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Abstract

I estimate the effect of attending an associate's degree in nursing program on nursing licensure. I use student-level academic data for all California community college students, matched to public records on all nursing licenses earned in the state. I produce causal estimates using random variation from admissions lotteries at a large nursing program. Enrolling in the program increases the probability of having an active nursing license by 59 percentage points within three years. By seven years the effect is smaller and not statistically significant. I estimate the value of a nursing license as approximately $5,000-$6,000 per year.

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1 Introduction

Community colleges have gained prominence amid rising concerns about the training of skilled workers in the labor market (Acemoglu and Autor, 2011; Bailey et al., 2003). Community colleges have several distinct missions, a primary one being career technical education (CTE). Nationwide, 70% of all subbaccalaureate credentials are in CTE program, including over half of all associate degrees (National Center for Education Statistics, 2022). In recent years, policymakers have focused new attention on expanding CTE programs, especially in growing fields like healthcare and advanced manufacturing (Buerhaus, Auerbach and Staiger, 2014; White House Office of the Press Secretary, 2012; Council of Economic Advisers, 2023).

In this context, it is crucial to understand the role of existing CTE programs in affecting the labor market outcomes of their students. A growing literature has documented a wide range of earnings returns to different community college programs, with particularly large returns in healthcare fields (Belfield and Bailey, 2017; Stevens, Kurlaender and Grosz, 2019; Jepsen, Troske and Coomes, 2014). Less is known, however, about the mechanisms that drive these earnings returns. Some evidence points to particularly large returns in programs that have explicit connections with employers (Katz et al., 2022). One unresolved question is whether students ultimately use their training in a specific occupation as a jumping off point for a career in that field. Similarly, little is known about how long students remain in their chosen occupation after their training ends.

In this paper I study the effect of enrolling in an associate degree in nursing (ADN) program on career trajectories. I use the random lottery used for admissions at a large ADN program in California to study the causal effects of enrolling in the program. Admissions lotteries are rare in the community college context, and postsecondary education in general, but are often used in certain programs with limited capacity and high demand (Gurantz, 2015; Bohn, Reyes and Johnson, 2013; Bound and Turner, 2007). By leveraging these lotteries, this paper provides causal evidence of the mechanism that drives large earnings returns to healthcare programs.

I rely on several data sources that allow me to track community college students throughout their coursework in community colleges and into their subsequent careers. I use detailed individual-level information from the California Community Colleges since 1992, combined with the results

of admissions lotteries at one large ADN program between 2005 and 2015. I supplement these sources with the full set of nursing licenses awarded by the state's board of nursing. Thus, I can observe which of the applicants to the ADN lotteries ultimately become licensed registered nurses, whether they obtained other types of nursing licenses, and if these licenses ever expired without renewal.

Using the result of a student's first application as an instrument, I find that enrolling in the ADN program leads to a 59 percentage point increase in having a nursing license within three years. This suggests that the program is able to lead students into the labor market, with jobs that fit their training. However, by seven years after application, the effect is positive but smaller and no longer statistically significant. This long after first applying, some students may have won admission through a subsequent lottery, or attended nursing programs at other institutions.

I also find that enrolling in the program has no effect on earning additional specialty nursing licenses, except for in two cohorts. In other words, graduates of the program are, in general, no more likely to continue to move up along this dimension of the career ladder within the time period I study. In part this lack of an effect may be due to too short a followup period: these are licenses that require additional training, such as masters or doctoral degrees. Of course, there may be effects of enrollment on other types of career advancement that I cannot observe. For example, these nurses may take on increased responsibilities or more specialized duties that do not require licensing.

The findings are consistent with large earnings effects that, while always large and positive, decline after the first three years Grosz (2020). The results in this paper help explain why. The program helps admitted students onto an upward career trajectory as registered nurses sooner than students who lose their first lottery. For some students, the program also leads to further progress up the career ladder by earning specialty licenses that come with additional compensation.

This paper makes several contributions to the literature. First, I estimate the causal effect of an existing, at-scale community college CTE program. I rely on variation from a random lottery, which is unusual in studies of at-scale postsecondary programs. Second, I study whether a program that trains students for a particular occupation causes its students to eventually work in that occupation. Although seemingly obvious, this is a question that is essential for understanding the mechanism by which educational attainment leads to labor market outcomes. It is also a question that has not

been tackled often in the literature, usually because of a lack of data. Third, by relating the main findings to prior work on the effect of enrollment on earnings, I can produce a back-of-the-envelope estimate of the value of an RN license on earnings. I find that the value of the license ranges from $5,000-$6,000 in the first seven years following enrollment. This finding contributes to a large literature about occupational licensing and labor market outcomes.

This paper proceeds as follows. Section 2 provides background on the literature and institutional context. Section 3 describes the data. Section 4 discusses the methodology. Section 5 contains the main results. Section 6 concludes.

2 Background

I study a program that awards an associate's degree in nursing (ADN). In order to work as registered nurses, graduates of ADN programs must also pass a national licensing exam, the NCLEX-RN, which they may retake multiple times. My analysis is set in California, which has the largest system of community colleges in the country (California Community College Chancellor's Office, 2016). In 2021 the state's community colleges awarded 4,652 ADN's, representing by far the most popular CTE degree program in the state.

I focus on the ADN program at Central College[2] which is located in California's Central Valley, and whose ADN program is among the largest in the state. The program requires four consecutive semesters with a pre-determined set of courses, and hands-on experience at nearby hospitals and clinics. Central College's ADN curriculum is standard relative to other ADN programs offered at community colleges across the state.

Because of overwhelming demand, all community college ADN programs in California have admissions systems. Beginning in the early 1990s, though, the California Community Colleges did not allow ADN programs to use "evaluative" admissions based on measures like grades or work experience. In 2007, Central College and 27 of the state's other 70 ADN programs used lotteries. The remaining programs used waitlists or first-come-first-served systems. That same year, the state passed AB-1559, which repealed the ban on evaluative admissions and led colleges to change their admissions processes. In fact, Central College itself no longer uses a lottery for its ADN program

[2]Anonymized for confidentiality reasons.

admissions.

