of the Non-Resident Enrollment Shares, by Type, on Third-Year Outcomes for In-State Students, Various Model and Sample Modifications.

	(1)	(2)	(3)
Out-of-State Enrollment Share, 0-100 Scale			
Outcomes:			
Enrolled in the Same Major at MU	-0.0004 (0.0017)	-0.0004 (0.0014)	-0.0005 (0.0018)
Enrolled at MU	0.0006 (0.0004)	0.0004 (0.0004)	0.0004 (0.0005)
Enrolled at Any System Campus	0.0003 (0.0003)	0.0002 (0.0003)	0.0001 (0.0003)
Cum. Credit Hrs.	0.0265 (0.0284)	0.0228 (0.0272)	-0.0013 (0.0448)
Cum. GPA	0.0010 (0.0007)	0.0008 (0.0006)	-0.0000 (0.0015)
Foreign Enrollment Share, 0-100 Scale			
Outcomes:			
Enrolled in the Same Major at MU	-0.0050** (0.0025)	-0.0043** (0.0020)	-0.0055* (0.0027)
Enrolled at MU	-0.0024* (0.0014)	-0.0025* (0.0014)	-0.0032** (0.0014)
Enrolled at Any System Campus	-0.0019* (0.0010)	-0.0021** (0.0009)	-0.0024*** (0.0009)
Cum. Credit Hrs.	-0.0216 (0.0626)	-0.0218 (0.0654)	-0.1145 (0.0982)
Cum. GPA	-0.0034 (0.0021)	-0.0028 (0.0020)	-0.0070 (0.0043)
Major Fixed Effects	X	X	X
Year Fixed Effects	X	X	X
Major Characteristics		X	
Student Characteristics	X	X	
N	40,638	40,638	40,638

Notes: Column (1) replicates our main findings in Table 5. The coefficients for major and student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Table 7. Estimated Effects of the Non-Resident Enrollment Share on Third-Year Outcomes for In-State Students, Allowing for Effect Heterogeneity by the Gender and Race of In-State Students.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Non-Resident Enrollment Share, 0-100 scale	-0.0014	0.0001	-0.0001	0.0098	0.0002
	(0.0019)	(0.0004)	(0.0004)	(0.0291)	(0.0008)
Non-Resident Enrollment Share*Female	0.0013	0.0006	0.0004	0.0301*	0.0009*
	(0.0008)	(0.0004)	(0.0003)	(0.0174)	(0.0005)
Non-Resident Enrollment Share*Black	0.0005	-0.0002	0.0001	-0.0282	0.0005
	(0.0010)	(0.0005)	(0.0003)	(0.0317)	(0.0009)
Non-Resident Enrollment Share*All Other non-White Racial/Ethnic Groups	-0.0006	-0.0006	0.0002	0.0021	-0.0010*
	(0.0010)	(0.0004)	(0.0004)	(0.0244)	(0.0005)
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.13	0.06	0.04	0.21	0.30
N	40,638	40,638	40,638	40,638	40,638

Notes: The non-resident enrollment share is on a 0-100 scale for the interactions, although the label is suppressed for brevity. The group "All Other non-White Racial/Ethnic Groups" combines in-state students identified as Asian, Pacific Islander, Hispanic and Other Race/Ethnicities, as shown in Table 1. White and male are the omitted race/ethnicity and gender categories. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Table 8. Estimated Effects of Out-of-State Domestic and Foreign Enrollment Exposure on Third-Year Outcomes for In-State Students, Majors in the Top Quartile of Non-Resident Growth Compared to Other Majors.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Top Quartile Out-of-State*Post Out-of-State (λ_1)	0.0117	0.0162**	0.0067	0.4514	0.0255*
	(0.0335)	(0.0070)	(0.0049)	(0.3942)	(0.0146)
Top Quartile Foreign*Post Foreign (λ_2)	-0.0811	-0.0163	-0.0127	0.0269	-0.0239
	(0.0677)	(0.0126)	(0.0101)	(0.6588)	(0.0174)
P-value for $H_0 : \lambda_1 = \lambda_2$	0.254	0.009	0.054	0.528	0.022
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.13	0.06	0.04	0.21	0.30
N	40,638	40,638	40,638	40,638	40,638

Notes: Post Out-of-State is for year 2008 and after; Post Foreign is for year 2011 and after. $H_0 : \lambda_1 = \lambda_2$ is in reference to Equation (5). The null hypothesis is that the coefficients on the out-of-state and foreign enrollment interaction terms are equal. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Table 9. Estimated Effects of the Non-Resident Enrollment Share on Sixth-Year Outcomes for In-State Students in Entering Cohorts from 2004-2010.