Central College ran its lottery twice per year, for admission to a spring and fall cohort of new ADN students. To become eligible, students were required to complete 36 units of coursework in fields like math and biology, at Central College or at other community colleges, and to complete a short application form. The results of the random lottery were posted online. Admitted students could accept the offer but could not defer to a future cohort, while rejected students could reapply to the following cohort's lottery by simply clicking a button on the online portal within a week. Upon four rejections, entailing two full years, applicants were given a higher probability of admission.[3]

3 Data and Summary Statistics

I combine three sources of individual-level data. First, I use statewide data for all California community college students, from the California Community College Chancellor's Office (CCCCO), between 1992 and 2021. For each student, I observe term-level coursework, grades, academic outcomes such as the type and subject of each certificate or degree they earned or the four-year institution to which they transferred, financial aid information, and various demographic characteristics. Based on college websites and course catalogs, I also have information on program prerequisites and requirements for completion. This allows me to determine which students enrolled in an ADN program at each college. Information on prerequisites also allows me to calculate a student's GPA in these courses, since many programs have grade cutoffs for admission based only on a subset of courses.

Second, I use admissions lottery data from Central College's ADN program for each lottery between Fall 2005 and Fall 2015. The data include applicant name, gender, date of birth, and an internal identification number. Because the lottery is run at the college level, there is not a perfect match with the statewide academic data system. Instead, I match students in the lottery dataset to students in the statewide administrative dataset based on the few identifying characteristics that exist in both: the first three letters of their first and last name, their birth date, and their gender. I am able to match 83 percent of all 4,726 Central College ADN applicants to student records in the

[3]See Grosz (2021) and Grosz (2020) for more information Central College's prerequisites and program requirements, as well as other institutional details on the prevalence of lotteries in nursing admissions in California.

statewide data. There do not appear to be systematic patterns that would correlate the probability to be matched with a student's lottery status: the difference in match rate between winning and losing applications is 1.1 percentage points with a p-value of 0.46.[4]

Third, I use publicly available data on nurse licenses from the California Department of Consumer Affairs.[5] For each nurse license administered by the state, I observe the name of the license holder, the day the license was issued, the date of the latest renewal, and whether the license is current or expired. The data include licenses for approximately 750,000 registered nurses since 1939, and is updated monthly. The other licenses available in the data include Nurse Midwives, Nurse Practitioners, Public Health Nurses, Nurse Anesthetists, and several other smaller groups. Because a license is required to work as a nurse in the state, these data give me the ability to observe the set of individuals working as registered nurses in the state at any point in time during my study period. Although there is no individual identifier, I link separate licenses across a single person using the person's name.[6] I limit the license data to the set of nurse licenses that were issued after one year following a student's application to Central College's program, since the program itself takes a minimum of 4 semesters.[7] I merge the license data to the application data using first and last name. While some nurses could have earned their degree and left the state, this is likely a small fraction (DePasquale and Stange, 2016; Johnson and Kleiner, 2020).

Table 1 shows descriptive statistics about lottery applicants at the time of their first application. Approximately three quarters of applicants are female. Although many do not have a race or ethnicity identified in the data, among those that do the majority are Latino. Furthermore, first-time applicants tended to be non-traditional students, with an average age of 30. The table also shows that many students had taken courses at other community colleges in the state, and many received a tuition waiver or some other type of financial aid. The second column of the table shows the difference in student characteristics between winners and losers in their first lottery application, controlling for lottery cohort. All of the differences are small and none are statistically significant, consistent with a well-randomized lottery process.

[4]For more details on the match process and additional robustness checks, see Grosz (2020).
[5]Available at https://www.dca.ca.gov/consumers/public_info/index.shtml.
[6]For example, a registered nurse who then also earns a Nurse Practitioner license.
[7]For example, I match the Spring 2005 applicants to licenses issued since January 2006; Fall 2005 applicants to licenses issued since July 2006, etc. I remove duplicates in terms of first and last names.

4 Methodology

I estimate the effect of enrolling in the ADN program on subsequent labor market outcomes. I assume the following relationship:

$$y_{ict} = \beta_0 + \beta_1 D_{ic} + X_i \beta_2 + \mu_c + \zeta_t + \varepsilon_{ict} \tag{1}$$

where y_{ict} is the outcome at time t for student i in application cohort c, and D_{ic} is a dummy variable taking a value of one if the student enrolled as part of the cohort. Even controlling for observable student characteristics X_i and cohort fixed effects μ_c, the treatment is correlated with the error term, thus biasing estimates of β_1. To resolve the bias, I use an instrument that takes advantage of the random variation produced by the admissions lotteries.

I leverage the fact that the application lottery is randomly assigned and a strong predictor of enrollment in the program. I focus on the result of the first application a student submits, since students may reapply if they are not admitted. The first stage equation takes the form:

$$D_{ic} = \gamma_0 + \gamma_1 Admit_i + X_i \gamma_2 + \eta_c + e_{ic} \tag{2}$$

where $Admit_i$ is the result of an applicant's first lottery. The coefficient γ_1 represents the fraction of compliers, for whom winning their first lottery leads to enrolling in the ADN program that semester. There are two main types of non-compliers. The first are students who are admitted but do not take up the offer. Students are not allowed to defer admission to later cohorts, so this set of non-compliers is non-existent. The second set of noncompliers are students who gain admission outside the lottery process, which is rare. I define the treatment D_{ic} as immediate attendance following a lottery win, as opposed to ever enrolling in the program. This is because many first-time losers ultimately win later lotteries. First-time lottery losers who ultimately enroll do so after a delay of at least a semester.

Appendix Table A1 shows estimates of the effect of winning the first lottery on academic outcomes. Most notably, the first lottery increases immediate enrollment in the program by 25 percentage points. This first stage effect is large and highly statistically significant. Not surprisingly, winning admission to the program also has large positive effects on ever enrolling in the program,

as well as on completing the Central College ADN or an ADN at any community college. The results are consistent with an approximately 50 percent attrition rate among enrolled students. The low completion rates across the state's colleges were a primary reason programs chose to move away from lotteries.

5 Results

5.1 Effect of Enrollment on New RN Licenses

Figure 1 shows estimateds and 95% confidence intervals of the effect of enrolling in the ADN program on receiving a nurse license after applying to the Central College ADN program. The coefficient estimates and standard errors are in Appendix Table A2. Because the program takes two years to complete, I do not expect any effect on nurse licensure in the first year after application; in fact, the coefficient is a precisely estimated zero.

Students who complete the program on time and then take the NCLEX-RN exam immediately would earn their license within two years of starting the program. I do observe large effects of enrolling in the program on licensure two years after application, an increase of 33 percentage points. Within three years after application, students who enrolled in the program were 59 percentage points more likely to have earned a nursing license. This is a massive increase, as only 7.9 percent of all applicants earn their license within three years.

Starting in the fourth year following application, though, there is no longer any effect of enrollment on earning a license. In fact, in the fifth year the effect is negative and statistically significant. The likely explanation for this switch is that, by five years following the initial lottery, some of the applicants who had initially been rejected ultimately completed an ADN. They could have enrolled at Central College by winning a subsequent lottery, but could also have enrolled at other community colleges or at for-profit institutions. By the sixth and seventh year following the first application, however, there is no discernible effect: the coefficient estimates are small and not statistically significant.

Another way to see these results is to examine the cumulative effects of enrollment; that is, the effects on ever receiving an RN license within a certain time period. Appendix Table A3 shows these effects. They are essentially the sum of the point-in-time results from the previous table. By

the third year after application, students who had enrolled in the program were 60 percentage points more likely to have earned an RN license. By the seventh year this effect was still positive, but smaller and no longer statistically significant.

5.2 Effect of Enrollment on Maintaining Active RN Licenses

In addition to observing the timing of when nurses initially receive their RN license, I can also observe whether the ADN program has an effect on nurses maintaining active RN licenses. This is important, as it speaks to whether the community college training increases the chances that students remain in an occupation in the long run. To study this margin, I incorporate data on license delinquencies.

A license is valid until the last day of the month following the nurse's second birthday after the license was issued. For example, the first expiration date for a nurse with an August birthday who earned her license in July of 2016 would be August 31, 2018. Upon renewal, the license expires every two years thereafter, at the end of the birthday month every other year. In order to renew a license, nurses must pay a fee and demonstrate proof of having completed 30 hours of continuing education. Nurses who have paid the fee but not provided the continuing education credits have their license listed as inactive, while nurses who also do not pay the fee have their license listed as delinquent.[8] Among the cohorts of nurses I study, which include all RN licenses granted since 2005, 24 percent of licenses were delinquent by 2022, while only 0.6 percent were inactive.

The data from the California Board of Nursing note the current status of each license, as well as its expiration date. Thus, I can observe whether licenses expired at every year after application. A limitation is that I can only observe whether a license is currently delinquent; licenses that were delinquent and then were subsequently renewed would appear active.

I combine the data on new licenses and delinquencies to observe the set of active RN licenses at any point. Figure 2 shows the effect of enrollment in the program on having an active RN license in the years following the first application. The figure shows a sharp increase in the first two years,

[8] A nurse may choose to have her license listed as inactive in order to avoid paying the additional fee to reactivate a delinquent license. To renew an inactive license, or a license that has been delinquent less than eight years, a nurse must submit an additional fee and continuing education credits. To reactive a license that has been delinquent longer than eight years, a nurse must also provide proof of competency, either through a current active license in a different state, or by retaking the licensing exam. In 2022, renewal fees were $190 for active licenses, $280 for delinquent licenses under eight years, and $350 for delinquent licenses over eight years.

which mirrors the effect of the program on new licenses discussed earlier. By the second year after application, students who enrolled were 33 percentage points more likely to have a license. By the third year this had jumped to 59 percentage points. However, because the effect of enrolling only occured in the second and third years, by the fourth year the cumulative effect had declined to 44 percentage points. After that, the cumulative effect was positive but not statistically significant. I interpret this as suggestive evidence of a sustained positive effect of enrollment on eventual licensure. In other words, enrollment in the lotteried program led to an increase in the likelihood of becoming a nurse, which was not completely washed away by lottery losers eventually also becoming nurses. Moreover, the delinquency magnitudes are also small enough to not make a large difference in these effects.

I also directly estimate the effect of enrolling in the ADN program on having a delinquent license, in Appendix Figure A1. The main drawback with this approach is that a nurse must earn a license for it to become delinquent. In other words, if the program increases the probability of becoming a nurse, it also increases the probability of lapsing on the license. As a potential fix to this, panel b) of Appendix Figure A1 shows estimates of the effect of the program on delinquent licenses, but only among students who ever received a license to begin with. Both figures show small, slightly positive effects in later years, which are not statistically significant.

5.3 Effect of Enrollment on Earning Other Nursing Licenses

The nurse licensing data also allow me to explore nurse career trajectories beyond the first step of obtaining a license to practice as a registered nurse. Several specializations require additional licensing in California, as in other states. I observe whether the Central College applicants earned these licenses in addition to an RN license. Importantly, an RN license is required in conjunction with these additional licenses. During the time period I study, 97 percent of additional licenses match individuals who had previously also obtained an RN license. Thus, I consider these additional license as indicating a nurse who has progressed to an occupation with further requirements and responsibilities, rather than a different career altogether. Of course, many nurse specializations do not require additional licensing. So, this analysis gives just one view into the possible trajectories licensed nurses can go down in their early careers. Moreover, these additional licenses require extra training such as master's and doctorates, and so the seven year followup I

use might not be enough to observe effects.

Figure 3 shows estimated effects of enrolling in the ADN program on receiving any of the specialty licenses up to seven years after initial application to the Central College ADN program. The coefficient estimates and standard errors are in Appendix Table A4. The figure shows a different story than the previous one. Here, there are no effects of enrollment on earning a specialty license in the first few years after application. However, in the fifth year, there is a positive and statistically significant effect of enrollment, of 11 percentage points, which goes away by the sixth and seventh years after application. This one positive effect in the fifth year is driven entirely by public health nurse licensure among just two of the late cohorts of applicants.[9]

Appendix Table A5 breaks out the different types of specialization licenses, and shows the estimated effect of enrolling in the Central College program on ever earning one of these licenses seven years after application. Relative to RN licenses, there are very few specialty licenses, with the most common being Public Health and Nurse Practicioner licenses. The bulk of the effect of the program comes from Public Health licenses: the other coefficients are small, negative, and not statistically significant. Of course, there are other specializations that do not require additional licenses, so to the extent that the nurses in the sample embark on those trajectories, I would not be able to observe them.

5.4 Robustness and Sensitivity

The results I have shown so far only include lottery fixed effects, since admission is only random among applicants for a particular cohort. Appendix Tables A1-A6 present the main results, with the inclusion of various individual characteristics as controls. Demographic controls include race, ethnicity, gender, and age at application. Other controls include a student's GPA in courses prior to application, as well as receipt of various types of financial aid: Board of Governor's fee waiver, Pell Grants, Cal Grants, and other loans. In all cases, the estimates are virtually identical after the inclusion of these controls, which is not surprising given the random lottery.