	Graduated in the Same Major at MU	Graduated at MU	Graduated at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Non-Resident Enrollment Share, 0-100 scale	0.0015	0.0006	0.0001	0.1728	-0.0016
	(0.0012)	(0.0007)	(0.0007)	(0.1053)	(0.0015)
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.18	0.10	0.10	0.27	0.17
N	26,140	26,140	26,140	26,140	26,140

Notes: Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Online Appendix

Appendix A
Supplementary Tables

Appendix Table A.1. Results from Regressions of Student Characteristics on the Out-of-State and Foreign Enrollment Shares, as in Equation (2).

	Male	Asian	Black	Hispanic	Other Race	ACT Math	ACT Math Missing	ACT English	ACT English Missing	HS. Pctile. Rank	HS. Pctile. Rank Missing
Out-of-State Enrollment Share	0.0011	-0.0001	0.0006	-0.0000	0.0001	-0.0072	0.0001	-0.0045	0.0001	-0.0208	0.0007
	(0.0007)	(0.0001)	(0.0004)	(0.0001)	(0.0002)	(0.0083)	(0.0001)	(0.0101)	(0.0001)	(0.0407)	(0.0006)
Foreign Enrollment Share	0.0001	0.0007	0.0007	-0.0001	-0.0013**	-0.0299	-0.0002	-0.0376	-0.0002	-0.1231	-0.0005
	(0.0013)	(0.0005)	(0.0017)	(0.0005)	(0.0006)	(0.0282)	(0.0005)	(0.0321)	(0.0005)	(0.1096)	(0.0013)
Overall P-value	0.94										
Major Fixed Effects	X	X	X	X	X	X	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X	X	X	X	X	X	X
R-squared	0.20	0.01	0.01	0.01	0.01	0.14	0.01	0.08	0.01	0.07	0.06
N	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638	40,638

Notes: This table is the analog to Table 3 in the main text. It displays estimates from tests designed to detect observable student sorting in response to changes in the major-level non-resident enrollment share, by non-resident type. The joint p-value is based on a randomized inference test and gives the likelihood of observing at least one statistically significant coefficient by chance (see text for details). Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.2. Estimated Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Departmental Faculty Sizes and Average Salaries, Overall and Per-Student.

	Number of Full Time Tenure-Track Faculty	Average Number of Full Time Teaching Faculty	Salary of Tenure-Track Faculty (Nominal $)	Number of Full Time Tenure-Track Faculty Per Student	Number of Full Time Teaching Faculty Per Student	Average Salary of Tenure-Track Faculty (Nominal $) Per Student
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0068	0.0095	5.4217	-0.0002	-0.0001	-2.0178
	(0.0061)	(0.0103)	(32.1608)	(0.0002)	(0.0001)	(1.6266)
Foreign Enrollment Share, 0-100 Scale (γ_2)	0.0084	-0.0057	75.5981	-0.0022	0.0001	-3.5945
	(0.0105)	(0.0169)	(68.9333)	(0.0016)	(0.0003)	(3.1075)
P-value for $H_0 : \gamma_1 = \gamma_2$	0.202	0.445	0.374	0.196	0.540	0.690
Major Fixed Effects	X	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X	X
Student Characteristics	X	X	X	X	X	X
R-squared	0.98	0.71	0.96	0.91	0.64	0.89
N	565	565	565	565	565	565