Reduced form estimates of effects of winning the first lottery on earning a new license,

[9] Appendix Figure A2 shows the estimated effect at the fifth year after the lottery, split out by each individual application cohort year. For most years the effects are small and not statistically significant. The large positive effect is entirely driven by two cohorts, 2012 and 2013.

maintaining the license, and earning an upgrade license are in Appendix Tables A7-A9. These are ultimately just scaled versions of the main results, and are also robust to the inclusion of additional controls.

Comparing the third and fourth panels, however, gives a different picture. In the early period, the effects on specialty licenses are null for all years. This is in contrast to the main results, which showed an increase in just one year. The figure shows that this increased effect is coming exclusively from cohorts in the later years. This sheds some doubt on the true effect of the program on increasing specialty nurse licenses, and raises the question of whether there are just a few cohorts that may have had a particular focus on specialty licenses. To investigate further, I estimated the effect of the program on specialty licenses for lotteries, grouped by academic year.

5.5 Value of a License

In previous work I have estimated the effect of enrolling in the Central College ADN program on earnings and employment, using the same identification strategy (Grosz, 2020).[10] Using the new results on the effect of enrollment on licensing, I can produce a back-of-the-envelope estimate of the value of a nursing license. A long literature seeks to understand the value of licenses, which restrict supply and thus accrue rents to license holders. Much of this literature leverages variation in licensing requirements across occupations over time and geographic areas (Gittleman, Klee and Kleiner, 2015; Gittleman and Kleiner, 2016; Kleiner and Krueger, 2013). Here, I explicitly estimate the effect of enrollment in a program on earning a license, and relate that estimate to the associated effect on earnings.

First, I divide the estimates of the effect of enrollment on earnings by the estimates of enrollment on having a current license. The results are in the first panel of Table 2. Each column corresponds to a certain number of years since the date of first application to the Central College admissions lottery. At two years following the lottery, I estimate that having an active license more than doubles earnings. That effect is even higher in later years. When estimated in earnings levels, rather than logs, I find that the value of an RN license ranges from approximately $10,000-$17,000.

[10] Appendix Table A10 recreates mean effects of enrollment on earnings and employment from Grosz (2020), which estimated effects between one and 21 quarters after the application. Thus, the estimate of enrollment on earnings and employment for the sixth year is based only on the 21st quarter following the application, and there is no estimate for the seventh year.

In other words, for the applicants who enroll in the program and ultimately obtain a license, that license has massive payoffs within just a few years.

These calculations likely overstate the value of the license if there is additional value to enrollment and the associate degree itself. Existing estimates of the labor market returns to an ADN do not disentangle these effects. In order to adjust the back-of-the-envelope estimates of the value of the license, I incorporate additional estimates from the literature on the returns to individual credits, as well as the returns to associate degrees in occupations that do not have licensing.

The second panel of the table adjusts the estimated earnings effects by the return to a degree that does not require licensing. Stevens, Kurlaender and Grosz (2019), using California data, estimate the effect of a career-technical associate degree in non-health fields at $569 (5.6 percent) per quarter.[11] Reducing the estimated earnings effects by these amounts lead to lower implied value of the license, which is even negative in the first year when estimated in levels. Nevertheless, for most years the implied value of the license remains large and positive.

The third panel further adjusts the estimated earnings effects by the returns to enrollment independent of the degree or the license. Liu, Belfield and Trimble (2015) estimate that, in North Carolina, each quarter of enrollment leads to an increase in earnings of $17 (0.4 percent), while Jepsen, Troske and Coomes (2014) estimate this increase at $9 per quarter. I use the former, larger estimate for these calculations. An ADN takes 8 quarters to complete, so I multiply these estimates accordingly. This adjustment further reduces the estimates of the value of the license, yet it remains positive in most years.

There are obvious limitations to this exercise. The estimates of the returns to an associate degree and enrollment come from separate populations and are not explicitly independent of licensing. Furthermore, these additional estimates are only available for the full time period after a student's completion or enrollment, so they do not take into account that these effects may change over time. Nevertheless, this exercise provides suggestive evidence of the large and positive value of a nursing license for community college students.

[11] These estimates are roughly similar to those from studies in other states, as noted in Belfield and Bailey (2017).

6 Conclusion

In this paper I estimate the effect of enrolling in a community college nursing program on earning and maintaining a nursing license. Because I rely on variation from random lotteries, I can estimate the causal effect of enrollment. I show that there is a large and positive effect in the first years following a student's application to the program, but this effect fades over time. One potential reason for this fadeout is that applicants who were not admitted to the program could have earned nursing degrees elsewhere.

Overall, the results in this paper provide evidence that enrollment in the program led to the employment of students as nurses, and that such employment is lucrative. It also suggests that the large earnings effects might be due in large part from students gaining access to high-demand and lucrative employment opportunities sooner than their peers. As other students find seats in other programs, including at more expensive for-profit colleges, the earnings effects decline. A policy implication of this work is, then, that further expansion of nursing programs is a potentially efficient policy.

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7 Tables and Figures

Table 1: Applicant Characteristics and Lottery Balance

	(1) Mean	(2) Admit-Reject Difference
Female	0.777	0.0437
		(0.0378)
White	0.212	0.0104
		(0.0358)
Latino	0.295	0.0288
		(0.0360)
Asian	0.103	-0.00753
		(0.0247)
Black	0.0413	0.0116
		(0.0159)
Race Not Specified	0.348	-0.0433
		(0.0467)
Age at Application	30.35	-0.303
		(0.737)
GPA	2.706	0.00524
		(0.122)
Prior Enrollment in Other District	0.203	-0.0231
		(0.0426)
Had Tuition Waiver	0.810	-0.0309
		(0.0496)
Had Cal Grant	0.222	-0.0421
		(0.0409)
Had Pell Grant	0.508	-0.0879
		(0.0539)
Had Other Loans	0.0829	-0.0281
		(0.0274)

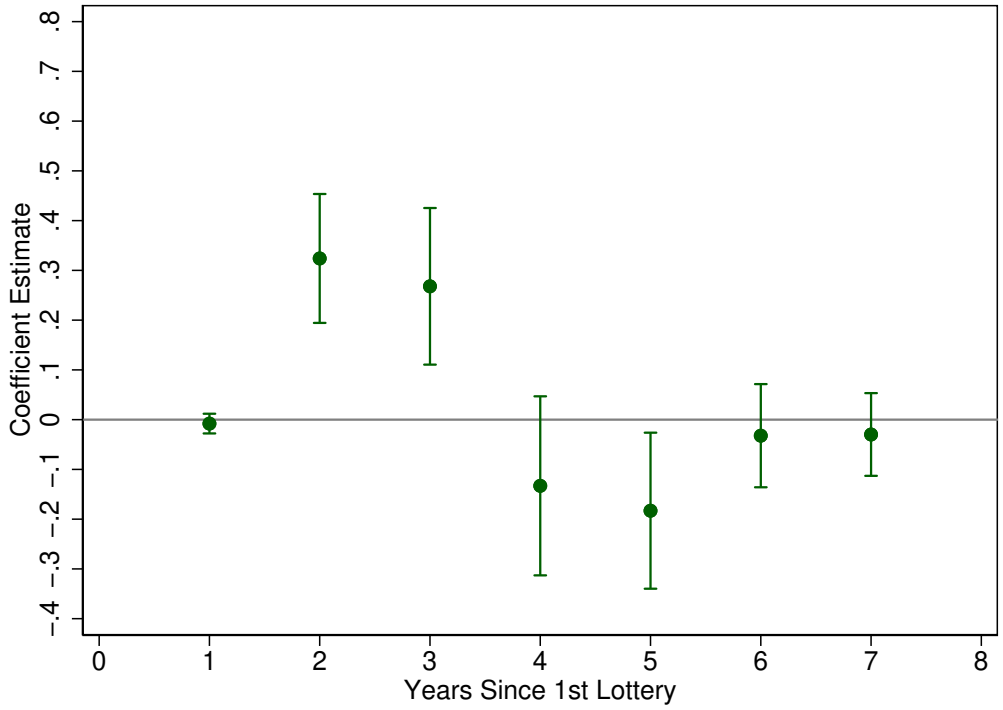
Notes: The first column shows mean characteristics for 3,748 applicants in the spring 2005 to fall 2015 Central College ADN lotteries, measured at term of first application. GPA measures grades in prerequisites prior to application. Enrollment at other district is defined as ever having taken a course at a community college outside Central College's district. Cal Grant is state-specific financial aid. The second column show results of regressing each characteristic on lottery admission and cohort fixed effects. Standard errors are clustered at individual level.

Table 2: Estimated Value of License for Earnings and Employment

	(1)	(2)	(3)	(4)	(5)
Year Since Applied	2	3	4	5	6
A. Unadjusted Estimates					
Earnings (Log)	1.10	0.92	1.34	1.53	1.77
Earnings ($)	2487	9294	11724	14312	16587
B. Adjusted For Degree					
Earnings (Log)	0.39	0.53	0.84	0.71	0.77
Earnings ($)	-4715	5397	6677	5944	6427
C. Adjusted For Degree and Enrollment					
Earnings (Log)	0.29	0.48	0.77	0.59	0.63
Earnings ($)	-5145	5163	6376	5444	5819

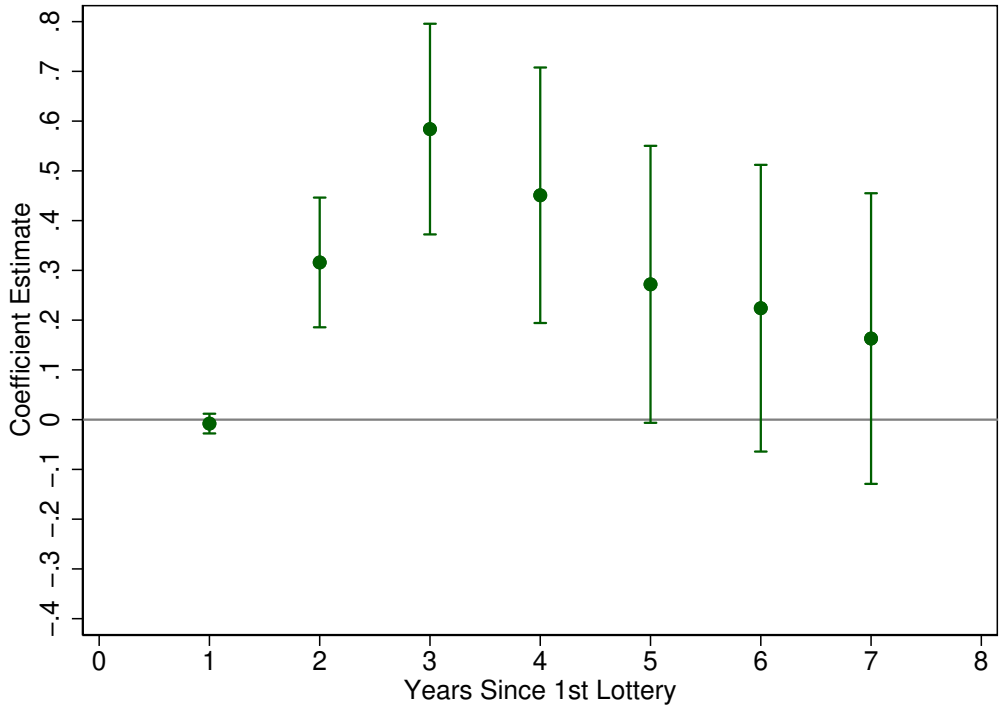
Notes. Table shows estimates of the implied value of having an active RN license on earnings and employment at each number of specified years since first applying to the Central College ADN program. The estimates are calculated by dividing the estimates from Grosz (2020), reproduced in Appendix Table A10, by the estimated enrollment effect on having an active RN license, from Figure 2. Panel B subtracts $569 per quarter or 5.6 percent per quarter to the earnings return, as per Stevens, Kurlaender and Grosz (2019). Panel C additional subtracts an additional $17 per quarter or 0.4 percent per quarter, as per Liu, Belfield and Trimble (2015).

Figure 1: IV Estimates of Nursing Program Enrollment on Receipt of New RN License