Notes: This table reports results from analogs of equation (2) where data are aggregated to the major-by-year level and the dependent variables measure department resources, as indicated by the column headings. Columns 1-3 evaluate departmental resources in total and columns 4-6 evaluate resources per student (i.e., in columns 4-6 we divide the departmental resource measures by the total number of enrolled undergraduate majors—of all resident types and in all grade levels—in that year). Faculty salary data are reported in nominal dollars but the year fixed effects adjust for salary growth over time. Data problems with non-tenure-track (NTT) faculty salaries over the timespan of our panel do not permit a reliable year-to-year comparison, which is why salary information is only reported for tenure track faculty. The coefficients on the student characteristic variables, which in these models are aggregated to the major-by-year level, are excluded for brevity. Note that the major-by-year sample size is less than 594 (54x11) for two reasons: (a) we could not assign specific departments to compute salaries for two interdisciplinary majors, and (b) several smaller majors do not have new enrollees in every year from 2004-2014—i.e., the major-by-year panel is (very slightly) unbalanced. Robust standard errors in parentheses are clustered at the major level.
Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.3. Full Output from Panel A in Table 4.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Non-Resident Enrollment Share	-0.0008 (0.0016)	0.0004 (0.0004)	0.0001 (0.0003)	0.0228 (0.0280)	0.0006 (0.0007)
Male	0.0431** (0.0156)	-0.0227** (0.0074)	-0.0194** (0.0051)	-3.9971** (0.3447)	-0.1547** (0.0175)
Black	0.0024 (0.0251)	-0.0623** (0.0127)	-0.0510** (0.0119)	-8.1222** (0.5253)	-0.2949** (0.0178)
Asian	0.0394 (0.0304)	-0.0098 (0.0178)	-0.0020 (0.0148)	-0.6953 (0.8856)	-0.0529** (0.0168)
Hispanic	-0.0320** (0.0117)	-0.0168 (0.0168)	-0.0051 (0.0137)	-2.0100** (0.6318)	-0.0612** (0.0226)
Other Races	-0.0062 (0.0125)	-0.0430** (0.0131)	-0.0378** (0.0107)	-3.0618** (0.6595)	-0.0921** (0.0202)
ACT Math	0.0062** (0.0019)	0.0080** (0.0008)	0.0041** (0.0007)	0.8484** (0.0578)	0.0301** (0.0019)
ACT Math Missing Indicator	-0.1560** (0.0738)	0.0891 (0.0913)	0.1193 (0.0918)	-2.9422 (3.2948)	0.0980 (0.1805)
ACT English	0.0007 (0.0013)	0.0031** (0.0008)	0.0013** (0.0005)	0.4220** (0.0385)	0.0214** (0.0009)
ACT English Missing Indicator	0.1230* (0.0684)	-0.1478* (0.0857)	-0.1866** (0.0913)	-2.3706 (3.5072)	-0.1538 (0.1973)
H.S. Percentile Rank	0.0021** (0.0007)	0.0040** (0.0002)	0.0026** (0.0002)	0.4135** (0.0174)	0.0143** (0.0005)
H.S. Percentile Rank Missing Indicator	0.0230** (0.0093)	0.0333** (0.0095)	0.0160** (0.0059)	-1.2514* (0.6640)	0.0294 (0.0217)
Constant	0.1812* (0.1067)	0.2246** (0.0250)	0.5678** (0.0228)	-0.9354 (2.3570)	0.6676** (0.0714)
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
R-squared	0.13	0.06	0.04	0.21	0.30
N	40,638	40,638	40,638	40,638	40,638

Notes: See notes to Table 4.

Appendix Table A.4. Non-IV Estimates of the Effects of the Non-Resident Enrollment Share on Third-Year Outcomes for In-State Students, Using the 2008-2014 Subsample Only.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Panel A. Standard Model					
Non-Resident Enrollment Share	-0.0027*	0.0001	0.0005	0.0155	0.0010
	(0.0015)	(0.0005)	(0.0004)	(0.0360)	(0.0011)
R-squared	0.15	0.07	0.04	0.21	0.28
N	26,368	26,368	26,368	26,368	26,368
Panel B. IV Model (repeated from Table 4)					
Non-Resident Enrollment Share	-0.0050	0.0008	0.0016	-0.0633	0.0004
	(0.0164)	(0.0019)	(0.0013)	(0.0716)	(0.0052)
R-squared	0.15	0.06	0.04	0.21	0.28
N	26,368	26,368	26,368	26,368	26,368
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X

Notes: Panel B replicates the results from Panel B in Table 4 for ease of comparison. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.5. Output from the First-Stage Regression of the IV Model.

	Coefficient (Standard Error)
Predicted In-State Enrollment	-0.057** (0.018)
Predicted Out-of-State Domestic Enrollment	-0.036** (0.008)
Predicted Foreign Enrollment	-0.034 (0.254)
Male	0.021 (0.053)
Black	0.166 (0.111)
Asian	-0.121 (0.091)
Hispanic	0.301 (0.216)
Other Races	-0.119 (0.112)
ACT Math	-0.007 (0.009)
ACT Math Missing Indicator	-0.302 (0.960)
ACT English	-0.010 (0.009)
ACT English Missing Indicator	0.278 (0.961)
High School Percentile Rank	-0.002 (0.002)
High School Percentile Rank Missing Indicator	0.094 (0.061)
Constant	77.300** (18.018)
Major Fixed Effects	X
Year Fixed Effects	X
F-statistic (excluded instruments)	13.23
R-Squared	0.91
N	26,368