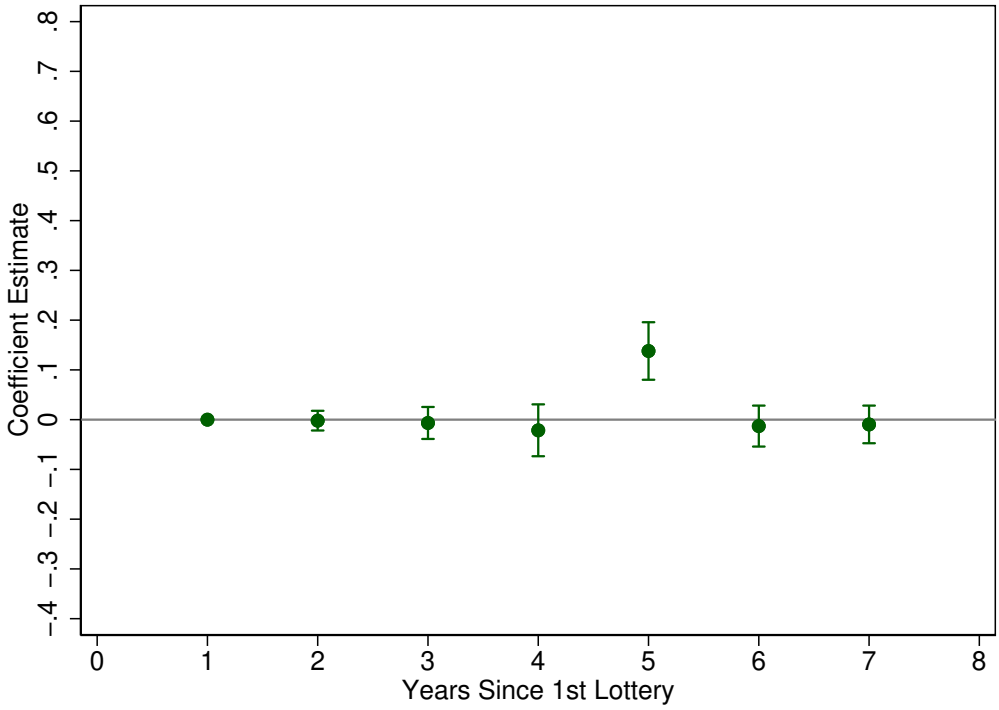
Notes. Figure shows estimates and 95 percent confidence intervals of the effect of enrolling in the Central College ADN program, instrumented by the result of the first application. Sample consists of applicants in the spring 2005 to fall 2015 Central College ADN lotteries. The outcome is having an RN license that was issued within the specified number of years since application. Standard errors are clustered at the individual level.

Figure 2: IV Estimates of Nursing Program Enrollment on Having Active RN License



Notes. Figure shows estimates and 95 percent confidence intervals of the effect of enrolling in the Central College ADN program, instrumented by the result of the first application. Sample consists of applicants in the spring 2005 to fall 2015 Central College ADN lotteries. The outcome is having an unexpired RN license at each specified number of years since application. Standard errors are clustered at the individual level.

Figure 3: IV Estimates of Nursing Program Enrollment on Upgrade License



Notes. Figure shows estimates and 95 percent confidence intervals of the effect of enrolling in the Central College ADN program, instrumented by the result of the first application. Sample consists of applicants in the spring 2005 to fall 2015 Central College ADN lotteries. The outcome is having a non-RN nursing license that was issued within the specified number of years since application. Standard errors are clustered at the individual level.

A1 Additional Tables and Figures

Table A1: Effect of First Lottery Result on Academic Outcomes

	(1) Enroll Immediately	(2) Ever Enroll	(3) Complete Program	(4) Any ADN
A. No Controls				
Win first lottery	0.259***	0.174***	0.169***	0.140***
	(0.0267)	(0.0361)	(0.0345)	(0.0376)
N	3748	3748	3748	3748
Y-Mean	0.0934	0.193	0.187	0.237
B. Demographics Controls				
Win first lottery	0.257***	0.172***	0.167***	0.138***
	(0.0266)	(0.0355)	(0.0345)	(0.0376)
N	3748	3748	3748	3748
Y-Mean	0.0934	0.193	0.187	0.237
C. Demographics, Financial Aid, Academic Controls				
Win first lottery	0.262***	0.188***	0.165***	0.135***
	(0.0265)	(0.0348)	(0.0343)	(0.0374)
N	3748	3748	3748	3748
Y-Mean	0.0934	0.193	0.187	0.237

Notes. The sample consists of students who first applied between spring 2005 and spring 2009. Enrolled immediately is enrollment in the Central College ADN program the following semester. Ever enrolled is ever having enrolled in the Central College ADN program. Complete program is earning an ADN from Central College. Regressions control for calendar year, application cohort, demographics (age, gender, race), academic background (prior GPA, prior number of units), prior financial aid receipt (Pell Grants, tuition waivers), and prior labor market experience (mean prior earnings, any prior employment in health). Standard errors are clustered at the individual level.

Table A2: IV Estimates of Immediate Enrollment on Receipt of New RN License

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	2	3	4	5	6	7
A. No Controls						
Enroll	0.332***	0.267**	-0.151	-0.192*	-0.0315	-0.0295
	(0.0678)	(0.0816)	(0.0936)	(0.0815)	(0.0536)	(0.0431)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0280	0.0502	0.0699	0.0510	0.0227	0.0144
B. Demographics Controls						
Enroll	0.338***	0.271***	-0.144	-0.193*	-0.0302	-0.0308
	(0.0683)	(0.0821)	(0.0938)	(0.0819)	(0.0539)	(0.0433)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0280	0.0502	0.0699	0.0510	0.0227	0.0144
C. Demographics, Financial Aid, Academic Controls						
Enroll	0.324***	0.268***	-0.133	-0.183*	-0.0322	-0.0298
	(0.0661)	(0.0803)	(0.0918)	(0.0800)	(0.0529)	(0.0424)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0280	0.0502	0.0699	0.0510	0.0227	0.0144

Notes.The sample consists of students who first applied between spring 2005 and spring 2009. Enrolled immediately is enrollment in the Central College ADN program the following semester, and is instrumented with being admitted in the first application lottery. The outcome is receipt of a new RN license in the specified year since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A3: IV Estimates of Immediate Enrollment on Ever Receiving an RN License

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	2	3	4	5	6	7
A. No Controls						
Enroll	0.325***	0.591***	0.441***	0.249	0.217	0.188
	(0.0682)	(0.111)	(0.133)	(0.145)	(0.150)	(0.153)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.200	0.223	0.237
B. Demographics Controls						
Enroll	0.330***	0.601***	0.457***	0.264	0.234	0.203
	(0.0687)	(0.112)	(0.134)	(0.145)	(0.151)	(0.154)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.200	0.223	0.237
C. Demographics, Financial Aid, Academic Controls						
Enroll	0.316***	0.584***	0.451***	0.268	0.236	0.206
	(0.0665)	(0.108)	(0.131)	(0.143)	(0.148)	(0.151)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.200	0.223	0.237

Notes.The sample consists of students who first applied between spring 2005 and spring 2009. Enrolled immediately is enrollment in the Central College ADN program the following semester, and is instrumented with being admitted in the first application lottery. The outcome is ever having received an RN license within the specified year since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A4: IV Estimates of Immediate Enrollment on Receipt of New Upgrade License