Notes: Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Brief Explanation of Table A.5

The first-stage regression predicts the major-by-year non-resident enrollment share as a function of enrollment counts by residency status. The coefficients for all three enrollment variables are negative, which reflects the fact that smaller majors (by enrollment) have a higher non-resident enrollment share on average. The gap between the coefficients on (a) the in-state student count and (b) the non-resident student counts reflects the intuitive fact that conditional on total size, majors with more non-resident students prior to 2008 have higher non-resident enrollment shares from 2008 onward (put another way, if we replace the in-state student enrollment count in the regression with total enrollment, and leave everything else as is, the total-enrollment coefficient is negative and the coefficients on the non-resident variables turn positive).

Appendix Table A.6.1. Estimated Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Third-Year Outcomes for In-State Students, Randomly Dropping Six Majors, Iteration 1.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0004	0.0005	0.0003	0.0217	0.0012
	(0.0018)	(0.0004)	(0.0003)	(0.0277)	(0.0007)
Foreign Enrollment Share, 0-100 Scale (γ_2)	-0.0043	-0.0018	-0.0014	0.0113	-0.0031
	(0.0026)	(0.0015)	(0.0012)	(0.0667)	(0.0022)
P-value for $H_0 : \gamma_1 = \gamma_2$	0.247	0.125	0.132	0.871	0.047
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.14	0.06	0.04	0.21	0.30
N	38,466	38,466	38,466	38,466	38,466

Notes: The six majors randomly dropped from these regressions are Natural Resources, Computer and Information Sciences, Special Education and Teaching, Apparel and Textiles, Computer Engineering, and Political Science and Government. The coefficients for student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.6.2. Estimated Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Third-Year Outcomes for In-State Students, Randomly Dropping Six Majors, Iteration 2.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0001	0.0004	0.0001	0.0151	0.0007
	(0.0018)	(0.0004)	(0.0003)	(0.0293)	(0.0007)
Foreign Enrollment Share, 0-100 Scale (γ_2)	-0.0051**	-0.0024*	-0.0018	-0.0323	-0.0027
	(0.0026)	(0.0014)	(0.0011)	(0.0613)	(0.0021)
P-value for $H_0 : \gamma_1 = \gamma_2$	0.119	0.049	0.057	0.415	0.100
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.12	0.07	0.04	0.21	0.30
N	37,641	37,641	37,641	37,641	37,641

Notes: The six majors randomly dropped from these regressions are Food Science, Health Professions and Related Clinical Sciences, Housing and Human Environments, Pre-Pharmacy Studies, Occupational Therapy, and Electrical and Electronics Engineering. The coefficients for student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.6.3. Estimated Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Third-Year Outcomes for In-State Students, Randomly Dropping Six Majors, Iteration 3.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0003	0.0006	0.0003	0.0294	0.0011
	(0.0019)	(0.0004)	(0.0003)	(0.0304)	(0.0008)
Foreign Enrollment Share, 0-100 Scale (γ_2)	-0.0054	-0.0027	-0.0015	-0.0204	-0.0038
	(0.0034)	(0.0019)	(0.0011)	(0.0706)	(0.0029)
P-value for $H_0: \gamma_1 = \gamma_2$	0.205	0.084	0.092	0.476	0.087
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.14	0.07	0.04	0.21	0.30
N	37,466	37,466	37,466	37,466	37,466

Notes: The six majors randomly dropped from these regressions are Agricultural Mechanization, Agricultural Communication/Journalism, Industrial Engineering, Biology/Biological Sciences, Social Work, and Economics. The coefficients for student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.6.4. Estimated Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Third-Year Outcomes for In-State Students, Randomly Dropping Six Majors, Iteration 4.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0003	0.0008*	0.0004	0.0286	0.0010
	(0.0018)	(0.0004)	(0.0003)	(0.0303)	(0.0008)
Foreign Enrollment Share, 0-100 Scale (γ_2)	-0.0051*	-0.0027*	-0.0019*	-0.0356	-0.0019
	(0.0025)	(0.0014)	(0.0011)	(0.0619)	(0.0018)
P-value for $H_0 : \gamma_1 = \gamma_2$	0.144	0.017	0.028	0.297	0.116
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.14	0.06	0.04	0.21	0.30
N	39,701	39,701	39,701	39,701	39,701