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	2	3	4	5	6	7
A. No Controls						
Enroll	-0.00251	-0.00691	-0.0228	0.139***	-0.0149	-0.0100
	(0.0102)	(0.0166)	(0.0270)	(0.0301)	(0.0213)	(0.0196)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.000800	0.00213	0.00560	0.00534	0.00347	0.00293
B. Demographics Controls						
Enroll	-0.00198	-0.00684	-0.0223	0.140***	-0.0148	-0.00962
	(0.0103)	(0.0167)	(0.0272)	(0.0303)	(0.0214)	(0.0197)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.000800	0.00213	0.00560	0.00534	0.00347	0.00293
C. Demographics, Financial Aid, Academic Controls						
Enroll	-0.00197	-0.00662	-0.0214	0.138***	-0.0129	-0.00958
	(0.0101)	(0.0164)	(0.0266)	(0.0295)	(0.0210)	(0.0193)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.000800	0.00213	0.00560	0.00534	0.00347	0.00293

Notes. The sample consists of students who first applied between spring 2005 and spring 2009. Erollment in the Central College ADN program the following semester is instrumented with being admitted in the first application lottery. The outcome is receipt of a new upgrade license in the specified year since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A5: IV Estimates of Enrollment on Receipt of New Specialty Licenses

	(1) Anesthisist	(2) Nurse Practitioner	(3) Public Health	(4) Clinical
Enroll	-0.00136	-0.00227	0.0903	-0.00132
	(0.0101)	(0.00582)	(0.0491)	(0.00822)
N	3748	3748	3748	3748
Y-Mean	0.000800	0.000267	0.0187	0.000534

Notes. The sample consists of students who first applied between spring 2005 and spring 2009. Enrollment in the Central College ADN program the following semester is instrumented with being admitted in the first application lottery. The outcome is receipt of the specified license within seven years since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A6: IV Estimates of Immediate Enrollment on Active Nurse License, With Additional Controls

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	2	3	4	5	6	7
A. Demographics Controls						
Enroll	0.330***	0.601***	0.457***	0.268	0.223	0.161
	(0.0687)	(0.112)	(0.134)	(0.145)	(0.150)	(0.152)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.199	0.218	0.231
B. Demographics, Financial Aid, Academic Controls						
Enroll	0.316***	0.584***	0.451***	0.272	0.224	0.163
	(0.0665)	(0.108)	(0.131)	(0.142)	(0.147)	(0.149)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.199	0.218	0.231

Notes. The sample consists of students who first applied between spring 2005 and spring 2009. Enrollment in the Central College ADN program the following semester is instrumented with being admitted in the first application lottery. The outcome is having an active, unexpired RN license in the specified year since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A7: Reduced Form Effect of Winning First Lottery on Having New Nurse License

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	2	3	4	5	6	7
A. No Controls						
Win first lottery	0.0859***	0.0689***	-0.0390	-0.0496*	-0.00816	-0.00763
	(0.0153)	(0.0204)	(0.0239)	(0.0205)	(0.0139)	(0.0112)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0280	0.0502	0.0699	0.0510	0.0227	0.0144
B. Demographics Controls						
Win first lottery	0.0868***	0.0696***	-0.0371	-0.0496*	-0.00775	-0.00791
	(0.0153)	(0.0204)	(0.0238)	(0.0205)	(0.0139)	(0.0112)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0280	0.0502	0.0699	0.0510	0.0227	0.0144
C. Demographics, Financial Aid, Academic Controls						
Win first lottery	0.0850***	0.0701***	-0.0349	-0.0478*	-0.00844	-0.00780
	(0.0154)	(0.0204)	(0.0239)	(0.0206)	(0.0139)	(0.0112)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0280	0.0502	0.0699	0.0510	0.0227	0.0144

Notes. Table shows estimates of the effect of a student being admitted to the Central College ADN on the first application. The sample consists of students who first applied between spring 2005 and spring 2009. The outcome is having an active, unexpired RN license in the specified year since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A8: Reduced Form Effect of Winning First Lottery on Having Active Nurse License

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	2	3	4	5	6	7
A. No Controls						
Win first lottery	0.0840***	0.153***	0.114***	0.0653	0.0533	0.0377
	(0.0156)	(0.0251)	(0.0332)	(0.0372)	(0.0384)	(0.0392)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.199	0.218	0.231
B. Demographics Controls						
Win first lottery	0.0849***	0.154***	0.117***	0.0689	0.0574	0.0415
	(0.0156)	(0.0250)	(0.0331)	(0.0371)	(0.0383)	(0.0391)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.199	0.218	0.231
C. Demographics, Financial Aid, Academic Controls						
Win first lottery	0.0830***	0.153***	0.118***	0.0712	0.0588	0.0427
	(0.0156)	(0.0251)	(0.0331)	(0.0371)	(0.0383)	(0.0391)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.0288	0.0790	0.149	0.199	0.218	0.231

Notes. Table shows estimates of the effect of a student being admitted to the Central College ADN on the first application. The sample consists of students who first applied between spring 2005 and spring 2009. The outcome is having an active, unexpired RN license in the specified year since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A9: Reduced Form Effect of Winning First Lottery on Having New Upgrade License

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	2	3	4	5	6	7
A. No Controls						
Win first lottery	-0.000649	-0.00179	-0.00590	0.0359***	-0.00384	-0.00259
	(0.00265)	(0.00432)	(0.00699)	(0.00678)	(0.00550)	(0.00507)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.000800	0.00213	0.00560	0.00534	0.00347	0.00293
B. Demographics Controls						
Win first lottery	-0.000509	-0.00176	-0.00574	0.0361***	-0.00381	-0.00247
	(0.00265)	(0.00432)	(0.00700)	(0.00679)	(0.00550)	(0.00507)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.000800	0.00213	0.00560	0.00534	0.00347	0.00293
C. Demographics, Financial Aid, Academic Controls						
Win first lottery	-0.000518	-0.00174	-0.00562	0.0361***	-0.00337	-0.00251
	(0.00265)	(0.00432)	(0.00701)	(0.00680)	(0.00551)	(0.00507)
N	3748	3748	3748	3748	3748	3748
Y-Mean	0.000800	0.00213	0.00560	0.00534	0.00347	0.00293