Notes: The six majors randomly dropped from these regressions are Agricultural Communication/Journalism, Parks, Recreation and Leisure Studies, Industrial Engineering, Chemistry, Physics, and Drama and Theatre Arts. The coefficients for student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.6.5. Estimated Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Third-Year Outcomes for In-State Students, Randomly Dropping Six Majors, Iteration 5.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0005	0.0004	0.0001	0.0114	0.0006
	(0.0019)	(0.0004)	(0.0003)	(0.0294)	(0.0007)
Foreign Enrollment Share, 0-100 Scale (γ_2)	-0.0050*	-0.0020	-0.0021**	-0.0125	-0.0040*
	(0.0026)	(0.0015)	(0.0011)	(0.0684)	(0.0022)
P-value for $H_0 : \gamma_1 = \gamma_2$	0.192	0.112	0.026	0.720	0.038
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.12	0.07	0.04	0.21	0.30
N	36,838	36,838	36,838	36,838	36,838

Notes: The six majors randomly dropped from these regressions are Management, English Language and Literature, Biochemistry, Social Work, Sociology, and Health Professions and Related Clinical Sciences. The coefficients for student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.7. Effect Heterogeneity in the Effects of the Out-of-State Domestic and Foreign Enrollment Shares on Third-Year Outcomes for In-State Students, STEM versus non-STEM majors.

	Enrolled in the Same Major at MU	Enrolled at MU	Enrolled at Any System Campus	Cum. Credit Hrs.	Cum. GPA
Out-of-State Enrollment Share, 0-100 Scale (γ_1)	-0.0003	0.0007*	0.0004	0.0323	0.0012*
	(0.0016)	(0.0004)	(0.0003)	(0.0287)	(0.0007)
Foreign Enrollment Share, 0-100 Scale (γ_2)	-0.0041	-0.0009	-0.0011	-0.0212	-0.0056*
	(0.0044)	(0.0019)	(0.0013)	(0.0657)	(0.0033)
Out-of-State Enrollment Share*STEM	-0.0009	-0.0006	-0.0010**	-0.0362	-0.0016**
	(0.0015)	(0.0006)	(0.0004)	(0.0356)	(0.0008)
Foreign Enrollment Share*STEM	-0.0013	-0.0023	-0.0010	0.0112	0.0043
	(0.0045)	(0.0025)	(0.0018)	(0.1135)	(0.0039)
Major Fixed Effects	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X
Student Characteristics	X	X	X	X	X
R-squared	0.13	0.06	0.04	0.21	0.30
N	40,638	40,638	40,638	40,638	40,638

Notes: STEM majors are as designated by the Department of Homeland Security. H_0: $\gamma_1=\gamma_2$ is in reference to Equation (2), adding interaction terms between STEM major indicators and Out-of-State Domestic and Foreign Enrollment Shares. The null hypothesis is that the coefficients on out-of-state and foreign enrollment shares are equal. The coefficients for student characteristics are excluded for brevity. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.

Appendix Table A.8. Estimated Effects of Non-Resident Enrollment Shares on the Selectivity of College Majors, Conditional on Remaining Enrolled at MU at the start of Year-3.

	Change in Major Selectivity	Change in Major Selectivity
Non-Resident Enrollment Share	0.0069	
	(0.0045)	
Out-of-State Enrollment Share, 0-100 Scale (γ_1)		0.0067
		(0.0043)
Foreign Enrollment Share, 0-100 Scale (γ_2)		0.0085
		(0.0083)
P-value for $H_0 : \gamma_1 = \gamma_2$	NA	0.764
Major Fixed Effects	X	X
Year Fixed Effects	X	X
Student Characteristics	X	X
R-squared	0.25	0.25
N	29,141	29,141

Notes: The outcome variable measures the difference between student *i*'s major at the start of year-3 and the initial major, in terms of entering students' average math and English ACT scores in those majors (based on the year of student *i*'s entry into MU). The sample is restricted to students who remained enrolled at MU by the beginning of year-3. For students who do not switch majors between entry and the 3rd year of college, the change in major selectivity is zero. Students who move to more selective majors have positive values and those who move to less selective majors have negative values. H_0: γ_1=γ_2 is in reference to Equation (2). The null hypothesis is that the coefficients on out-of-state and foreign enrollment shares are equal. Robust standard errors in parentheses are clustered at the major level. Significance levels: ** 5 percent level, * 10 percent level.