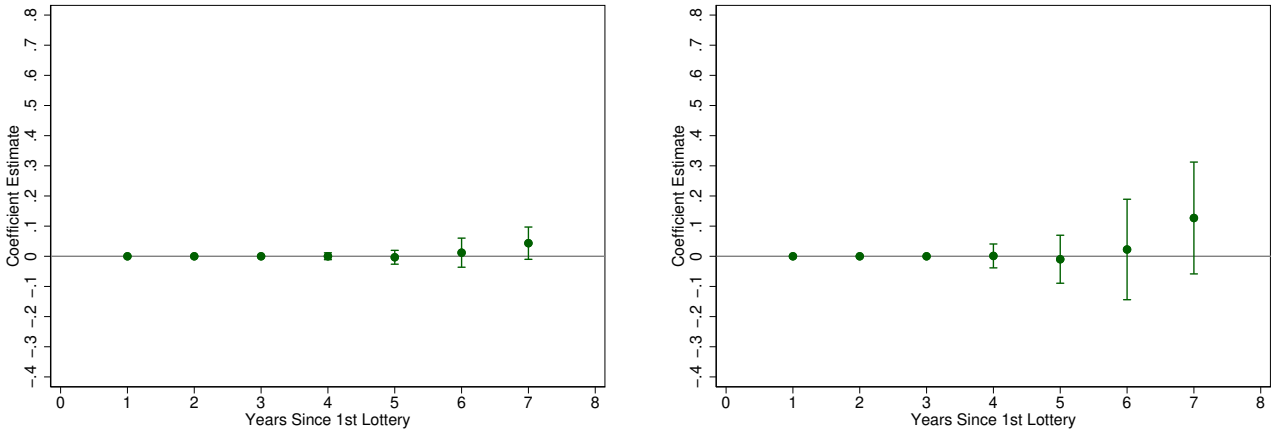
Notes. Table shows estimates of the effect of a student being admitted to the Central College ADN on the first application. The sample consists of students who first applied between spring 2005 and spring 2009. The outcome is having an active, unexpired RN license in the specified year since application. All regressions control for application cohort. Demographic controls include age, gender, and race. Academic and financial aid controls include prior GPA, prior number of units, prior financial aid receipt (Pell Grants, tuition waivers). Standard errors are clustered at the individual level.

Table A10: IV Estimates of Immediate Enrollment on Earnings and Employment, from Grosz (2020)

	(1)	(2)	(3)	(4)	(5)	(6)
Year Since Applied	1	2	3	4	5	6
A. Earnings (log)						
Enroll	0.171	0.348	0.536	0.605	0.418	0.397
	(0.25)	(0.21)	(0.37)	(0.26)	(0.19)	(0.40)
B. Earnings($)						
Enroll	1031	786	5428	5288	3893	3716
	(1574)	(1368)	(2216)	(2203)	(1909)	(1928)
C. Employment						
Enroll	0.082	0.011	0.243	0.126	0.165	0.21
	(0.17)	(0.17)	(0.11)	(0.11)	(0.10)	(0.09)

Notes. This table shows point estimates and standard errors from Figure 3 of Grosz (2020). These are instrumental variables estimates of immediate enrollment in Central College ADN program, instrumented with result of first lottery. Effects at each year come from a separate regression, with 1,730 students at each point. The outcome is log earnings. Regressions control for calendar year, application cohort, demographics (age, gender, race), academic background (prior GPA, prior number of units), prior financial aid receipt (Pell grants, tuition waivers), and prior labor market experience (mean prior earnings, any prior employment in health). Standard errors clustered at the individual level.

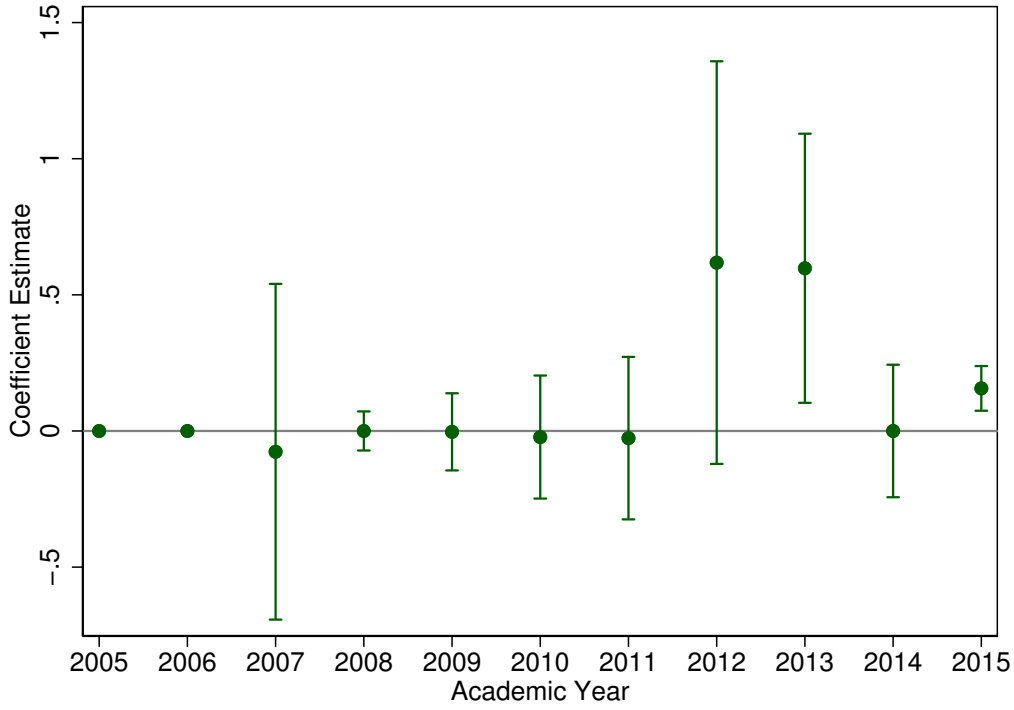
Figure A1: IV Estimates of Nursing Program Enrollment on RN License Expiration



a) Unconditional b) Conditional

Notes. Figure shows estimates and 95 percent confidence intervals of the effect of enrolling in the Central College ADN program, instrumented by the result of the first application. Sample consists of applicants in the spring 2005 to fall 2015 Central College ADN lotteries. The outcome is having an RN license that was issued within the specified number of years since application. Standard errors are clustered at the individual level.

Figure A2: IV Estimates of Nursing Program Enrollment on Upgrade License in 5th Year After Application, by Calendar Year of Application



Notes. Figure shows estimates and 95 percent confidence intervals of the effect of enrolling in the Central College ADN program, instrumented by the result of the first application. Sample consists of applicants in the spring 2005 to fall 2015 Central College ADN lotteries. The outcome is having an RN license that was issued within the specified number of years since application. Standard errors are clustered at the individual level.